



**Asia-Pacific  
Economic Cooperation**

## **Improving Food Markets in APEC Economies: Can the Cost of Food be Lowered?**

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**APEC Policy Support Unit**  
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## **EXECUTIVE SUMMARY**

The aim in this report and the research that supports it is to make a policy contribution to the development of secure and sustainable food production systems in the APEC region through efficient regulatory arrangements, public infrastructure as well as efficient production, distribution logistics and marketing arrangements. While there are many elements to achieving an economy's food security objectives, the focus here is on identifying behind-the-border structural impediments in the agrifood system and examining how these impediments interfere with market systems. The aim is to indicate how structural impediments in the agrifood system can be reduced with a view to identifying priority policy approaches.

The sharp rise in food prices that began in 2006 and abated in the middle of 2008 raised global concerns about food prices and the security of access to food supplies. Consumers and governments became acutely aware of how quickly a combination of high levels of demand and a downturn in production could lift food prices to the point where rising expenditure on food had become a major issue in both developed and developing economies.

Food security is about affordable and secure access to a diet that meets the nutritional demands of consumers. In the context of the efficiency of the agrifood system itself, food security has four related elements, namely improved affordability, improved reliability, improved accessibility and improved food safety.

These elements are not necessarily complementary and in some instances will be competing either directly or through the need to draw on public expenditure. Priorities in APEC economies will vary.

### **THEMATIC OVERVIEW**

Food markets and systems within the APEC region are diverse. This has a significant bearing on the type and relative importance of behind-the-border impediments in individual economies as well as on options for reform. While there is no single road map for behind-the-border reform that will be appropriate for all APEC economies, there are common elements that reflect stages of economic development and the relative importance of food production to an economy as well as cultural choices about food, what is produced, how it is produced and the way in which it is marketed.

There are food security issues that can be addressed directly through behind the border reforms, directed at the food sector or the economy more generally, and there are constraints that reflect fundamental aspects of an economy's natural endowments and development path. The reliability of domestic supplies will in large part be determined by climate. Increasing urbanisation will inevitably lead to the transfer of land and water resources from agriculture to industrial and urban use. These constraints will often shape the priorities for reform.

With increasing incomes and urbanising populations, there are strong economic and policy incentives to modernise food processing and distribution with an emphasis on increased quality and range of choice, reduced wastage and lower costs. This is being achieved largely through increased vertical coordination through the agrifood system. However, production systems are and will continue to be dominated by small scale enterprises in many APEC economies. While

there will be pressure for smallholder farms to increase the scale of their operations, the pace at which this occurs will reflect the broader movement of labour from food production to other sectors of the economy. In the near to medium term, the primary driver of improved food marketing will be how the existing structure of agriculture can be integrated into a rapidly changing processing and distribution sector. In particular, how can fresh food product with desired quality attributes be more efficiently sourced and amalgamated as it leaves the farm gate or boat?

Another important and dominant theme concerns structural adjustment issues, particularly for developing economies. In part, this concern arises from the rapidly growing imbalance in the pace of adjustment in primary food production and processing and distribution sectors of the agrifood system and how producers will access downstream channels of the food marketing system. There will be similar issues downstream. Smaller processors and consumers may find it very difficult to access large scale specialised procurement systems and supermarkets.

A point of departure between developing and developed APEC economies is the relative priority of competition policy. In developed APEC economies with a large agrifood sector, there continues to be concern expressed about the level of concentration in processing and food distribution and the effects that this may have on farm level and consumer prices. While the farm to retail price spread has been increasing, so has the demand for more elaborately transformed food products and greater levels of service. The empirical evidence as to the effect of market structure on competition is mixed.

Research and development has underpinned the growth in food supplies over the past 50 years. Much of this research was publicly funded by a limited number of developed economies. The spillover benefits to the rest of the world were substantial and were enhanced by international research centres under the Consultative Group on International Agricultural Research (CGIAR). With expanding populations and rising incomes and thus increasing food demand, the demand and the need for innovation throughout the agrifood system will also rise.

However, with the exception of China, public agricultural research and development funding has not kept pace with growing populations and growth rates have declined in real terms in developed economies. Stronger intellectual property rights have strengthened private sector research but this research is more narrowly directed and the spillover benefits are limited.

The recent global food crisis may be seen as necessitating an expansion in publicly funded research but other demands on public funding are becoming more pressing as well. The value of coordination and collaborative research across APEC economies is likely to become of increasing value. This is, in part, acknowledgment of the benefits of agglomeration and integration that has helped to drive private research.

## **GLOBAL FOOD PRICES AND FOOD SECURITY**

Between January 2006 and mid-2008, world market prices for food commodities rose by more than 75 per cent, wheat prices doubled and prices in the international rice market increased threefold. The sharp rise in food prices sent a strong signal to producers. Production increased and prices started to fall in the second half of 2008. In welfare terms the largest effects were incurred in low income economies where food can account for a high percentage of household budgets.



The proportion of income spent on food in developing economies is of the order of 4 to 5 times greater than in developed economies. Around half of total disposable income is spent on food in Indonesia, the Philippines and Viet Nam. Because such a large fraction of this expenditure is on staples there is little room to shift diets. As a consequence, the negative income effect of a price change in developing economies is roughly 10 times greater than in developed economies. In Indonesia, the Philippines and Viet Nam a 10 per cent increase in food prices is estimated to reduce real incomes by around 4 per cent, in line with their expenditure on food. In the developed economies such as Australia, Japan and the United States a 10 per cent increase in food prices is estimated to be equivalent to a reduction in incomes of less than half of one per cent.

It is a clear corollary from the previous discussion on the effects of prices on incomes, that income growth will have a key role in improving food security in developing economies. At the same time, increasing incomes will have a relatively large impact on level and diversity of food demand in developing economies. While this will place upward pressure on prices, increased demand for domestically sourced food will help to lift rural incomes.

Successful broad based economic reform will increase productivity of food processing and transport, as well as wholesale and retail distribution. This will reduce the cost of food to consumers while at the same time increasing the demand for domestically as well as internationally sourced food products.

## **FOOD PRODUCTION**

The ongoing need to increase productivity in food production systems is a major theme of this report. The importance of improving the efficiency of domestic food production is twofold. First, it improves the real terms of trade for producers. That is, it effectively lowers the cost of inputs relative to outputs and therefore improves producer incomes. Second, it moves or keeps domestic prices in line with international markets. Products sourced domestically will move toward import parity, that is, the delivery price of products bought from a foreign economy. Products that are sourced both locally and internationally will move toward export parity, that is, the price received by domestic producers when they sell products overseas accounting for the fact that product must still be transported.

The development of and access to improved inputs are crucial if agricultural productivity is to be improved.

The potential benefits of the development and commercialisation of genetically modified crops are large. They include increased yields, reduced reliance on herbicides and pesticides. While the decision to allow or disallow the commercial use of GM crops is one that APEC economies will take independently, there may be justification for broadening the scope of research, particularly with respect to in situ trials. Trials provide information on how well adapted new varieties are in different locations and helps to identify ongoing research needs. The value of allowing trials may be seen more as a safety net, and a means to address food security problems in the future. Greater coordination and transparency of regulatory arrangements for developing GM plant varieties across APEC economies is one means of increasing food security in the region.

Impediments also exist in the development and commercialisation of agrichemicals and pharmaceuticals. The cost of regulatory compliance, excluding health and environmental risk

assessment, is a substantial component of overall research and development costs. Developing clearly targeted and transparent regulatory systems in developing economies will be important in attracting research investment that meets the specific needs of developing economies, especially as the productivity of primary food production increases more generally.

From a developing economy perspective, access to farm inputs is an equally important issue. Smallholder primary producers often do not have the financial reserves needed to purchase inputs and have limited capacity to service debt. Smallholder primary producers are likely to attract a risk premium for borrowings, regardless of the source of funds. There are other issues such as limited time frames to repay loans which reduces marketing options and precludes longer term capital investments, as well as exposure to broad macroeconomic settings (which affects real rates of interest and inflation). Setting up the right institutional arrangements to increase access to credit markets is an important policy challenge especially in the context of limiting reliance on public funds.

Plant and animal protection inputs into food production are important in both developing and developed APEC economies. The protection of agricultural and fisheries resources from endemic pests and diseases is generally an ongoing cost of food production. The eradication and control of endemic diseases, as well as managing the threat of plant and animal diseases, is an important role for governments and cooperation across borders is critical to that role.

The longer term sustainability of agriculture and fisheries is a central issue. Agricultural land and water degradation can occur for a number of reasons. Low incomes and a lack of information can result in situations where farmers do not have the means to address problems, such as soil erosion, economically. Government input and output subsidies can lead to the exploitation of marginal land resources that are not well suited for sustained production. Governments have a range of options to address these problems, including regulations such as land use restrictions, publicly funded reserve programs and education.

## **FOOD PROCUREMENT, PROCESSING AND DISTRIBUTION**

The general incentives that are driving the evolution of food procurement and distribution across APEC economies are remarkably similar. There is a common emphasis on improved methods for sourcing food with the aim of lowering transactions costs and better meeting increasing consumer demand for quality and a greater range of food products. Improvements in transport handling logistics allow firms to take advantage of improved infrastructure, to reduce direct costs as well as to reduce wastage and increase product quality. New market formats allow the exploitation of larger scale logistics and handling systems and that provide a greater range of consumer choice.

The differences in the way distribution systems are evolving in the developing and developed economies are largely due to the extent to which the incentives for cost savings are driving the pace and scale of change. The challenge being addressed in developing economies is twofold. The first is to find an efficient way to integrate the changes in food distribution systems with the transition from traditional to modern primary production practices. The second is to keep pace with the rapid rates of urbanisation that are fundamentally changing the food distribution task.

Vertical integration and coordination is central to addressing these challenges. Vertical integration can reduce cost wedges, aid in the efficient allocation of risk and improve the

responsiveness of supply to shocks, thereby improving the overall resilience of food markets to changing economic conditions over the short and long run.

The nature of vertical integration within a supply chain can vary, from full ownership and control of various production processes along the supply chain on the one hand, to less formal forms of coordination such as long term or ongoing contractual arrangements on the other.

There may be an advantage for smallholders to become specialised providers of produce for a given supermarket chain or specialised wholesaler. This specialisation allows for economies of scale to be established or to take advantage of available supplies of specialised labour. In turn, this may reduce the logistical and transport costs for retailers and wholesalers in transporting and distributing produce from a region of small landholders if they are producing similar products. The existence of contractual agreements can connect output and credit markets, improving access to credit. Contracts for outputs can also serve to provide price incentives for product quality and safety that are not found in traditional market channels.

The establishment of commercial contracts for sourcing products in developing and transitional economies suffers from a number of problems, mainly associated with the enforceability and policing of commercial agreements. The advancement of regulatory controls in contract negotiation and contract enforcement will obviously improve the working of these markets and the inclusion of smaller and medium sized landholders.

The expansion of international food processors and retailers and processors in many developing economies has been heavily reliant on acceptance of foreign investment opportunities by these economies. Limited access to foreign investment has the effect of placing a constraint on the level of possible domestic investment, as well as introducing a price premium as scarce domestic funds are competed for in a number of industries. In addition, insulated capital markets preclude greater diversification of investment risks, resulting in a further cost premium on the cost of capital. At the same time, foreign direct investment is associated with the transfer of expertise in areas such as procurement and inventory management.

Quality has become an increasingly important aspect of the downstream marketing strategies of food processors. It requires highly specific investments for coordination among participants with respect to the definition of detailed quality standards, methods of production, and controls for guaranteeing conformity of products to what is demanded.

There are a number of areas in which improved food transport can increase food security. Some of these rely on improved infrastructure. Improvements to road and other transport networks allow larger loads per vehicle, which, in turn, increases the efficiency of transport. Centralised transport hubs support a greater use of containerisation. Some of these improvements rely on technological innovations, such as real time monitoring of truck performance and fuel consumption. Improved loading practices, better containers and improved refrigeration can reduce wastage and damage. Improved logistics also improve capacity utilisation.

The largest difference between developing and developed APEC economies in terms of the transport task is that developing economies have a greater level of geographic dispersion in food production, often in remote areas with poor transport infrastructure. In addition there are more densely populated urban areas with highly congested transport infrastructure. There is also a limited level of investment in modern transport vehicles, such as refrigerated trucks and specialised livestock carriers. However, the rate at which transport infrastructure, particularly road transport, is being expanded is much faster in emerging APEC economies – this, in turn, is creating incentives to rapidly modernise transport logistics.

## **FOOD SAFETY AND RELIABILITY**

While difficult to assess with accuracy, the human and economic costs of unsafe food are substantial. Food safety and quality considerations are an essential part of meeting food security objectives. They are critical ‘whole-of-chain’ issues affecting the demand and supply of food products, market prices and volumes, and domestic and international market access, as they affect the health and welfare of food consumers.

Public food safety standards are important in the context of establishing minimum standards for and liabilities of market participants and to promote trade. In developing economies standards will continue to be important along traditional marketing channels. The emergence of large scale processors, retailers and international food preparation firms in developing APEC economies is leading to a rapid increase in the use of private standards that are often well above public standards. Vertical coordination along the chain has additional food safety benefits as food quality management and safety systems are vulnerable to the ‘weakest-link’. At any point along the chain food safety can be compromised but there are points where this is more or less likely to occur. Vertical coordination along the chain facilitates the establishment of process standards at critical points in the system.

Tracking and tracing systems facilitate the recall and destruction of potentially dangerous consumer products. The systems can be particularly important in food processing given that a range of products are often combined to produce a product, for example, frozen vegetables that are sourced both locally and internationally. Monitoring the results of tracking systems will also help to identify local hazards and priorities for introducing process standards. For efficient quality changes the costs of the quality of the tracking and tracing system must at least be offset by the willingness of consumers to pay for the changes in quality. That is, given the quality innovation is being driven by consumer demand, the increase in the price of food products must be less than the increase in value to the consumer from improved quality. The benefits of improved food safety and quality may not be as readily perceived as an increase in price. In some instance this may require educating consumers as to the benefits of higher quality food.

Food storage occurs at every level of the food marketing chain and is an integral part of both food safety and reliability. Storage is required to manage seasonality of fresh food supplies, to facilitate processing and distribution and manage shortfalls in production. One of the largest differences between the agrifood sectors of developing and developed APEC economies is in food distribution systems and the level of investment in storage infrastructure throughout the agrifood system. Improved storage facilities can substantially reduce wastage and improve food quality and safety.

Public stockholdings of maize, rice and wheat has been declining over the past decade. This has, in part, been offset by increased private sector stockholding but overall reserves have

fallen. The global food crisis raised the issue of whether economies should consider the development of strategic reserves.

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## RECOMMENDATIONS

The changes that are occurring in the agrifood system in the APEC region are being driven largely by economic incentives, although the focal points and magnitude of these incentives vary extensively across the region. There is a common emphasis on the gains that can be achieved through improved economic efficiency at each stage of the agrifood system and the need to respond to growth and changing composition in the demand for food.

The priority of improving the efficiency of the agrifood system from the farm gate or dock to the consumer reflects the fact that efficiency gains will lead to not only lower prices for consumers but higher returns to food producers.

These improvements will for the most part be achieved through efficient markets along the agrifood system. These markets are likely to change at a rapid pace given changes in technology and rates of economic growth in developing economies in particular. Governments will need to ensure that the institutional arrangements supporting these markets are appropriate. Public regulation and investment will need to be well-targeted to address market failures.

To underpin these changes it is important that markets for inputs and outputs function efficiently and that all market participants have access to the necessary channels within the agrifood system. This is of particular importance in developing economies where marketing channels are evolving rapidly.

Ultimately, food security depends on the ability of food producers to meet growing food demands as incomes and populations rise. It is important that the market can signal efficient investments.

This section presents seventeen recommendations drawn from the analysis in the body of the report. The recommendations are grouped into categories relating to food production, procurement systems, food processing, and transport handling and storage. Other than their being categorised, the recommendations are in no particular order.

### RECOMMENDATIONS FOR IMPROVING FOOD PRODUCTION

#### **1. Address the issue of declining public investment in research and development (R&D), including through regional cooperation**

While the value of R&D in increasing the productivity of food production is well recognised, public investment in R&D is declining. APEC's work in technical assistance and capacity building, disseminating best practices, and helping to build economic conditions conducive to investment and trade in technology make it a valuable venue to foster R&D cooperation. APEC fora should explore regional cooperation to bolster conditions conducive to investment and innovation in agricultural R&D. This includes work to facilitate the use of new varieties of crops, to reducing dependence on petroleum-based agricultural inputs such as fertilisers and fuel, and promoting sustainable development in agricultural production.

## **2. Improve governance frameworks**

The governance framework within which the agricultural system operates can have a significant influence on agricultural productivity. A study conducted of 127 economies and found that given the same amounts of agricultural inputs, the same education level, and the same climate conditions, an economy with better governance can generate more agricultural outputs. Good governance does this by increasing agricultural labour productivity and facilitating the accumulation of agricultural capital stock.

## **3. Cooperate on the management of plant and animal pests and diseases**

This has two key elements:

- Cooperation in managing livestock and plant movements across borders; and
- Sharing of information on exotic pests and diseases. While this is well established for animal industries it is less developed for plant industries. Plant pests and diseases are extremely diverse and it can be difficult to identify threats and appropriate responses.

## **4. Work with member economies to develop regulatory frameworks in regards to agricultural biotechnology**

APEC may be able to help member economies develop appropriate frameworks in the APEC region through technical cooperation and capacity building activities.

## **5. Initiate policies that promote sustainability**

APEC should explore ways to promote best practice for sustainable use and management of land, water, and other natural resources relevant to the regional food supply. Policies that promote sustainability will increase food security because unsustainable practices eventually lead to lower rates of productivity. There is the capacity for the transfer of useful knowledge between developed and developing APEC economies despite differences in agricultural systems.

## **6. Recognise the importance of producer incomes**

In developing economies the issues of food prices, security and producer incomes are linked. The expansion of output by primary food producers will depend to a large extent on their capacity to use farm inputs that increase yields and allow better management of pests and diseases. These inputs tend to be traded on international markets. The issues at a domestic level relate to the capacity of producers to access these markets in a way that requires diminishing government support. This can only be achieved in developing economies if producers can generate higher incomes. This can in part be achieved through:

- Improved access to finance, with assistance that is not restricted to the use of specific farm inputs and subject to sunset provisions;
- Increased access to market and technological information;
- Public investment in transport in rural areas; and



- Facilitation of structural adjustment and interim support measures during transition.

## **RECOMMENDATIONS FOR IMPROVING PROCUREMENT SYSTEMS**

The coordinated sourcing of inputs can generate substantial cost savings given the fundamental structural differences in scale between primary production and processing in developing economies. The cost savings to entities in the post-grower supply chain of dealing with larger farms is generating pressure for the amalgamation of a large number of small farms. In the short to medium term cost savings are likely to be achieved through the formation of farm cooperatives.

### **7. Facilitate the development of formal and informal institutional arrangements that will assist in restructuring the supply chain, particularly in regards to increasing farm size**

Governments can assist by supporting the ongoing development of formal and informal institutional arrangements. For example, for cooperatives to be effective in the longer term, they need to be appropriately structured to make joint investments and deal with free riders. The expanded use of informal arrangements, such as preferred lists of suppliers, might also be more effective if supported through a government registry.

Vertical integration and coordination can play an important part in reducing costs along the food supply chain. Vertical integration can facilitate the efficient allocation of risk and improve the responsiveness of supply to shocks, thereby improving the overall resilience of food markets to changing economic conditions over the short and long run. However, there are instances in which vertical integration has the potential to reduce economic welfare. In such cases the potential gains from vertical integration on the cost side should be carefully balanced against the possible risks of higher consumer prices. In developing economies, these potential gains are likely to be quite substantial when compared to developed economies that already have large investments in integrated food systems.

Given the relatively large proportion of farmers in developing, transitional and middle income economies, the rapid expansion of major food retailers and the corresponding move toward a smaller number of larger scale farms could potentially result in an extended and costly adjustment phase where former land holders are excluded from the domestic food market and need to find alternative occupations.

## **RECOMMENDATIONS FOR IMPROVING FOOD PROCESSING**

### **8. Afford sufficient legal protection to innovation in the supply chain so that firms are encouraged to invest, but not so much that competition is stifled**

Innovation is a driver of productivity increases all along the supply chain. Varietal, logistical, technical and commercial innovations have led to new and specialised products that provide choice to consumers. Food processors will be encouraged to invest wherever there are intellectual resources (such as those offered through agglomeration and labour market pooling) and protection of intellectual property. Firms have an incentive to make investments in intellectual capital and innovate if they can capture the returns of such investment. The protection of a firm's brand names, trademarks, copyrights and patents is particularly important.

However, from a public policy perspective it is important that protection is not so great that firms become immune from competition. Limits on the life of some protections (patents, for example) foster the evolution of new innovation. The level of protection should reflect the level of capital that has been sunk in product development.

### **9. Develop systems for monitoring trends affecting small and medium businesses**

APEC could assist developing economies put in place monitoring systems for analysing trends affecting small and medium enterprises such as:

- the emergence of new quality, environmental or logistics standards
- the possible substitution of traditional local industries by imports or new large scale producers; and
- expansion of supermarkets as the leading marketing channel for SME products.

Structural adjustment is likely to be rapid, and information will assist small and medium businesses to keep pace. Systems of monitoring may also include domestic benchmarking of finance costs and availability.

### **10. Foster foreign direct investment**

Foreign direct investment has been important to the growth of the food processing sector in many developing economies, not least because of the knowledge transfer that usually accompanies the establishment of a new business by a foreign company.

## **RECOMMENDATIONS FOR IMPROVING TRANSPORT, HANDLING AND STORAGE**

Good transport infrastructure leads to better food distribution logistics. In developing economies, ongoing investments in infrastructure will lower the costs of food distribution.

### **11. Consider whether government regulation of transport infrastructure (with private ownership) is more suitable than government ownership**

A common justification for public provision of transport infrastructure is that it ensures people have access to markets. A move toward more competitive markets, however, changes the role of government from one of providing infrastructure and services to one of monitoring and regulating the performance of other infrastructure service providers to ensure the interests of users and the general public. The move to more competitive markets can be facilitated by separating the government functions of planning, regulating, coordinating and monitoring from the functions of developing and operating infrastructure or services. More autonomous agencies and enterprises can manage publicly-owned commercial assets more efficiently and ultimately facilitate the transfer of these assets to a regulated private sector.

The efficiency of transportation will only become more important as energy costs increase. APEC economies need to consider whether their transport policy will need to change if oil and other energy prices continue to rise. This has the capacity to fundamentally shift the comparative advantage of international and regional trade.

Food handling and storage occurs at every stage of the food marketing chain. In developing economies, investments in better packing and cold storage facilities can substantially reduce wastage and improve food safety.

## **12. Consider whether government-run or private-run buffer stocks are more effective**

Food stocks are an important aspect of food security. Where private storage is thought to be insufficient, governments may choose to initiate their own buffer stock schemes. However, it is possible that government stocks may displace private stocks over time, so they should be managed closely. Strategic reserves should have transparent rules for acquisition and disposal of stocks. Transport costs are an important consideration. When food and energy prices move together, it may be advantageous to have reserves onshore in food-importing economies.

## **RECOMMENDATIONS FOR IMPROVING WHOLESALE AND RETAIL FOOD DISTRIBUTION**

The expansion of multinational food retailers into developing and transitional economies presents opportunities and policy challenges for food markets in these economies. The movement towards modern food procurement and distribution systems seems set to accelerate.

The rapid expansion of major food retailers with associated pressures to amalgamate small farms could result in small scale, low-income landholders being excluded from the domestic food market and in them needing to find alternative work.

## **13. Consider whether governments should facilitate access to a rapidly changing food distribution system, perhaps by upgrading traditional wholesale and retail channels**

Producers will need to adapt to procurement systems that require greater volumes, increased quality of food products and greater levels of accountability. This will be achieved through increased production and improved marketing from the farm gate. The balance between the two will largely be a reflection of how quickly agriculture is able to adjust structurally.

It may be necessary to upgrade traditional wholesale and retail market channels to avoid isolating small producers and disadvantaged consumers. Smallholder producers that are no longer viable will become more dependent on the food distribution system. The need for safety net programs to assist those with poor access to secure food sources may decline overall but there is likely to be a greater need for such programs in rural areas.

## **RECOMMENDATIONS FOR IMPROVING FOOD SAFETY**

Improved food safety is another shared challenge. Private food quality and process standards that are well established in developed APEC economies are becoming increasingly important in developing APEC economies. The standards rely heavily on a whole-of-supply-chain approach and the identification of key hazards and risks. This requires extensive vertical coordination. Governments will need to weigh concerns regarding vertical integration with the benefits of increased food safety as well as reduced costs.

Food safety regulation will continue to have a key role. This is especially the case in developing economies that will still be dependent on traditional marketing channels well into the medium to long term. However, simply relying on regulation is likely to be inadequate and public investment to upgrade these traditional marketing channels is likely to be required. Improved regulation may also facilitate producer access to export markets.

**14. Be mindful of the tradeoff between high food safety and quality standards on the one hand, and higher production and consumer costs on the other**

Food safety and quality are important determinants of consumer welfare, but improvements in food safety and quality lead to higher production costs and therefore higher consumer prices. Government policies need to be mindful of this tradeoff and focus carefully on identifying market failures and addressing those failures with policies that pass cost-benefit tests. For example, the quality of a tracking and tracing system must at least be offset by the willingness of consumers to pay for the changes in quality.

While generalisations about the costs and benefits of compliance are difficult, many APEC developing economies have demonstrated the benefits of meeting international standards. This suggests that most economies can progressively align domestic food safety regulation without undermining the cost of food to consumers.

The proliferation of private food standards (often more stringent and more complex than official standards) may call for additional policy attention to facilitate domestic production and exchange and to address potentially adverse distributional effects, especially in relation to small farmers. At the same time there is evidence that with effective government support, small farmers can succeed in this challenging environment.

**15. Consider whether it is appropriate to shift the focus of policy from one of reacting to food safety events to one of preventing food safety events**

Considerable scope exists for improving domestic food safety regimes in the APEC region. Priorities include improving risk analysis, increasing coordination across agencies and rebalancing regulatory approaches away from reactive strategies (aimed at correcting problems after they occur) and toward proactive strategies that prevent breakdowns in the food supply chain.

The effects of agglomeration may be important in increasing food quality and safety while keeping costs down. As isolated efforts to increase quality and safety start to gain momentum, agglomeration can reduce the costs of acquiring necessary inputs and result in a pool of knowledge and human resources. Governments in developing APEC economies may have an important role initially in promoting quality assurance systems and the adoption of better processing technologies.

In developing economies in particular, there will continue to be a large number of food production and distribution channels ranging from traditional to modern. These channels will have very different risk profiles and compliance costs. Food safety policy will need to acknowledge and potentially take on different roles within those channels to cost effectively improve food safety for all consumers.

## **RECOMMENDATIONS FOR IMPROVING ECONOMY-WIDE INFLUENCES ON FOOD SECURITY**

### **16. Facilitate broad based economic reform and trade openness**

Reforms that promote economic growth and higher incomes will make food, food reliability and food safety more affordable. Trade exposure ensures that domestic food prices are largely bounded by world prices, adjusted for conditions of export and import parity. These conditions largely reflect transport costs but also include costs of meeting health and quarantine standards.

### **17. Share experiences of reform**

The sharing of individual APEC economy's regulatory reform experience to aid structural adjustment in the future will assist developing economies set the fundamentals of competition policy before it is heavily relied upon, as it is currently in developed economies.



## PART 1: MOTIVATION AND ANALYTICAL APPROACH

### 1. INTRODUCTION

The sharp rise in global food prices between 2006 and mid-2008 presented major challenges for a wide range of economies at different levels of development. While prices for most commodities have fallen sharply in the past year – due largely to increased production and, to a lesser extent, weaker demand – base level food prices in 2009 remain above their 2003-04 levels (World Bank 2009).

The spike in prices highlighted the risks from higher and more volatile food prices in the future. The international development community has mobilised to promote action on several fronts including expanding social protection systems, sustaining improvements in smallholder food production, moving to improve international food markets through reducing agricultural trade distortions and developing an international consensus on biofuel policies (UN Secretary General 2008).

Enhanced regional cooperation by bodies such as Asia-Pacific Economic Cooperation (APEC) can also help ensure member economies respond to current and future concerns about food prices and food security with appropriate policy strategies.<sup>1</sup> This report, commissioned by the APEC Policy Support Unit, aims to identify opportunities and options for APEC economies to improve the efficiency, resilience and sustainability of food systems in the region.

The main focus is on the role that behind-the-border structural impediments play in raising the costs of food to consumers in APEC economies, with particular emphasis on developing economies. Reducing such impediments, and in the process improving market structure, regulatory, infrastructure and distribution systems, can make an important contribution to meeting food security objectives directly as well as to improving the broader economic performance of APEC economies.<sup>2</sup>

The core premise in this report is that an efficient, well-functioning and innovative domestic food supply chain provides the foundation for improving long term food security and reducing unnecessary cost wedges between farm gate and consumer prices. This in turn can make a significant contribution to more secure and affordable food supplies, including by improving the resilience and flexibility of food systems in the face of changing market conditions and global shocks.

The aims in this study are relevant to both net food importers and exporters in the region. They are consistent with APEC's goal of deeper regional economic integration. The focus on behind-the-border barriers provides a natural complement to APEC's traditional agenda of reducing border barriers to trade and investment in the region, including in the agrifood sector. It also supports the goal of reducing rural poverty in developing economies, in recognising the need to increase productivity and thereby increase producer incomes.

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<sup>1</sup> APEC member economies are: Australia; Brunei Darussalam; Canada; Chile; People's Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; The Republic of the Philippines; the Russian Federation; Singapore; Chinese Taipei; Thailand; the United States; and Viet Nam.

<sup>2</sup> Food security is where 'all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO 1996).

In addition, the report builds on APEC's increasing focus on structural reform, defined by APEC Ministers as 'improvements made to institutional frameworks, regulation and government policy so that "behind-the-border barriers" are minimised to improve economic performance and advance regional integration' (APEC 2008).<sup>3</sup>

This study does not seek to duplicate the considerable research that has been conducted or commissioned internationally on specific issues such as agricultural development, reducing trade distortions or improving social safety nets.

Certain themes emerge and recur throughout the report.

The first concerns the respective roles of the private and the public sector in addressing behind-the-border impediments. In many cases, the strengthening of market institutions and the development of the private sector is a prerequisite to improving supply chain efficiency, resilience and sustainability. Structural reform in this context may mean both an increase in economic welfare and reducing the role and footprint of government.

In other circumstances, stronger public sector capacity may be needed to correct market failures and to ensure that economic, social and environmental goals are met. Examples may include improved competition policy arrangements or a greater public sector role for correcting market failures and reducing transactions costs in an area such as food safety.

Overall, the study highlights the increasing premium attached to efficient, coordinated and responsive governance that: (a) improves the investment climate (affected by institutions, infrastructure, capacity and transactions costs); (b) provides core public goods; (c) builds strong partnerships with the private sector; and (d) ensures that key goals such as effective competition, broad social advancement and environmental sustainability are met.

A second theme arises as a consequence of the sheer diversity of food markets and systems within the APEC region. This has a significant bearing on the type and relative importance of behind-the-border impediments in individual economies as well as on options for reform. No single, 'one-size-fits-all' policy road map will be appropriate for all APEC economies.

A third and dominant theme concerns structural adjustment issues and the creation of both winners and losers, particularly in developing economies. This arises from the rapidly growing imbalance in the pace of adjustment in primary food production as opposed to processing and distribution sectors of the agrifood system. This will place considerable adjustment pressure on small scale agriculture. How tradeoffs are viewed by policy makers given scarce resources (especially in lower income APEC economies) will critically determine which sectors and participants in domestic markets benefit from reform and who bears the costs.

The organisation of the report is as follows. Part 1 of the report, comprising Chapters 1 to 3, sets out the introductory comments and the analytical approach. Chapter 2 outlines the policy background and includes a discussion of food security. Chapter 3 contains the conceptual approach to the issues and discusses the drivers of food prices. Part 2 of the report, comprising Chapters 4 to 7, analyses the agrifood system – including primary production (Chapter 3), food processing (Chapter 4), retail and wholesale food distribution (Chapter 5) and transport and

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<sup>3</sup> The APEC Leaders' Agenda to Implement Structural Reform (LAISR) includes five priority work streams – competition policy, regulatory reform, public sector management, corporate governance, and strengthening economic and legal infrastructure.



storage (Chapter 6). In Part 3 of the report, food security in the context of the broader economy is considered. Food safety issues and the broader reform agenda are outlined in Chapter 8 while conclusions are presented in Chapter 9.



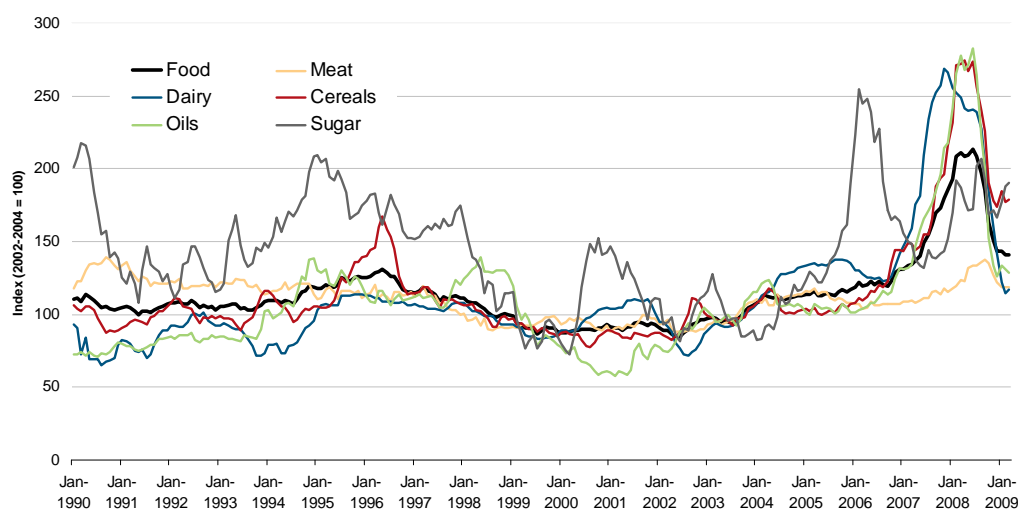
## 2. APEC FOOD MARKETS: RECENT DEVELOPMENTS AND POLICY CONTEXT

This chapter explores recent trends in global food prices and why food security has again become a major concern in many APEC economies. In highlighting the diversity of regional economies and of their agrifood systems, it also sets the scene for exploring the wide array of policy challenges within APEC economies whose governments wish to improve the functioning of domestic food supply chains.

Between January 2006 and mid-2008, world market prices for food commodities rose by more than 75 per cent with nearly all food commodities experiencing significant price increases (World Bank 2009). Of particular significance to many economies in the APEC region was the escalation in staple food grain prices, as wheat prices doubled and prices in the thinly traded international rice market more than tripled (World Bank 2008b).<sup>4</sup>

A combination of long term structural trends, cyclical factors and specific policy actions contributed to the large upswing in global food prices (see Box 1). The escalation, in turn, sparked considerable speculation about more-or-less permanent changes in the global food market with some observers concluding that the ‘era of cheap food’ may be over (ADB 2008b, The Economist 2007). Others have discounted such concerns in light of the subsequent sharp correction in international prices (see Figure 1). From this perspective, the commodity price boom is seen as merely ‘yet another cycle in the long history of commodity price cycles’ (World Bank 2009, p.89).

**Figure 1 Global food price trends**



Source: World Bank 2009

For many APEC economies, the escalation of global food prices nonetheless underlined the fragility of food security gains despite a prolonged period of strong economic growth, falling poverty and declining food prices in real terms. Hardest hit by the price spike were poor consumers in low income economies where food can account for a high percentage of

<sup>4</sup> Rice still accounts for one third of daily caloric intake in East Asia, with wheat (12.4 per cent) the second most important source (Brahmbhatt and Christiaensen 2008: 3).

household budgets. This can include many poor farmers with a net deficit in food production, that is, those who consume more than they produce.

For most developing and transitional economies in APEC, food accounts for one third or more of household expenditure with the ratio reaching around one half of total expenditure in economies such as Indonesia and Viet Nam. The equivalent share in industrialised APEC economies – the United States, Japan, Canada, Australia, and New Zealand – is less than 20 per cent of household expenditure.

### **Box 1 Global food prices: The spike and its determinants**

A sustained period of strong global growth and rising per person incomes, especially in large emerging markets such as China and India, provided the platform for higher food demand and a significant increase in global agricultural trade. The shift toward improved and more diversified diets in emerging economies helped underpin growth in the consumption of meat, dairy products and vegetable oil. Consequently, the demand for grains and oilseeds for livestock feed in developing economies rose disproportionately more than overall food demand (May et al. 2009).

The steep rise in global energy prices was a key driver of rising food prices directly via higher fuel costs in food production and transport and indirectly through higher prices for fertilisers and agricultural chemicals. According to World Bank research, roughly 15 per cent of the rise in global food prices can be traced directly to higher energy and fertiliser costs (Mitchell 2008).

Declining global stocks of food grains (the result of consumption outstripping production growth over several years) guaranteed that any new sources of demand, or disruptions to supply, would result in sharply higher prices. Stocks of rice, wheat and corn are estimated to have fallen by 40 per cent between 2002 and 2007 (ADB 2008b). In the face of higher demand, attempts to rebuild stocks and changes in buffer stock policies by some economies placed further pressure on grain prices.

A major new source of demand pressure has been sharply increased use of both cereals and vegetable oils in biofuel production. Cereal demand for industrial purposes such as biofuels rose by more than 25 per cent from 2000, compared with increases for food and feed of 4 per cent and 7 per cent respectively (FAO 2007). By 2007-08, ethanol production accounted for 23 per cent of corn use in the United States (May et al. 2009). Expanded bio-diesel demand in the European Union placed additional pressure on global demand for vegetable oils. Increased production of biofuel raw materials also induced significant spillover effects as farmers reduced land allocated to food crops.

Other factors found to have contributed to higher food prices include adverse weather events, such as prolonged drought in Australia, flooding in South Asia and poor crops in the European Union and the Ukraine. A weaker US dollar and increased speculative activity, linked to the flow of capital in commodity-indexed funds, may have played some role in price rises in 2007-08 (World Bank 2009).

Policy responses such as export restrictions, export taxes and consumer subsidies are widely seen as exacerbating prevailing trends in some cases. For example, rice export restrictions (including by Asia-Pacific economies) appear to have played a major role in boosting rice prices in 2008. By distorting relative prices, lowering domestic production incentives and shifting the burden of adjustment onto other economies, such actions are generally seen as counterproductive to long term food security.

As well as undermining gains in poverty reduction and food security, the spike in international food prices led to significant macroeconomic instability in a number of APEC economies. Food

price inflation hit double digits in several cases, including both net food importers and exporters (ADB 2008a, pp.3-4). In some cases, official headline figures significantly understated the scale of inflationary pressure due to measures taken by many economies to limit food price rises. As a result, in some economies fiscal positions came under strain as policy makers took steps to alleviate the full impact of food price rises on their populations, while for vulnerable, food-importing economies higher food prices led to a sharp deterioration in external balances.

During 2008 concerns about a ‘global food crisis’ gave way to wider concerns about the ‘global financial crisis’ and, subsequently, the ‘global economic crisis’. However, there remains considerable uncertainty about the longer term direction of global food prices. Current projections are for food prices in the next decade to stay higher, on average, than in the past decade (OECD-FAO 2008b, Peters et al. 2009). On both the demand and supply sides of the global food equation, a series of factors loom as potential sources of higher and more volatile food prices in coming decades. As well as directly influencing the level and volatility of food prices, they are among the deep structural drivers that will determine the future shape of globalisation and the evolution of food systems. A selection of these is set out below.

#### **A. GROWTH IN DEVELOPING ECONOMY POPULATION AND URBANISATION**

With developing economies already accounting for 80 per cent of global population and some areas continuing to experience strong population growth, aggregate food demand will continue to rise for many years. Rapid urbanisation in developing economies is reinforcing shifting patterns of food consumption. In the Asia-Pacific region as a whole, urban populations are estimated to increase by more than 580 million by 2020 compared to 2000 levels, as the total size of the region’s urban population overtakes the rural population for the first time in history (McKay 2008). This will drive major changes in food production and distribution in these economies and fuel concerns regarding the loss of agricultural land.

#### **B. WATER SCARCITY AND VULNERABILITY TO CLIMATE CHANGE**

Future water scarcity is likely to be felt across a number of economies in the APEC region. A joint study by the ADB and IFPRI (2008) indicates that water available for agriculture has already declined sharply over recent decades in Asia due in large part to increasing industrial and urban demand and this pressure is likely to continue. In China, irrigation water consumption as a share of total consumption is projected to decrease by 5-10 per cent by 2050 compared with 2000. More frequent and intense weather events possibly linked to climate change may have an adverse impact on agricultural output in parts of the Asia-Pacific region in the future.

#### **C. INCREASED PRODUCTION AND USE OF BIOFUELS**

Diversification of food crops toward biofuel production has increased sharply in the past decade. In most scenarios of increased use of biofuels analysed by the International Food Policy Research Institute (IFPRI) there are substantial implications for food prices (von Braun and Pachauri 2006).

A study by the World Bank (2009, p.7) has concluded that ‘biofuel demand has the potential to change permanently the nature (and price) of agricultural commodities’. APEC economies are among those where targets for biofuel use have been set. The United States, for example, has

mandated the use of 28.4 billion litres of biofuel for transportation by 2012. From 2007, Thailand has required 10 per cent ethanol in all petroleum (World Bank 2008a).

#### **D. DOUBTS SURROUND FUTURE GROWTH IN AGRICULTURAL PRODUCTIVITY**

Historically, agricultural productivity growth has allowed food production to keep pace with growing food demand. However, the spike in global food prices in 2007-08 has drawn attention to declining agricultural yields in a range of areas and the relative neglect of agriculture as a development priority in recent decades.

The share of annual World Bank lending going to agricultural projects has fallen from 30 per cent to 21 per cent since 1980 and only 4 per cent of total Official Development Assistance goes to agriculture (World Bank 2008a). This decline sits uncomfortably with the observation that food grain yields in many economies have stagnated since the 1990s after accounting for around 70 per cent of the increase in crop production in developing economies in the three decades prior to 1990.

Recognising that there are many influences on food markets over which individual governments have little or no influence only reinforces the case for coherent strategies to reduce behind-the-border impediments to supply chain efficiency.

#### **E. DIVERSE FOOD SYSTEMS AND POLICY PRIORITIES**

Policy priorities for improving food affordability and security will necessarily differ across APEC economies. In large part, this reflects the sheer diversity of economies and food systems within the region.

Appreciating this diversity helps in understanding the varying impacts of food price movements (both among and within economies) and the range of challenges that APEC economies face in improving the efficiency, resilience and sustainability of food systems. It also helps to identify those areas where there may be scope for increased cooperation or common approaches across the region.

APEC encompasses a broad spectrum of high, middle and low income economies with agrifood systems ranging from traditional to highly industrialised, a mix of food importers and exporters, as well as a broad range of natural resources, climatic conditions and demographics that shape comparative advantage within food supply chains. Added to this are differences in societal and consumer preferences, government policies and supporting infrastructure and market structures and institutions. This diversity based on a range of agrifood indicators is illustrated in Table 1.

A key point of variation surrounds the role of agriculture in APEC economies. Rapid growth and industrialisation has resulted in the farm sector's share of GDP falling to below 20 per cent in a number of transitional APEC economies (Figure 2). In developed regional economies, agriculture accounts for less than 10 per cent of national income and the labour force.

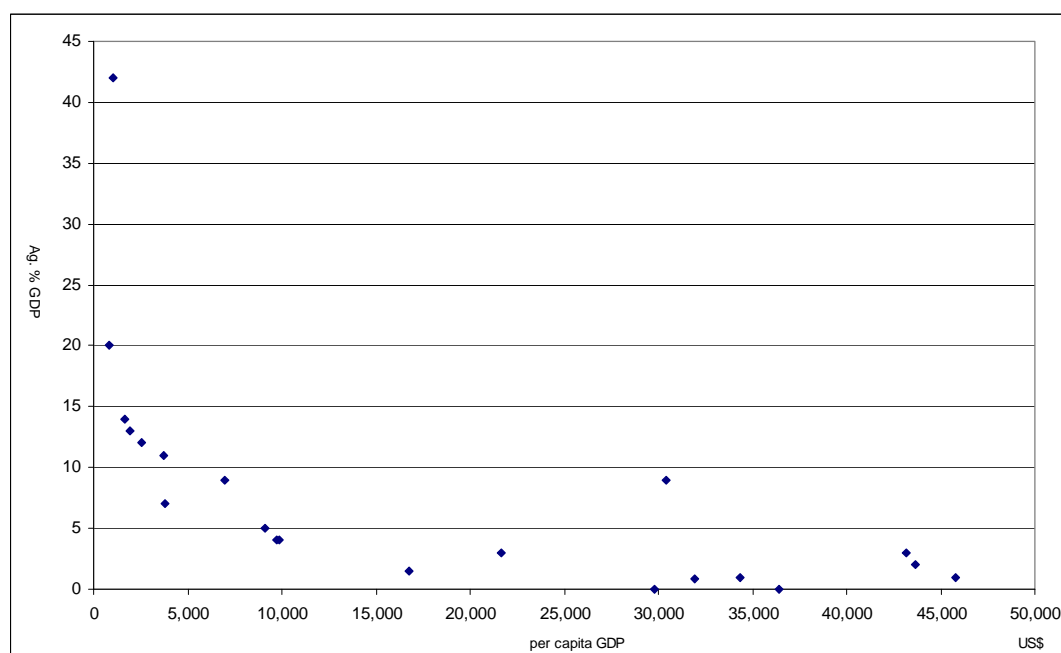
**Table 1 Key indicators – APEC economies**

	BASIC INDICATORS			AGRICULTURE INDICATORS			FOOD SECURITY INDICATORS		
	GDP	GDP/ person	Pop'n	Urban Pop'n % total	Agric. output % GDP	Agric. work- force % total	Agric. Land per capita	Food % H'hold Exp.	Prevalence of under- nourishment (% pop'n)
	<i>(US\$bn, 2007)</i>	<i>(US\$, 2007)</i>	<i>(mil, 2008)</i>	<i>(2006)</i>	<i>(2006)</i>	<i>(2005)</i>	<i>(2000-04)</i>		<i>(2002-04)</i>
Australia	909.7	43199	21.1	88	3	3.6	23	19.7	<2.5
Brunei Darussalam	12.3	31901	0.4	74	1	4.5	n.a.	n.a.	n.a.
Canada	1436.1	43674	32.9	80	2	2	2.2	18	<2.5
Chile	163.9	9884	16.6	88	4	13.2	1	22.5	4
China	3382.5	2560	1321.1	42	12	43 <sup>1</sup>	0.4	39.8	12
Hong Kong, China	207	29775	7.0	100	0	n.a.	0	25.8	n.a.
Indonesia	432.1	1921	224.9	49	13	42.1	0.2	47.9	6
Japan	4384.4	34318	127.8	66	2	4.4	0	19.8	<2.5
Korea	1049.3	21655	48.5	81	3	7.2	0	23.1	<2.5
Malaysia	186.7	6956	26.8	68	9	13	0.3	37.1	3
Mexico	1025.4	9742	105.3	76	4	15.1	1.1	34	5
New Zealand	128.9	30432	4.2	86	9	7	4.4	18.8	<2.5
Papua New Guinea	6.4	1055	6.1	14	42	75	n.a.	n.a.	13
Peru	107.4	3806	28.1	73	7	30	n.a.	31.8	12
Philippines	144.1	1626	88.6	63	14	35	0.2	45.6	18
Russian Federation	1294.4	9103	142.1	73	5	10.2	1.5	n.a.	3
Singapore	167	36384	4.6	100	0	n.a.	0	21.9	n.a.
Chinese Taipei	384.8	16759	23.0	58	2	5.1	0	n.a.	n.a.
Thailand	246.1	3742	65.7	33	11	42.6	0.3	39	22
United States	13807.6	45778	302.0	81	1	0.6	1.4	13.7	<2.5
Viet Nam	71.1	835	85.6	27	20	55.6	0.1	50.7	16

<sup>1</sup> Agriculture share of workforce drawn from China Statistical Yearbook (significantly higher figure reported by FAO).

n.a. means data not available.

**Sources:** International Monetary Fund, World Economic Outlook Database, April 2009, The World Bank, World Development Indicators, 2008, Food and Agriculture Organisation, FAOSTAT, Sandri et al. (2007), Economy sources, CIA Factbook.

**Figure 2** The role of agriculture in APEC economies

**Data source:** The World Bank, World Development Indicators, 2008, Food and Agriculture Organisation, FAOSTAT, Economy sources.

Non-agricultural sectors now dominate growth in large, transforming economies such as China and Indonesia. Even so, a relatively large percentage of the workforce remains involved in agriculture and a majority of the poor are in rural areas. High rural poverty rates underscore the importance of agricultural growth for improving rural incomes in those developing APEC economies with lower rates of urbanisation.

While growth in developing economies and globalisation are resulting in profound transformations of food consumption patterns, there remains significant heterogeneity in diets and consumer preferences across regional economies and a reliance on staples. Rice is still a major food staple for hundreds of millions of people in the APEC region. Maize, rice and corn comprise the major food resources across APEC economies.

Even among developed economies, diets vary markedly. For example, fish and seafood account for a much larger proportion of protein (relative to meat and poultry) in the more affluent parts of Asia when compared with the major Western economies in the Pacific Rim. In the case of Japan, notwithstanding broadly comparable income levels, fish and seafood supply more protein than meat. By contrast, in the United States and Australia, meat supplies eight or nine times as much protein as fish and seafood (FAO 2006, p.22).

Diversity is found also in the relative significance of international trade in food products to among APEC economies (Table 2). Some developed APEC economies are major net food exporters including the United States, Canada, Australia, and New Zealand – as indicated by the food specialisation index which is positive for a pure exporter and negative for a pure importer. Others such as Japan and Korea are heavily dependent on imported food. China sits on the margin with the potential to become a major influence on future world food prices. While international trade is important in developing Asia, with Southeast Asia as a major food surplus producing subregion, most food production is directed to domestic markets.



**Table 2 Trade indicators – APEC economies**

	Exports of food	Share total merchandise exports	Imports of Food	Share total merchandise imports	Food Trade Balance	Food Trade Specialisation index <sup>3</sup>	Revealed comparative advantage <sup>4</sup>
	(US\$m, 2007)	(%, 2007)	(US\$m, 2007)	(%, 2007)	(US\$m, 2007)		
Australia	17574	12.4	7650	4.9	9924	0.39	185
Brunei Darussalam <sup>1</sup>	8	0.1	361	17.2	-353	-0.96	1
Canada	31864	7.6	23252	6.1	8612	0.16	113
Chile	9651	14.1	3085	6.5	6566	0.52	210
China	33152	2.7	32290	3.4	862	0.01	40
Hong Kong, China <sup>2</sup>	3777	1.1	11189	3	-7412	-0.50	16
Indonesia	16308	13.8	7848	8.5	8460	0.35	206
Japan	3615	0.5	55283	8.9	-51668	-0.88	7
Korea	3343	0.9	15692	4.4	-12349	-0.65	13
Malaysia	16203	9.2	8549	5.8	7654	0.31	137
Mexico	14623	5.4	18239	6.5	-3616	-0.11	81
New Zealand	13442	49.8	2624	8.5	10818	0.67	743
Papua New Guinea <sup>1</sup>	1102	23.6	470	16.2	632	0.40	286
Peru	3839	13.7	2136	10.6	1703	0.29	204
Philippines	2938	5.8	3900	6.7	-962	-0.14	87
Russian Federation	12619	3.6	25184	11.3	-12565	-0.33	54
Singapore <sup>2</sup>	5099	1.7	7397	2.8	-2298	-0.18	25
Chinese Taipei	1983	0.8	7421	3.4	-5438	-0.58	12
Thailand	17690	11.6	5903	3.9	11787	0.50	173
United States	87593	7.5	87503	4.3	90	0.00	112
Viet Nam	9533	19.7	3932	6.5	5601	0.42	294

<sup>1</sup>. Statistics for Brunei Darussalam and Papua New Guinea are for agriculture as a whole.

<sup>2</sup>. Statistics for China; Hong Kong, China; and Singapore include re-exports.

<sup>3</sup>. The index of food trade specialisation is defined as net exports, divided by the sum of exports and imports of food products. A value of 1 indicates a pure food exporter and a value of -1 indicates a pure food importer.

<sup>4</sup>. The index of revealed comparative advantage is the share of food in an economy's exports as a ratio of food in world exports (world average =100). A ratio of greater than 100 indicates an economy has a comparative advantage as opposed other exports

**Sources:** WTO International Trade Statistics, 2008, Economy sources, Concept Economics calculations.

For economies with comparative advantage in agrifood products – as indicated by a high value of revealed comparative advantage in Table 2 – higher food prices can offer income and growth opportunities. This can be the case even for low income economies where food is a substantial share of household budgets, and may facilitate structural adjustment in urbanising economies. An example is Viet Nam where past international and domestic policy reforms resulted in increased rice prices. The impacts on food security and poverty alleviation were nonetheless positive given the economy's comparative advantage in rice production and the large share of the population engaged as net rice producers.

For other economies, however, the impacts of higher food prices can be severe causing significant transfers of income both among and within the economy. In general, higher food prices hurt the poor most, although at an individual household level, whether this is the case depends importantly on the products involved, the patterns of household incomes and expenditures, and the policy responses of governments (World Bank 2008a).

With varying vulnerability to higher food prices, the concept of food security itself has taken on different meanings in different contexts, not all of which accord with economic perspectives of sound policy (see Box 2). Durable improvements in food security require sustained reform on a broad front including: 1) a sustainable and increasingly productive domestic food producing industry; 2) an improved international trading environment; 3) well designed safety nets; and 4) efficient domestic markets. The primary focus in this study is on the fourth factor – in particular, the potential benefits to be secured from reducing behind-the-border structural impediments across market structure, regulatory, infrastructure and distribution systems for food.

**Box 2 What is food security?**

Food security hinges on the affordable access to enough food for an active healthy life. The recognition of basic physiological food requirements is tied to the nutritional target set by the Food and Agriculture Organization with food-insecure people defined as those consuming less than 2,100 calories a day. As this definition implies, food security is primarily an individual or household issue, though clearly certain economies – especially low income, food importing economies – are more vulnerable than others. Reflecting both production and trade dimensions, food insecure economies have been defined as those where ‘agricultural production is insufficient or too irregular to guarantee adequate supplies every year, and export revenue is not sufficiently strong to give confidence that, regardless of world market conditions, food could be imported to make up any shortfall without severe consequences for other import-dependent areas’ (Stevens et al. 2000, p.vi).

Policy interventions are only one dimension of a broad understanding of food security, albeit an important one that includes measures designed to promote food production, facilitate the operation of markets, enhance the availability and value of labour, and provide transfers and safety nets. Macroeconomic and a range of sectoral policies also have indirect effects on food security.

From an economic perspective concerns arise where food security is viewed as synonymous with food self sufficiency and thus appears opposed to the opening of domestic markets to foreign agricultural products. In general, the logic of market exchange that applies at an individual level is equally relevant for economies as a whole – purchasing some proportion of food requirements on world markets is consistent with improved food security. In support of this view, Dr Supachai Panitchpakdi (2005), the former Director-General of the WTO and the current Secretary-General of UNCTAD, has remarked that:

Past, as well as present, experience shows us that food security is best achieved in an economically integrated and politically interdependent world. In an interdependent world the effects of any deficit or surplus in food production in one economy can be spread over a broad range of economies. The burdens of short-term fluctuations and longer-term structural change are thereby reduced. Economic integration also keeps the cost of inputs for production down and ensures that markets will remain open at critical times.



### **3. CONCEPTUAL APPROACH TO THE ISSUES**

#### **A. INTRODUCTION: FLEXIBILITY, RESILIENCE AND SUBSTITUTABILITY**

Increases in relative prices of particular goods provide a signal to producers to increase their output of that good, and also provide consumers with a signal to reduce consumption and switch to other goods. Higher prices may also shift the policy priorities of governments. If prices were not permitted to rise in response fully to increases in relative scarcity, producers would have little incentive to bring forth additional supply, and consumers would have little incentive to reduce consumption. Shortages would tend to develop, and non-price methods of rationing would take place. In smoothly functioning markets, higher prices are part of the solution to meeting increasing and changing patterns of food demand. Well functioning markets also promote overall economic growth.

For a given negative supply side shock, food prices will be higher the less responsive or elastic food demand is to price changes. Intuitively, if there is a reduction in supply of a particular food product and consumers are able and willing to substitute out of that good and into other goods, then only a small increase in price is needed to ration the new reduced supply among consumers. Thus, the willingness of consumers to switch to substitutes in response to price changes will be a key determinant of the extent to which food prices rise in response to supply side shocks.

Similarly, for a given positive demand side shock, food prices will be higher the less responsive is food supply to price changes. If there is an increase in the demand for a particular food product and producers can readily substitute into production of that good away from the supply of other goods, then only a small increase in price is needed to provide an incentive to bring forth that alternative supply.

In other words, the flexibility of demand and supply owing to the presence of close substitutes in consumption and production will be a key determinant of the extent to which food prices rise in response to demand and supply side shocks. This is true for prices in individual markets as well as prices at the aggregate level. This reasoning also applies to shocks that increase the costs of inputs that are used in the production of many food products, such as labour, fuel and energy, water, fertiliser and land. If the supply of a particular factor input is disrupted, then the willingness of producers to substitute toward other inputs and the existence of close substitutes for that factor input will dampen any effective increase in relative factor scarcity, and reduce the rise in factor prices and production costs that is required to ration demand.

In general flexibility will be: 1) greater in the longer as opposed to the shorter term; 2) lower the more basic is a consumer's diet; and 3) lower in the face of constraints on the use of land, labour and water resources.

A lack of flexibility in developing economies to adjust consumption and production would imply that even small impediments can have large effects of food security. Thus even removing small impediments can generate substantial welfare gains.

## **B. THE DOUBLE-EDGED EFFECT OF FOOD PRICE INCREASES**

Increases in food prices can cause significant changes in consumer behaviour and reductions in consumer wellbeing. On the other hand, in many APEC economies, revenues from agricultural output and food production are a significant source of individual, household, and aggregate income. Farm workers derive wages and salaries from supplying agricultural labour, and farm owners derive profits from selling their agricultural output. Suppliers of other factors of production also depend on high returns to maintain their standards of living. To the extent that higher food prices are also associated with higher agricultural prices and wages, such increases will tend to increase these incomes and would be welfare enhancing (Aksoy and Isik-Dikmelik, 2008).

The response to food price changes of a household's wages also need to be taken into account in any complete welfare analysis of food price changes. If the household is a net supplier of labour and wages rise by more than prices, then this can be an additional source of welfare gain.<sup>5</sup> This means that even if consumers are net buyers, the negative welfare effects of higher consumer prices may be partially or completely offset by the welfare gain from increases in wage incomes.

The key point here is that a great deal of care must be taken when assessing the overall welfare effects of higher food prices. The welfare analysis of the next section still broadly applies, but it should be remembered that the effects of changes in wages are ignored. In addition, the welfare effects only apply to net food consumption rather than absolute levels of food consumption. It is important to bear all of this in mind, especially in economies where a substantial share of the population depends on income from agriculture.

The focus of food security policies in these economies will be on improved food distribution systems that will increase producer incomes as well decrease prices for consumers.

## **C. THE DEMAND SIDE: SUBSTITUTION AND INCOME EFFECTS**

In individual food markets microeconomic demand and supply factors will play an important part in influencing relative food prices. Possible demand side factors that will influence prices in individual markets include changes in income, tastes, and population. Prices in other markets will also be important as they affect consumers' disposable incomes as well as being possible substitutes, as for example seafood and meat. This section provides an analytical overview of possible sources of change in individual food prices and the importance of these factors in different types of economies, highlighting differences between developing and transition economies and developed economies.

### **i. The welfare effects of higher food prices**

Increases in food prices can cause significant changes in consumer behaviour and reductions in consumer wellbeing. These matters are dealt with in detail in Appendix A. A price rise effectively reduces a consumer's income but this can be partially offset if a consumer can replace the higher priced good with an alternative. For example, an increase in the price of meat may be partially offset by an increase in the consumption of legumes and rice. These welfare

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<sup>5</sup> See, for example, Ravallion (1990). Ravallion analyses the Bangladesh economy and finds that in the short run the rural poor typically become worse off when the price of food staples increases. However, over the long run, as wages respond to price changes, the welfare of the rural poor could actually increase.

effects of price changes can be captured by analysing substitution effects and the money equivalent of price changes using a willingness to pay approach.

Cross economy comparisons of the welfare effects of price changes is complicated by the fact that consumption and spending patterns tend to vary considerably across economies. The evidence suggests that among the basic groups of goods that individuals consume (such as housing and rent, fuel and electricity, clothing and footwear, housing, healthcare, education, and so on) demand for food tends to be the least responsive good to changes in price. This is true for both rich and poor economies.

However, consumers in low income economies tend to spend a greater proportion of their income on food. Thus, for these consumers, an increase in food prices is more comparable to a fall in real income and purchasing power over other goods and services than is the case for consumers in wealthier economies facing the same percentage increase in food prices. That is, for consumers in low income economies, even modest food price increases can be equivalent to a significant decline in real income. It follows that when food prices rise, consumers in poorer economies tend to reduce food consumption by more (in proportionate terms) than do consumers in wealthier economies.

The responsiveness of food demand to an increase in food prices is comprised of two conceptually separate but equally important effects:

- A substitution effect, which measures the degree to which a consumer substitutes out of food and into other goods, assuming that the consumer is compensated for the price change with an equivalent increase in real income; and
- 
- An income effect, which captures the reduction in real income or purchasing power brought about by the price increase.
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The empirical evidence suggests that the absolute size of this substitution effect increases, that is, consumers with lower incomes are more price responsive. However, at subsistence levels of food consumption, individuals no longer have any further ability to substitute away from food or related services.

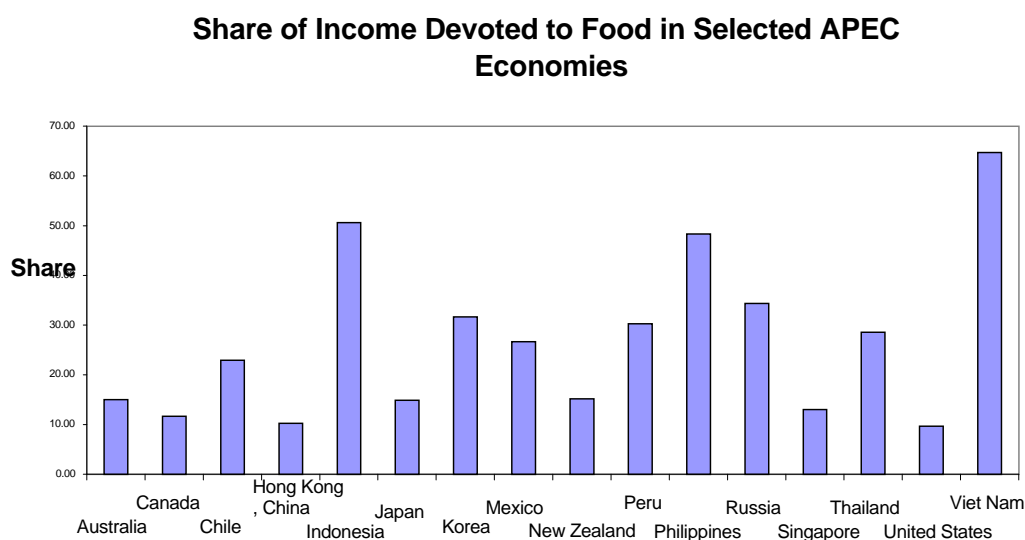
The income effect indicates the percentage change in a consumer's real income that is lost due to a price increase or gained through a price decline. In developing APEC economies the income effect ranges from about 0.15 per cent to nearly 0.5 per cent. In the developed APEC economies a one per cent increase in the price of food produces less than a 0.05 per cent reduction in disposable income. This provides a clear indication of how the welfare effects of an increase in food prices vary at different levels of income.

The relationship between incomes, food consumption, and the share of income devoted to food has been studied at length in the literature. The empirical evidence suggests that as incomes increase, food consumption increases but at a slower rate.

One of the most important empirical propositions in the economics literature is Engel's law, which states that the share of income devoted to food expenditure declines as income increases (Engel 1895). Under certain assumptions about consumer preferences, the share of income devoted to food expenditure can be used as an indirect indicator of living standards within and across economies. Indeed, a common approach to comparing living standards across

economies is to compute real discretionary expenditure, which is the inflation-adjusted amount of income that is available after spending on necessities (such as food) has been accounted for. Estimates of the share of income devoted to food for selected APEC economies are shown in Figure 3.

**Figure 3 Share of income devoted to food in selected APEC economies**



Source: Seale et al (2003), Table 3, page 15.

**Data source:** Source et al. (2003), Table 3, p.15

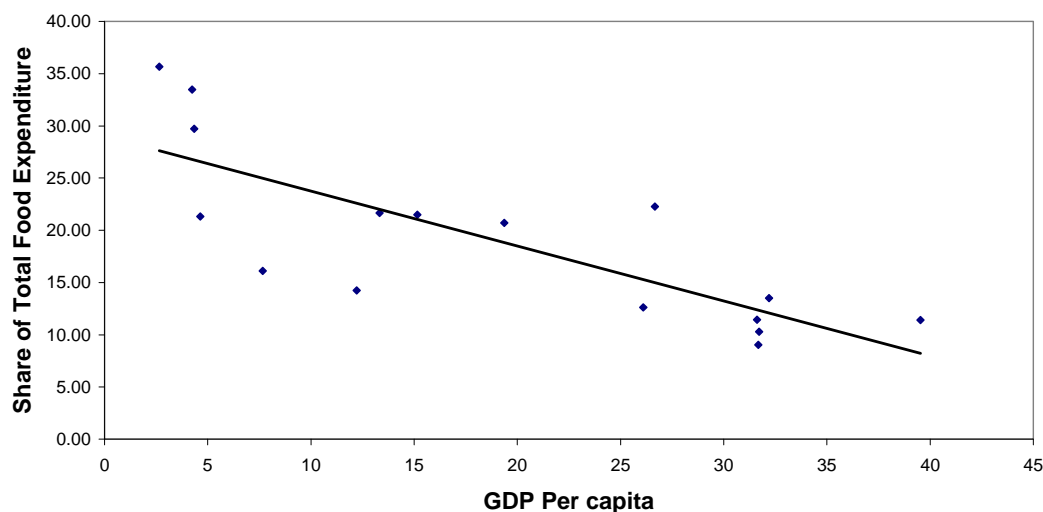
Calculations using these data suggest that for APEC economies, a one per cent increase in GDP per person is associated with a 0.62 per cent reduction in the share of expenditure devoted to food.

In poorer economies the demand for food tends to be more responsive to changes in income than in wealthier economies. That is, the income elasticity of demand falls as incomes rise. For APEC economies, an increase of \$1000 in GDP per person is associated with a -0.01 unit change in the income elasticity of demand for food.

Finally, poorer economies tend to spend a greater fraction of their food expenditure (as opposed to expenditure on all goods) on staples such as breads and cereals. This is illustrated for selected APEC economies in Figure 4.



**Figure 4 Share of bread and cereals expenditure as a proportion of total food expenditure in selected APEC economies**



Moreover, in APEC economies, breads and cereals is the only food subgroup for which spending as a share of total food expenditure is negatively related to GDP per person.

To isolate the effect of higher food prices in very poor economies where spending on bread and cereals is relatively large, it is necessary to look deeper into the consumption and price data and examine consumption patterns and prices for individual food items.

## ii. The welfare effects of volatile food prices

As mentioned earlier, food prices have gone through a period of significant volatility in recent years. In well-functioning markets the sources of price volatility can be traced to demand and supply side factors. Food prices will be more volatile if:

- Food demand is not responsive to price changes (demand is price inelastic). This means that relatively small supply-side shocks will produce large changes in equilibrium prices in order to ration supply and clear the food market;
- Food supply is not responsive to price changes (supply is price inelastic). This means that relatively minor demand-side shocks will produce large changes in equilibrium prices in order to ration supply and clear the food market;
- Food demand and supply are highly volatile, that is, are subject to frequent shocks; and/or
- Demand and supply shocks are not positively correlated, so that supply tends to fall when demand rises (and vice versa).
- 

It is not necessarily the case that more volatile prices reduce economic welfare because the benefits of lower prices may exceed the costs of lower prices, depending in large part on the distribution of prices over time. However, the distribution of changes in food prices tends to be right skewed; that is, the probability of sharp rises tends to be greater than the probability of sharp falls. As a consequence, consumer welfare is more likely to fall with more volatile food prices, particularly if consumers are highly risk averse.

## **D. THE SUPPLY SIDE: COSTS AND COST WEDGES**

In any market, final consumer prices can in principle be decomposed into the price received by primary producers, plus all of the additional costs that are involved in getting the good from producers to consumers. The approach taken in this report is to break down the supply chain into its main constituent parts, examine costs and cost wedges along the agrifood chain, analyse how these costs influence final consumer prices, and investigate policies and institutional arrangements that discourage lower costs and reduce flexibility, resilience and elasticities on the supply side of food markets.

Within the supply chain, there will be significant costs incurred by producers and consumers in indirectly doing business with each other. For food markets these costs include:<sup>6</sup>

- Transportation costs;
- Processing costs;
- Packaging and storage costs;
- Producer marketing, advertising and retailing costs; and
- Other transaction costs (such as verifying food quality and safety).

On the other hand, if the output market is not competitive, then consumer prices could be higher even though cost wedges and producer costs remain small or unchanged. In a non-competitive environment this mark-up would depend on the extent to which producers exploit any market power.

Higher producer costs and higher cost wedges ultimately lead to higher consumer prices. They can also make economies less resilient, slowing the response to shocks and increasing the welfare losses those shocks cause. The magnitude of costs and cost wedges will be influenced at each point in the agrifood system by:

- Productivity - direct influences on costs and value added at each individual point in the supply chain;
- Markets for inputs - the effect of input markets on costs at each individual point in the supply chain; and
- Markets for outputs - the effect of output markets on prices at each point in the supply chain.

### **1. Food markets with intermediaries: The food supply chain**

In general, intermediaries or ‘middlemen’ exist because they lower transactions costs by specialising in trading large volumes of goods. Unlike individual buyers and sellers, they are

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<sup>6</sup> Taxation will also drive a wedge between consumer and producer prices at each point in the supply chain. The costs of taxation are ignored here.

usually present in the market for long periods of time. They often create a reputation for provision of their services that outlasts more temporary market participants.

Intermediaries act as repositories of specialised and valuable information about markets, helping markets to clear in the short term and to function more efficiently in the long run. They can take advantage of economies of scale in their functions and invest in specialised capital, increasing labour productivity. In rapidly evolving markets, intermediaries can be an important source of innovation, providing services that meet the new demands of consumers, retailers and food processors.

By all of these means, the total cost wedge described above can be lowered if firms and individuals with a comparative advantage in distribution and intermediation supply the activities listed above, instead of consumers and producers directly supplying these services themselves.<sup>7</sup> The lowering of cost wedges increases the gains from trade that can be made between final buyers and original sellers. In other words, the existence of intermediaries allows resources to flow from lower to higher valued uses, increasing productivity in the economy as a whole.

### **Examples of intermediaries along the supply chain**

In the food industry there are typically several kinds of intermediaries along a supply chain. These could include firms that provide the following services:

- Physical transportation of food: Transportation costs are influenced by fuel costs, labour costs, equipment costs and the quality of transportation infrastructure. Some firms have particular knowledge of transportation networks and have a comparative advantage in the provision of transportation services.
- Searching and matching: Matching buyers and sellers is costly. Intermediaries may have a comparative advantage in matching the needs of purchasers and sellers.
- Advertising, marketing and market research: Providing product information is costly for individual suppliers, and providing information about tastes and willingness to pay is costly for buyers. Some intermediaries may have a comparative advantage in providing such information.
- Risk management (quantities): If consumer demand and producer supply are uncertain, then the intermediary plays the role of building up buffer stocks and inventories. This is potentially valuable to both sides of the market because it absorbs some of the individual costs of inventory and buffer stock management. The intermediary can pool the individual risks of excess supply and stockouts. Such an intermediary would have a comparative advantage in managing stocks and flows and perhaps also in providing storage facilities and technology.

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<sup>7</sup> See, for example, Alchian and Allen (1983), pp. 48-50.

- Risk management (safety and quality assurance): If product quality is variable, the intermediary may find it profitable to monitor quality and safety and to guarantee the quality of supply to purchasers. Intermediaries may alleviate adverse selection problems in regards to product quality.<sup>8</sup>
- Risk management (payment and delivery risk): If buyers are unreliable in making payments or if sellers are unreliable in making delivery, the intermediary may find it profitable to guarantee timely delivery and payment. This helps alleviate moral hazard problems<sup>9</sup> and ‘holdup’ problems (as well as other ex-post opportunistic behaviour<sup>10</sup>) that may occur after contracts are signed, or after delivery or payment has been made.
- Lowering transactions costs: Intermediaries may have a comparative advantage in providing bargaining and negotiation services that may allow buyers and sellers to negotiate more mutually beneficial agreements than those which they could secure if they negotiated on their own. For example, an intermediary’s understanding of the situations of both buyer and seller may suggest to them a contracting arrangement that is better suited to both parties.

Of course, none of these considerations imply that there should only be a single intermediary firm at each point in the supply chain. Intermediary markets are just like any other market. Competition between intermediaries improves individual supplier incentives, offers more choice for consumers, drives down costs, improves service quality and encourages efficient exit and entry.

In some cases, producer firms may themselves find it profitable to be involved in aspects of intermediation also. Vertical integration may reduce contracting costs because transfers become internal to the firm, rather than taking place across firms. It may also reduce the costs of verifying quality at each transfer point in the chain. Vertical integration is discussed in more detail in the following subsection.

At each point in the supply chain, market structure, regulatory and institutional arrangements and economic policies may also influence costs. For example, the services provided by intermediaries will reflect the degree of geographic concentration of agricultural production and processing, as well as the structure of wholesaling and retailing. Policy settings that influence both the level of costs and the responsiveness of supply to changes in demand include:

- The overall public policy environment (for example, the definition and enforceability of property rights, quality of formal and informal legal institutions, and the extent of corruption);

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<sup>8</sup> Adverse selection problems occur when sellers have more information about the quality characteristics of a product than do buyers. Buyers then base their willingness to pay for a specific good on their assessment of the average quality of the good. This reduces the revenue of high quality sellers and may cause some of them to withdraw supply from the market, thereby lowering the overall average quality of goods. If adverse selection problems are particularly severe, the market may unravel altogether.

<sup>9</sup> Moral hazard problems occur when one party to a contract (the agent) can take a hidden action that affects the welfare of the other party (the principal). Because the action is not observable by the principal, it cannot be directly contracted upon. The problem for the principal is to design indirect incentives to induce the agent to behave in a way that maximises the joint value of the contract between the parties.

<sup>10</sup> Ex-post opportunistic behaviour occurs when one party (the principal) has taken an action or committed to take an action that affects the joint value of the contract. The other party (the agent) then threatens to behave in a way that reduces this joint value and the principal’s payoff, unless the principal agrees to give the agent a more favourable share of the surplus.

- The specific legal and regulatory framework that applies to a particular part of the supply chain (for example, food safety regulation or road transport rules);
- Commodity taxation and taxes on intermediary transactions, which drive a wedge between the price received by producers and the price paid by consumers;
- Competition policy; and
- The economy's openness to international trade, foreign investment, innovation, and entrepreneurship, all of which influence technological progress and productivity growth.

## **E. VERTICAL INTEGRATION, COORDINATION AND MARKET CONCENTRATION**

In the analytical framework presented above, each separate intermediate good or service is assumed to be provided in a separate market by separate firms. However, there is no compelling economic reason why this must necessarily be the case. For example, although storage and transportation of food are two distinct economic activities, the existence of large common fixed costs may mean that it is less costly for a single firm to provide both these services, rather than for two separate firms to provide each.

Vertical integration refers to the extent to which upstream and downstream supply chain processes are unified within a single firm, as opposed to these being purchased from other firms through short or long term contracts. The nature of vertical integration within a supply chain can vary, from full ownership and control of various production processes along the supply chain on the one hand, to looser forms of coordination such as long term or ongoing contractual arrangements on the other. A firm's involvement in aspects of its product's supply chain can change over time, depending on the relative costs and benefits of vertical coordination and other commercial arrangements. This section briefly outlines some economic reasons for vertical integration and coordination and describes some of the policy issues that can arise.

### **i. Explanations for vertical integration**

#### **1. *The 'weak-link' argument***

Vertical integration is widespread in food processing. For example, Bhuyan (2005) reports that in the United States in the 1990s, the proportion of total production under integrated ownership or contractual arrangements was 100 per cent in the poultry industry, 98 per cent in vegetable processing, 40 per cent in potato production and marketing, and 26 per cent in milk processing. Some vertical integration results from the existence of economies of scope, which occur when the cost of producing given quantities of two or more separate goods together within the same firm are lower than the sum of the costs of producing those same quantities by separate firms (Baumol, Panzar and Willig, 1982). Traditionally this definition has been applied to goods which are physically produced in the same geographical location, within the same 'plant'. However, economies of scope can also be found in the production of services where a single management team controls the output of services from different physical locations.

For example, customer search and price negotiation services for a wholesale food company could in principle be produced at two completely different locations by two different individuals or groups of individuals, with most communication and coordination taking place

electronically. For all intents and purposes these services are supplied by the same firm, even though they are 'produced' at two distinct geographic locations. The cost of setting up and running these services in-house under the same management may be less than the cost of contracting two separate entities which are located in the same physical location, but which operate at arm's length from each other and from the management of the firm.

Economies of scope can also apply to indivisible inputs or services that are utilised at multiple physical locations by the same firm. For example, if a vertically integrated food business has multiple plants in different cities, it may be less costly to have a single, centrally located marketing and advertising unit, instead of a separate marketing unit at each physical location. The services provided by the firm's marketing unit - together with other services such as higher level managerial planning - are effectively joint inputs for each of the firm's production plants. This means that it is often more fruitful to think of the definition of economies of scope in terms of control over resources, coordinated decision making, and managerial authority, rather than activities that occur in the one physical location.

To take another example, consider food safety along the supply chain. Food safety may have joint production characteristics in the sense that externalities (or 'spillovers') may exist between different firms at different points in the supply chain. Poor quality verification standards at the primary production stage can reduce the price customers are willing to pay for the final retail product. The more likely it is that the activities of a particular firm in a supply chain can affect the profitability of other firms in the same chain, the higher the degree of vertical coordination and control is likely to be.

Some chains have characteristics that make spillovers more likely. Hirshleifer (1983) examined the characteristics of joint production technologies that transform individual privately supplied inputs into public goods that must, by definition, be consumed in identical amounts by all individuals. At one extreme, the output of 'weakest-link' public goods depends on the amount of input that is supplied by the individual who contributes least. In this case, inputs are highly complementary and it is the minimum contribution that determines the joint output. At the other extreme, the output of 'best-shot' technologies depends on the amount of input that is supplied by the individual who contributes most. In this case, it is the maximum contribution that determines the quantity of the joint output.

Food quality management and safety systems often possess 'weakest-link' characteristics. In order to remain fresh and free of disease, some perishable goods must be refrigerated for the entire time they spend in the supply chain. Each firm at each point must store the good at some minimum temperature in order to prevent spoilage. In these circumstances, the amount of care taken by one firm is not a substitute for a lack of care taken by others. If one firm fails to take adequate precaution, then other firms bear part of the cost. It is the minimum amount of care taken along the supply chain that is crucial, rather than the 'total' amount of care taken.

One way of dealing with these complementarities is for contracts along the supply chain to be contingent upon the quality of the product at each stage. However, if verification costs and transactions costs are sufficiently high, it may be efficient for a single firm to control all points of the supply chain.

## 2. *The transactions cost argument*

Coase (1937, 1988) also viewed vertical integration as a cost-reducing device, but instead emphasised integrations as a way of minimising the firm's costs of engaging in contracts with other entities. For example, a primary producer may wish to vertically integrate or coordinate with a food processor if the costs to the producer of repeatedly searching for new downstream food processors (and repeatedly negotiating over new sets of prices, terms and conditions) are relatively large.

Alternatively, consider the market for labour. If the costs to a firm of monitoring non-attendance or shirking on the part of an external, contracted party is high, then it may be more profitable to employ labour on a long term basis within a firm, where their efforts can be monitored more easily.

The costs of these kinds of decisions will also be determined by the kinds of employment contracts that can be written. For example, consider employment contracts for fruit pickers. If the employer can write piece-rate contracts (which pay a wage according to the volume of fruit picked) then direct and costly forms of employee monitoring may not be needed. The employer may not be concerned about adverse selection problems<sup>11</sup> in the labour market for fruit-pickers, and may be willing to employ large numbers of inexperienced workers on short term (even day-to-day) contracts.

On the other hand, such contracts may not be legally permitted. Then the firm may engage a labour hire company on a long term basis to supply it with workers who are monitored and have been screened by that company. Over time the two firms may even decide to vertically coordinate by entering into a long term contractual arrangement. In this way, legal institutions and (endogenous) transactions costs can determine the vertical boundaries of firms as well as the costs of output.

## 3. *Incomplete contracts, risk-sharing and verification costs*

Another reason for vertical integration along the food supply chain is the existence of risk, incomplete contracts and transactions costs that are associated with uncertainty and unanticipated outcomes. At various points in the supply chain the costs of production can often turn out to be much larger than parties anticipated. Ideally, firms along different points of the food supply chain would write complete contingent contracts that clearly specified their obligations in every possible state of the world. Firms could then also specify that delivery of goods should not occur when costs of production and delivery turn out to be too high, relative to the benefits.

But some contingencies cannot be foreseen. For example, certain extreme weather events may cause crop failures or diseases that were not foreseen by either the primary producer or the downstream wholesaler or retailer. Alternatively, it may simply be too costly for firms to set out every possible scenario and each firm's obligations in each of those scenarios. And even if such contracts were written, it may not be costless to verify whether certain events have or have not occurred. In other words, even a hypothetically complete contingent contract may be costly to enforce.

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<sup>11</sup> This is analytically similar to the adverse selection problem discussed earlier.

The existence of transactions costs and verification costs means that parties will not wish to sign complete contracts. But this lack of complete contracting creates its own problems. When, during the course of an economic relationship, certain unforeseen contingencies arise, conflicts of interest may also arise: buyers may want the contract to be performed but sellers may not, and the terms of the contract may not specify exactly what should happen.

These conflicts can be resolved by simple customs or rules (which the parties might implicitly agree to at the outset); by costly renegotiation; or by costly conflict in a court of law or via some other arbitration mechanism. Alternatively, firms might be able to avoid these costs altogether by vertically integrating at the outset. Of course, this does not remove the risk of unforeseen contingencies such as adverse weather events, but it does mean that risks of unanticipated costs are then shared within the joint entity, and formal contingent contracts and other costly mechanisms such as renegotiation or formal arbitration may not be required.

#### **4. *Asset specificity and the holdup problem***

A related reason for vertical integration and coordination relates to asset specificity. Firms along different points of the food supply chain often write spot contracts on a regular basis and in doing so form ongoing or long lasting economic relationships. Consider, for example, the relationship between a logistics provider and a food retailer. Suppose that the logistics provider invests a significant amount of resources over time tailoring its service range to the retailer, providing producer network information and products that are very specific to the retailer's quality requirements. Over time the logistics providers may build up a great deal of human capital and knowledge that is specific to that particular food retail client, in the sense that the logistics providers' specific human capital may be worth less to another retailing firm. Similarly, the retailer may not be able to easily find a logistics provider that provides such specialised services.

One firm may be able to behave opportunistically and increase its profits from the relationship by threatening to end the relationship and contract with a third party. The payoff from such threats depends on the degree of capital-intensity of output, the amount of investment by each firm in the specific relationship, and the outside market value of these relationship-specific capital assets. But the possibility that such threats may eventually be made means that firms may be reluctant to invest in relationship-specific capital in the first place. This in turn reduces the likelihood of efficient long run relationships developing over time.

One possible solution to this problem is for the firms to commit at the outset to vertically integrate, or to vertically coordinate in some other way (for example, by writing long term contracts). The possibility of asset specificity means that there may be significant gains from vertically integrating for these two firms. If they were to do so at the outset then each would tend to make surplus-enhancing investments without having to concern themselves with the possibility that the other might engage in opportunistic behaviour once those investments have been made. Effectively, with up-front vertical integration or coordination, the costs of either firm switching to an alternative would be relatively high, and this encourages them to sustain their vertical relationship.

#### **ii. *Market power, concentration and vertical integration***

In addition to (or instead of) vertically integrating to reduce costs, firms may also wish to vertically integrate in order to create or better exploit market power (market power is a term



used to describe a condition where a firm, or firms, can earn additional profits by raising the price of their output). However, even if this is the motivation for vertical integration, it does not necessarily make consumers worse off. For example, suppose the supply chain consists of two separate monopoly suppliers (for example, a monopoly wholesaler and a monopoly retailer), and suppose that the input to output ratio is fixed. The retailer's marginal costs are determined by the (monopoly) price charged by the wholesaler. In turn, the profits of the latter are determined by the (monopoly) retailer. If the downstream monopoly retailer chooses a price without taking into account the effect that his choice has on the profit of the upstream wholesaler then overall costs to consumers may increase and producer prices may decline.

In this situation a vertically integrated monopoly entity may be able to earn greater profits while charging consumers a lower price than would be charged by the unintegrated firm. The reason is that the vertically integrated entity can eliminate "double marginalisation", that is, the piling of mark-ups on top of mark-ups, effectively internalising the externality that exists between the two separate firms. This can result in a welfare gain for both producers and consumers.

Therefore, in some cases vertical integration may be more efficient than vertical separation, even if both firms have market power and even when there are no cost synergies or other reasons for integrating. The welfare gains from vertical integration can also be obtained by using different arms-length pricing schemes, such as franchise fees or resale price maintenance, but this is not always possible, particularly if there is demand uncertainty or if the downstream supplier has information about the market that the upstream supplier does not.

On the other hand, there are other instances in which vertical integration or coordination may reduce downstream competition. For example, a vertical merger or the signing of long term contracts between different entities along the supply chain may act as a barrier to entry in the upstream or downstream market. To take an example, suppose that in each of the upstream wholesale and downstream retail food markets there are only two producers. Suppose that the wholesalers compete on price and earn no economic profits, whereas retailers compete on quantities sold and earn excess duopoly profits. A merger between one of the wholesalers and one of the retailers may potentially result in higher prices and reduce welfare. The remaining non-integrated retailer now faces what is effectively a monopoly wholesaler, which raises the retailer's costs and makes it less able to compete with the new vertically integrated entity.

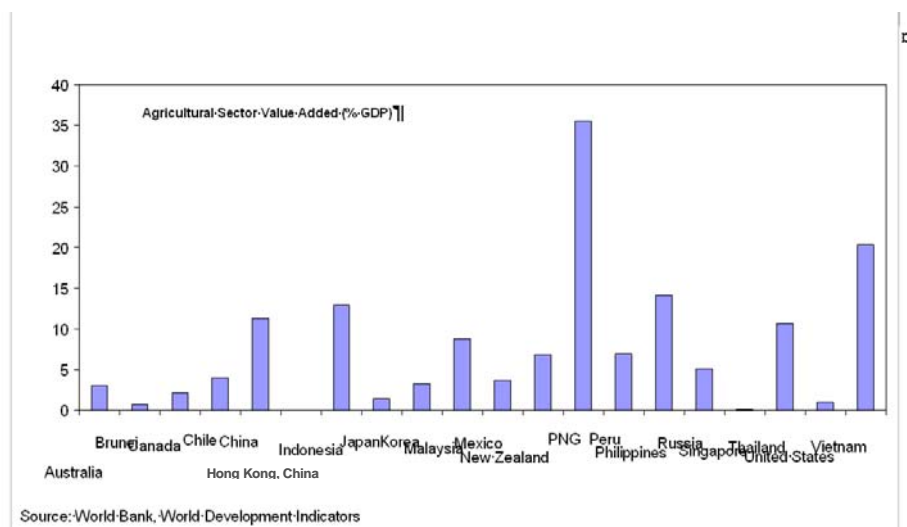
Therefore, in the absence of any cost synergies, this kind of 'input foreclosure' may reduce welfare. It is also straightforward to construct examples in which welfare-reducing 'customer foreclosure' is possible, where a downstream firm possessing market power vertically integrates with an upstream supplier that is not earning economic profits. The instances in which these kinds of welfare-reducing vertical mergers can occur are by no means ubiquitous. In other words, vertical foreclosure that simultaneously increases individual profits and reduces overall welfare is possible, but only under specific circumstances. Moreover, distinguishing between this kind of vertical integration on the one hand and cost-reducing, efficient vertical integration on the other can be very difficult in practice. These considerations suggest that any assessment of whether a specific instance of vertical integration will lead to, or has led to, higher consumer prices and lower overall welfare requires a very careful analysis of all of the factors that affect the gains and losses from the specific vertical relationship.

## F. MACROECONOMIC INFLUENCES ON FOOD PRICES

### i. Agriculture and long run aggregate growth patterns in APEC economies

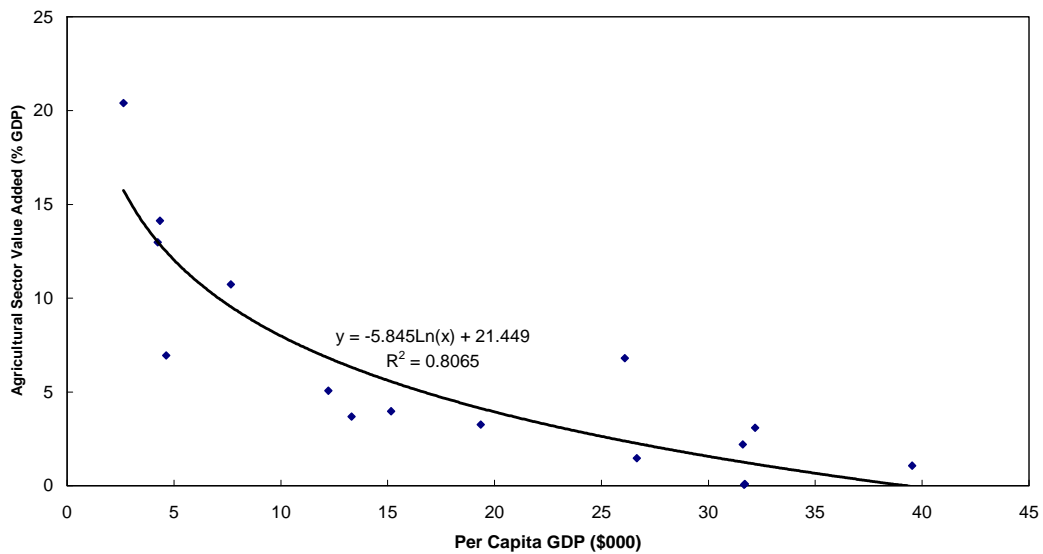
The economic importance of agriculture varies considerably among APEC economies (Figure 5). In urban economies such as Singapore and Hong Kong, China, for example, the value added directly by agriculture is less than one-tenth of one per cent of total GDP. At the other end of the spectrum, in Papua New Guinea, more than 35 per cent of GDP comes from the agricultural sector.

**Figure 5 Economic Importance of Agriculture in Selected APEC Economies**



The direct economic importance of agriculture in APEC economies negatively correlates with overall living standards. A 5.8 per cent increase in the level of per capita GDP is associated with a one percentage point reduction in the direct economic importance of agriculture, on average (Figure 6). This does not mean that the forced transfer of factors of production from agriculture to other sectors of the economy would increase the rate of economic growth, but that agriculture's share of an economy's output tends to decline as living standards rise.

**Figure 6 GDP per capita and the economic importance of agriculture in selected APEC economies**

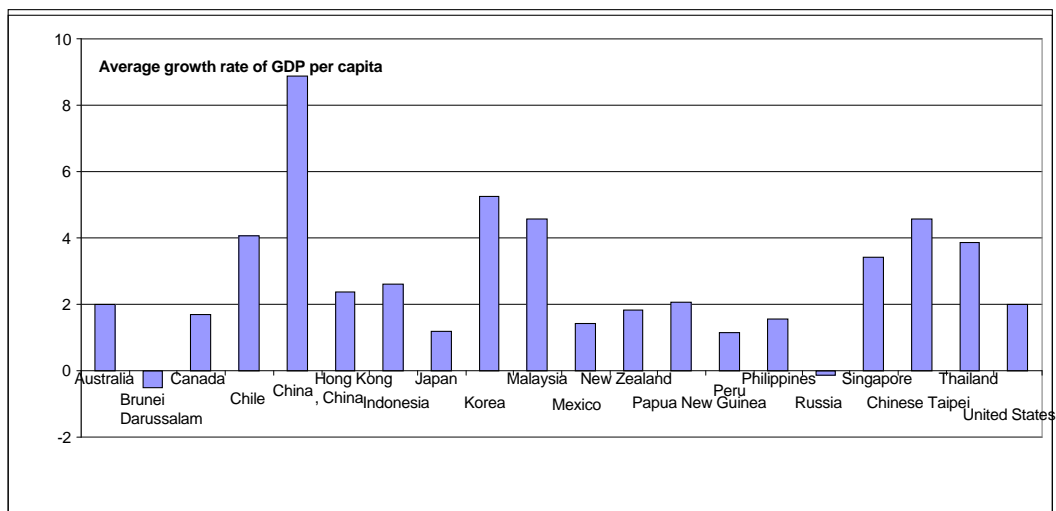


**Data source:** World Bank, World Development Indicators

Over the longer term, aggregate macroeconomic performance and the performance of the food sector in individual economies will be driven by economy-wide demand and supply side factors such as technological change and aggregate productivity growth, population growth and family size, income growth, urbanisation, and changes in tastes and consumption patterns. These factors will also partly determine macroeconomic resilience to aggregate shocks (such as shocks to energy prices) and the vulnerability of food markets to aggregate shocks.

There has been considerable variation in long run per capita GDP growth rates among APEC economies since 1970. Some economies, such as China and Korea, have enjoyed very rapid average growth rates since 1970, whilst others such as Brunei Darussalam and Peru have experienced much lower growth rates of per capita GDP (Figure 7).

**Figure 7 Average GDP per capita growth among selected APEC economies, 1989-2004**



**Data source:** Heston et al. (2006)

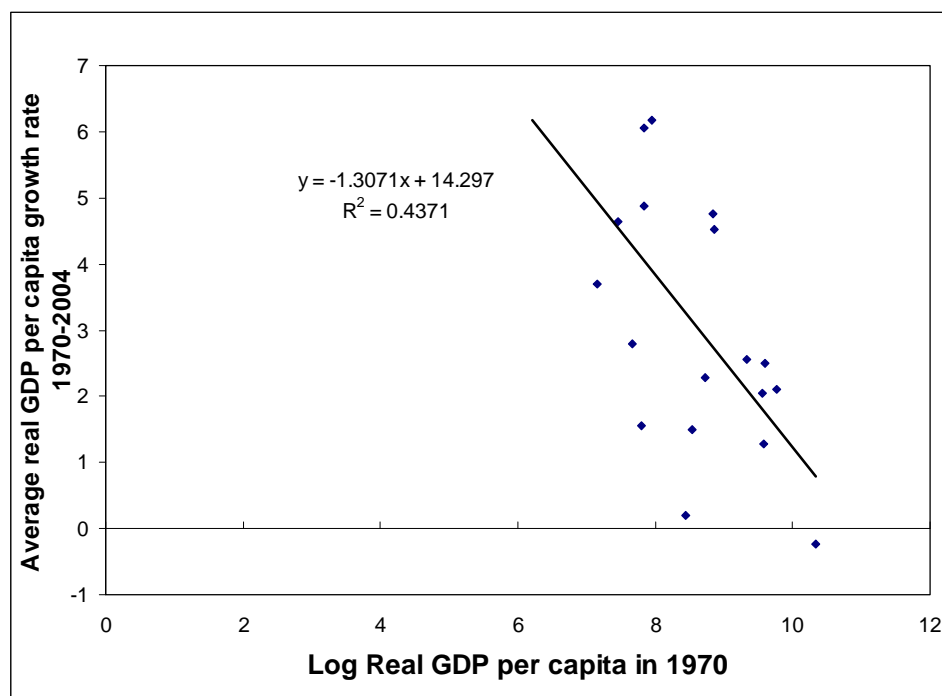
Neoclassical economic growth theory suggests that economies that start with lower initial levels of income (and lower levels of aggregate capital stock per person) should grow more rapidly over time than other economies, and should eventually ‘catch up’ with their counterparts. This ‘absolute convergence’ hypothesis is a prediction of the simple Solow-Swan growth model, and more elaborate versions of the neoclassical growth model.

Barro (2007) shows that for economies that are similar in terms of key macroeconomic parameters (such savings rates and population growth rates), absolute convergence tends to hold. For example, absolute convergence has been observed in the OECD economic grouping of economies.

Since savings rates and population growth rates vary considerably across APEC economies, we should not expect to observe much absolute convergence in the data. Nevertheless, the data indicate that there is some support for the absolute convergence hypothesis within the APEC grouping (Figure 8). On average, APEC economies that had relatively low levels of per capita GDP in 1970 have tended to experience relatively high growth rates since then. To the extent that this empirical pattern continues, we should expect poorer APEC economies’ per capita income levels to continue to catch up to levels in richer economies.

Given this convergence hypothesis continues to hold, we can expect food demand in developing APEC economies to continue to grow and diversify relatively rapidly. While this would generally mean food will become more affordable, we can also expect food prices to be placed under upward pressure. This may in turn disadvantage lower income segments of an economy’s population.

**Figure 8 Absolute Convergence among APEC economies, 1970-2004**



**Data source:** Heston et al (2006), own calculations

Household size and the influence of cultural and social norms on family size can also influence (and are influenced by) aggregate consumption preferences and food demand patterns. Deaton

and Paxson (1998) found that across both rich and poor economies, per capita food consumption tends to decline with average family size even after controlling for other variables, with larger declines observed in poorer economies. They suggest several explanations, including:

- economies of scale in food consumption and expenditure (for example, bulk buying);
- economies of scale in food preparation; and
- economies of scale in food waste management.

The sectoral allocation of factors of production and natural resources, as well as urbanisation and barriers to factor movements can also influence food prices and overall economic wellbeing. These influences have both supply-side and demand-side dimensions. Increasing urbanisation means that food processing, transportation and storage – each of which introduces new economic costs and technological challenges – becomes relatively more important in the food supply chain. Barriers to factor movements – in particular, the movement of labour and capital into and out of the agricultural sector – can also have significant implications for economic welfare. For example, Prescott and Hayashi (2009) find that barriers to rural-urban migration account for much of the economic stagnation experienced by Japan during the pre-war period.

On the supply side there are several macroeconomic factors that influence aggregate food prices. In the absence of technological progress and productivity growth, fixed supplies of land and other natural resources can place limits on an economy's long run per capita growth rate and reduce the capacity to increase food supplies in the longer term.

Technological progress in food production depends on many factors, including research and development and innovation, but also on an economy's ability and willingness to imitate and adapt discoveries from other economies to local industries and economic conditions. The rate of this technological diffusion depends on education levels, the extent to which economies trade with wealthier economies, and whether an economy has a well functioning political and legal system (Coe and Helpman, 1995). This highlights the importance of allowing market based incentives to drive food research and development as well as adoption. This will help ensure that technological innovation eases those constraints that are the greatest impediments to increased food production.

Such constraints can be mitigated – and indeed reversed – by ongoing productivity growth, technological progress and innovation. In the context of food prices, a useful way of classifying technological progress is the extent to which it is biased towards conserving natural resources and land (Nordhaus et al. 1992). In the presence of resource-saving and land-saving technological progress, the amount of these inputs which are required per unit of labour and capita to produce food declines over time, and the price of these resources relative to the prices of labour and capital would also tend to decline. Even if there are fixed factors and diminishing returns to labour and capital, ongoing technological progress can overwhelm the factors that would otherwise drag per capita growth down. The effect of this kind of technological progress on relative food prices would depend on the relative importance of these fixed factors in the production of final food outputs. In other words, if food production is highly intensive in land and energy, technological progress that is biased towards reducing this intensity per unit of

other inputs will dampen the price of food relative to other goods and services. A detailed discussion regarding the economics of productivity growth is contained in Appendix 0.

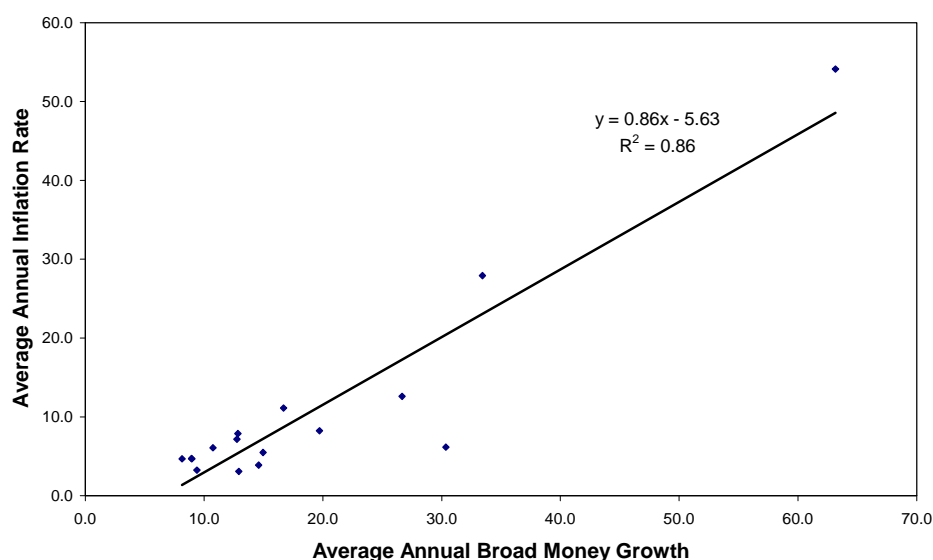
High rates of population growth can increase the supply of aggregate labour that is available as an input into food production. But due to diminishing marginal productivity of labour, population growth can restrict per capita economic growth, food output and per capita living standards. However, historically, productivity growth in food production has been biased toward labour savings. Further higher incomes also tend to reduce fertility rates and so income growth can act as a self-correcting break on population growth.

## **ii. Monetary factors**

In economies in which the standard basket of consumer goods is heavily weighted by food prices, average growth rates of absolute food prices over the long term may also be influenced by monetary factors. In other words, in some economies high absolute food prices may not solely be a symptom of real demand and supply side factors that only influence the price of food relative to other goods. Instead, high absolute food prices may be a symptom of increases in the general level of prices throughout the economy, with food prices being affected more heavily in certain economies because of the large weight of food in the standard consumer baskets of goods.

Several empirical studies have examined the influence of monetary factors on general price inflation. For example, McCandless and Weber (1995) use a sample of 110 economies for the period 1960 to 1990 to estimate the long run relationship between various measures of the money supply and consumer price inflation. Their results show that over this long time horizon there is a high (almost one-for-one) correlation between the rate of growth of standard measures of the money supply (for example, M1) and the growth rate of the general price level. A number of studies have examined the links between monetary factors and agricultural prices. For example, Barnett et al (1983) examine the large increases in US domestic agricultural prices in the 1970s and find that measures of the US money supply affected food component of the CPI after a lag of around three quarters of a year.

Data in APEC economies confirms these earlier results. Figure 9 plots average annual growth rates of money and inflation for the period 1970-2008 in selected APEC economies, using data from the International Monetary Fund. The results show that over the long run, a one percentage point increase in the growth rate of broad money is associated with a 0.86 percentage point increase in consumer price inflation over the same timeframe.

**Figure 9 Average annual money growth and inflation in selected APEC economies, 1970-2008**

**Data source:** International Monetary Fund, International Financial Statistics

## G. KEY MESSAGES

The key messages that emerge from this analysis of the conceptual issues are as follows.

- Over the long run, overall macroeconomic performance and economy-wide policies can be an important determinant of the microeconomic performance of food markets and of absolute levels of food prices and changes in absolute prices across the economy.
- Vertical integration and coordination can play an important part in reducing costs along the food supply chain. Vertical integration can reduce cost wedges, aid in the efficient allocation of risk and improve the responsiveness of supply to shocks, thereby improving the overall resilience of food markets to changing economic conditions over the short and long run. Overall, economic theory suggests that the instances in which vertical integration and coordination can reduce economic welfare are limited. Nevertheless, in such cases the potential gains from vertical integration on the cost side should be carefully balanced against the possible risks of higher consumer prices. In rapidly evolving markets, intermediaries can be an important source of innovation, providing services that meet the new demands of consumers, retailers and food processors.
- The value of the final good to consumers depends on the quality of storage provided by each firm along the supply chain, but it depends on the minimum amount of care taken by all producers, not the sum of care taken. If one firm fails to take adequate precaution, then all firms (as well as consumers) may bear the cost. The amount of care taken by one firm is not a substitute for care taken by others. In this case it is the care taken by the ‘weakest-link’ firm that is crucial and which determines the quality of the final good.
- Food safety and quality are important determinants of consumer welfare, but improvements in food safety and quality lead to higher production costs and therefore higher consumer prices. Government policies need to be mindful of this trade-off and focus carefully on identifying market failures and addressing those failures with policies that meet cost-benefit tests.

- Food markets are an important source of income in many APEC economies. Higher prices reduce consumer welfare for net food buyers, but can also increase producer incomes. This means that it is important to focus on net food consumption rather than absolute food consumption when assessing the economic effects of price changes. It is important to bear this in mind, especially in economies where a substantial share of the population depends on incomes from agriculture.
- In economies in which the standard basket of consumer goods is dominated or heavily weighted by food prices, average growth rates of absolute food prices over the long term may also be influenced by monetary factors. In other words, in some economies high absolute food prices may not solely be a symptom of real demand and supply side factors that only influence the price of food relative to other goods. Instead, high absolute food prices may be a symptom of increases in the general level of prices throughout the economy, with food prices being affected more heavily in certain economies because of the large weight of food in the standard consumer baskets of goods.



## **PART 2: THE AGRIFOOD SYSTEM**

### **4. PRIMARY PRODUCTION**

The characteristics of primary food production systems (agriculture, aquaculture and wild caught fisheries), vary greatly across the APEC region. This variation reflects differences in physical geography, climate, level of economic development, demography and culture.

The differences between primary food production systems in developing and developed economies are largely a function of two related factors. The first is the relative contribution of labour versus purchased farm inputs and capital. A second, and related factor, is the number of food producing enterprises relative to the overall level of food production.

International trade creates strong links between the food prices faced by consumers throughout the APEC region. Openness to trade limits the extent to which consumers are exposed to high local costs of production, as well to the effects of shocks to domestic production caused by pests, diseases, and climate. Domestic producers that are able to compete on export markets also supply domestic markets at prices determined on world markets.

In terms of average food prices – the prices that consumers face on a day to day basis – there is often a gap between the price for produce that is locally sourced and the price for produce that can be sourced through both international and regional trade (see Box 3). This price gap is largely the result of transport costs, including losses referred to as shrinkage or wastage, as well as the costs of meeting either export or import standards. Efficient domestic production will help see that prices continue to fall from import parity price (or above) toward export parity price.

The capacity of domestic food producers to keep pace with increased demand from increasing populations and income will contribute to the overall security of world food supplies, especially in highly populated economies. The robustness and resilience of food production systems to climatic variability, pests and diseases will help to limit the likelihood of domestic food shortages.

There are two main areas of focus with respect to improving food security and primary production. The first area of focus is on increasing the productivity of agricultural, aquaculture and fishing enterprises. It is also important to recognise that increased productivity growth, particularly in agriculture, can also enhance the productivity of downstream agents participating in the agrifood system. Increased farm sizes and more efficient marketing at, or just after, the farm gate can reduce the number and cost of transactions – with implications for both prices and quality for consumers.

The second area of focus is on increasing the reliability of supply in both the immediate and longer term. Sustainability and resilience are important for long term reliability. Issues of sustainability and resilience include the diversion of land and water resources to industrial and urban uses, and maintaining genetic diversity to limit susceptibility to plant and animal diseases.

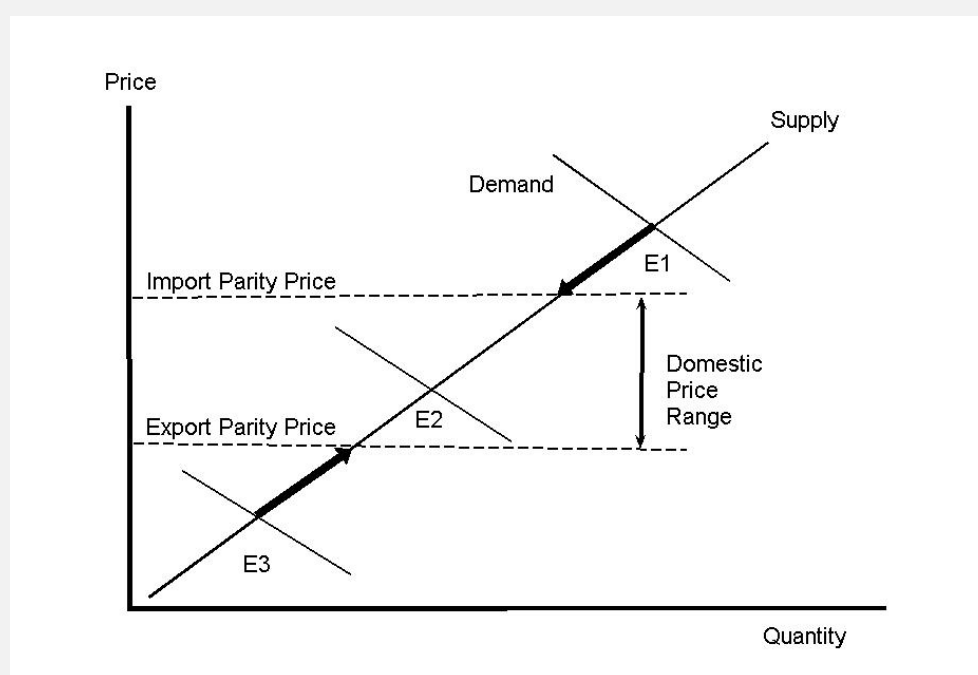
### Box 3 Import and export parity prices and domestic price

Import and export parity prices are based on the value of imports and exports at a particular geographic location. That is, inclusive of transport and other costs incurred prior to landing the product. Export parity price is the value of a product in the exporting economy. That is, the price excluding costs of reaching a particular export destination.

Given a market that is trade exposed but does not influence world price, import and export parity prices bind domestic prices. This gives rise to three possible price scenarios (see Figure 10).

1. If the equilibrium of domestic supply and demand were to occur at a price greater than the import parity price, E1, then domestic supply would fall to the import parity price as it would be cheaper to import than it would be to pay the domestic price. The import parity price effectively creates a ceiling on the price that domestic producers will receive and domestic consumers pay so long as the product is traded. Prices for non traded goods can be above import parity price.
2. If the equilibrium of domestic supply and demand were to occur at a price less than the export parity price, E3, then domestic supply would increase to the export parity price as it would be more profitable to export than it would be to receive the domestic price. The export parity price effectively creates a floor on the price that domestic producers will receive and domestic consumers pay.
3. If the equilibrium of domestic supply and demand occurs between the import and export parity prices, E2, the price will be determined by the equilibrium of domestic supply and demand, and will be in the range marked “domestic price range”. Within this range prices are sensitive to changes in both domestic demand and supply.

**Figure 10 Import and export parity prices**



Productivity growth means more products can be produced with fewer or less costly inputs. Productivity growth is essential to longer term food security as production can be increased to meet the demands of growing populations, despite the transfer of fixed supplies of land, labour and other scarce resources to other sectors of the economy. Productivity growth is also important for maintaining and increasing the incomes of primary producers, which in turn allows these producers to access the physical and information resources needed to expand production and further increase productivity.

The reliability of food supplies is related to productivity but the link is complex. Increased productivity can enhance, or come at the expense of, reliability. For example, it is widely accepted that better fisheries management can increase productivity and reliability of supply. However, the widespread adoption of higher yielding plant varieties with a common genetic makeup can result in large scale crop losses due to plant pest or disease outbreaks that affect the majority of production.

The objective of this chapter is to identify the key drivers of productivity growth in primary production in APEC economies and to identify the impediments to greater productivity growth and the need to consider issues of reliability. Regulatory and institutional arrangements, public investment, as well as macroeconomic and other economic policies can have significant effects on productivity growth in primary production and on the reliability of food supplies. The removal of impediments can improve market price signals, lowering costs and increasing the responsiveness of supply to changing demand conditions. In some cases policies may be in place to address welfare concerns (such as rural poverty) or market failures (such as resource degradation). Some of these policies may enhance food security and some may impede it. In the latter case the issue is whether the objectives of these policies can be met with less impact on the productivity and reliability of food production. Some policies may also involve tradeoffs, for example, between food security and food prices.

While many policies have an affect on food security, improving food security may not be the primary goal of some policies and may be a secondary goal or by-product of the policy. For example, input subsidy programmes that primarily address rural poverty can result in increased primary production. Although these policies may initially appear to support food security these policies may create distortions in the broader economy that ultimately undermine the goals of food security. For this reason, in identifying policy options to increase food security, primary consideration is given to policies that will improve the security of food production and that can serve to increase overall economic welfare – or at least not create distortions and decrease economic welfare. Additionally, attempting to draw a clear line between domestic policies that serve as forms of trade protection, as opposed to policies for increasing food security or raising rural incomes to promote sustainable farm production, is not possible and has not been attempted.

The chapter is organised as follows:

- The characteristics of primary production in APEC economies;
- Improving the productivity and resilience of firms engaged in primary food production individually and in some cases collectively;
- The markets for inputs; and

- The markets for outputs.

## **A. PRIMARY PRODUCTION IN APEC ECONOMIES**

Primary production is the production of food products that can be sold principally as fresh or live product to consumers or food processors, with minimal transformation by industrial processes. Beyond producing these products, a primary producer may also provide services, such as on-farm storage of grains and transport of produce from farms to wholesale and retail markets.

Primary production across the APEC region is diverse. For the purposes of analysing the various types, primary production across the APEC region is categorised in four groups:

- Developing economies production with a large number of small farms, low levels of capital investment but generally high levels of fertiliser and agrichemical use, and a large percentage of the total labour force engaged in primary production;
- Developed economies production with large scale, capital intensive farms and fisheries, with a small proportion of the labour force engaged in primary production.
- Developed economies production with small scale farms that are reasonably labour intensive. This group includes Japan and Korea. Agricultural industries in these economies are protected to maintain amenity and cultural values. These economies are discussed only briefly in this chapter.
- Production of economies with large populations relative to their primary production base that depend to a large extent on food imports, such as Hong Kong, China and Singapore. These economies are not discussed at any length in this chapter.

Within these groupings there is still considerable diversity. Around 85 per cent of the population of Papua New Guinea depends on subsistence agriculture while agriculture in Thailand is highly export-oriented. Agricultural production in Chile is more closely aligned to systems in New Zealand and Australia than systems found in most of Southeast Asia. Brunei Darussalam is somewhat unique among Southeast Asian economies because its high average income confers food security. The average farm in Japan is less than two hectares in size, but Japan has the second largest fish catch in the world and the world's most advanced aquaculture systems. Agriculture in the Russian Federation is a mix of large scale, formerly collective farms, and a growing number of smallholder farms. There are, however, common attributes with respect to primary production in most APEC economies.

In developing economies the movement of labour from the agricultural sector to other sectors of the economy creates adjustment costs that may need to be balanced against the wider and ultimately much larger gains from economic growth and development. The transition path will constrain the extent to which, and rate at which, primary food producers can adopt more capital intensive systems in these economies. However, as the transition of labour between agriculture and other sectors of the economy promotes economic development this will limit the net costs of adjustment in primary production systems.

In developed economies there is still pressure for structural adjustment in agriculture. Average farm sizes in Australia, Canada, New Zealand and the US are becoming larger and less labour intensive. The structure of agriculture is similar to other industries, in that 20 to 30 per cent of the farms account for 70 to 80 per cent of agricultural production. Much of the adjustment pressure is on relatively small farms located near more urbanised areas. The broader economic implications of the movement of land and labour out of agriculture are much less significant in developed economies than for developing economies.

Despite these differences, increasing the incomes of primary food producers is a central policy objective in nearly all APEC economies. There are two basic differences in most developing and developed APEC economies. The first is that increasing production is seen as an equal if not more important policy goal than increasing farm incomes. The second is that the design and effectiveness of policies will depend more critically on adjustment costs. The transition to larger scale farming will potentially create large numbers of both winners and losers and in economies with a large number of small farms, the number of potential losers is large.

Brief profiles of primary production and a discussion are presented below. The emphasis is on agriculture. These profiles draw on statistics that were compiled in a database for this project. The full data and sources are available from the APEC Policy Support Unit. Table 3 contains data for all APEC economies, broken into the groups described above.

Of the developing APEC economy group a striking feature is the sheer number of farms. This is particularly true in China and Southeast Asia. However, even in Mexico and Peru, where farm sizes are substantially larger than in Asia, farm numbers are still counted in the millions. This points to the importance of the logistics needed to source inputs, market products, provide information and manage pests and diseases.

With the exception of Chile, the value of output per farm is low, particularly in China, Indonesia and Viet Nam. Low income levels make it difficult for farms to finance the purchase of farm inputs such as fertiliser and other agricultural inputs, as well as for accessing longer term loans to purchase capital equipment. While lower food prices for consumers may be the goal of improved food security, maintaining farm incomes and increasing the efficiency of food production is a critical policy objective in most developing APEC economies. A goal that is well aligned with longer term food security objectives.

In the developed APEC economies with large scale agriculture the farm size is many magnitudes of order larger than in the developing economies with farm numbers counted in the thousands. The average value of farm output is large which is expected for large scale farming. The high average value of output per employee points to high labour productivity.

In those developed APEC economies with small scale farming, the value of output per employee is relatively high. This is probably related in some degree to government support for traditional agriculture.

**Table 3** Summary statistics of agricultural production in APEC economies

	Population	Percentage of workforce employed	Contribution to GDP	Average farm size (hectares)	Approximate no of farms	Value of output	Value of output per farm	Value of output per employee
	(millions, 2008)	(per cent, 2005)	(per cent)	(hectares, 1990-1997)	(1990-1997)	(billion US\$ 2007)	(US\$ 2007)	(US\$ 2007)
Developing economies with extensive agriculture								
Chile	16.6	13.2	4.8	83.7	182,052	7.9	43,218	8,143
China	1321.1	43	10.6	0.7	830,340,299	347.7	419	1,001
Indonesia	224.9	42.1	13.5	0.9	54,942,529	58.4	1,064	1,240
Malaysia	26.8	13	9.7	-	-	18.1	-	12,439
Mexico	105.3	15.1	3.7	24.6	4,373,474	37.8	8,653	5,508
Papua New Guinea	6.1	75	32.8	-	-	2.0	-	721
Peru	28.1	30	8.5	20.2	1,057,568	9.1	8,632	2,983
Philippines	88.6	35	14.7	2.2	5,648,148	21.2	3,749	1,644
Russian Federation	142.1	10.2	4.1	-	-	52.9	-	6,847
Thailand	65.7	42.6	11.4	3.4	5,535,714	28.0	5,053	1,738
Viet Nam	85.6	55.6	19.0	0.5	18,446,154	13.5	731	511
Developed economies with large scale farming								
Australia	21.1	3.6	2.5	3,601.7	123,594	22.7	183,866	56,311
Canada	32.9	2	2.0	349.1	193,354	28.7	148,545	78,993
New Zealand	4.2	7	4.4	-	-	5.7	-	35,798
United States	302.0	0.6	1.2	197.2	2,102,910	165.7	78,791	177,932
Developed economies with small scale farming								
Japan	127.8	4.4	1.4	1.2	3,910,000	61.3	15,689	21,075
Korea	48.5	7.2	3.0	1.1	1,791,429	29.1	16,242	16,596
Economies with limited primary production								
Brunei Darussalam	0.4	4.5	0.7	-	-	0.1	-	10,050
Hong Kong, China	7.0	na	na	na	na	na	na	na
Singapore	4.6	na	na	na	na	na	na	na
Chinese Taipei	23.0	5.1	1.5	-	-	5.8	-	10,392

**Note:** na is not applicable, a dash (-) means that data was unavailable

**Source:** FAOStat, World Bank database, CIA Factbook.

## B. PRODUCTIVITY

Put simply, productivity is about producing more with less. In part, productivity increases are the result of innovation. However, just as food production systems in APEC economies are diverse, production system within economies are also diverse. Some are close to best practice and others may be able to increase productivity by moving toward best practice. In summary, there are three principal ways to increase the productivity of primary food production.

- Increase technical efficiency – that is, for a given technology, make the most physically effective use of inputs such as land, seed and other inputs. A common reason why food production systems are not technically efficient is a lack of information or training.
- Increase allocative efficiency – that is, take into account the costs of both inputs and outputs to obtain the greatest value of food that is produced. This is where not only the direct costs of inputs and outputs are considered but the indirect costs of adjustment or environmental degradation also need to be addressed.
- Augment production technologies – that is, increase the frontier of technical efficiency through innovation.

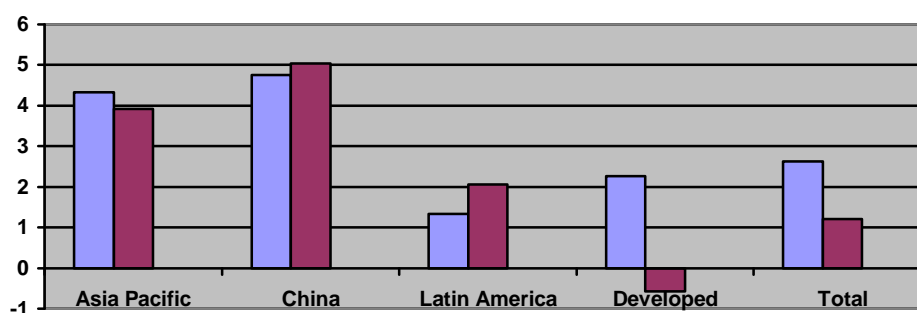
#### i. Innovation, sustainability and resilience

The transformation of agriculture in the 20<sup>th</sup> century was largely driven by agricultural research and development in just a small number of developed economies, notably the US, Germany, France and Japan (Pardey et al. 2006). At the centre of this transformation were innovations in plant breeding, agricultural chemicals and pharmaceuticals and the development of mechanised agriculture. With the rapid growth in food production, a number of environmental and other concerns have emerged with regard to the sustained use of these practices. However, the task of increasing food supplies to meet growing populations and incomes has not diminished. Increased productivity through innovation will need to play a major role in ensuring the security of world food supplies.

Against this need is, what some observers regard as alarming, changes to agricultural research and deployment at a global scale. Private research, which is conducted primarily in developed economies, has become increasingly focused on developed economy issues. The incentives for private companies to develop technologies for less developed economies is limited (Bradford et al 2004). While public research in developed economies, such as Australia, has shifted from an agricultural science focus to an environmental science focus.

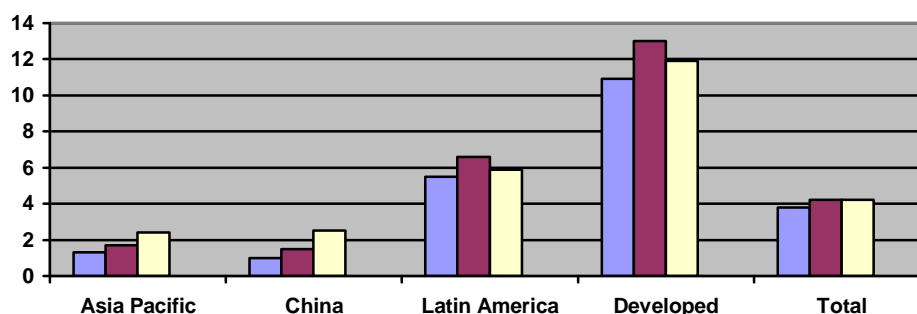
Overall trends indicate that outside of Latin America and China, the rate of increase in real spending on public agricultural research and development has fallen, as can be seen in Figure 11. It can be seen in Figure 12 that between 1991 and 2000, real expenditure on agricultural research and development has increased in the Asia Pacific and China but fallen elsewhere.

**Figure 11 Regional and world growth in public agricultural research and development expenditure: 1981-2000.**



Data source: Pardey et al 2006

**Figure 12 Regional and world expenditure per person agricultural research and development expenditure: 1981-2000.**

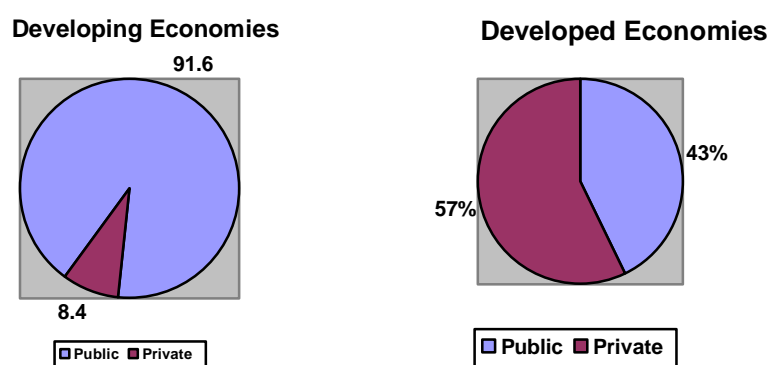


**Note:** Figures are in 2000 dollars

**Data source:** Pardey et al. 2006

The share of public and private agricultural research and development expenditure in both developing and developed economies is shown in Figure 13. The relative importance of public research in developing economies stands out clearly against the much more balanced expenditure in developed economies.

**Figure 13 Shares of public and private agricultural research expenditure in developing and developed economies: circa 2000.**



**Data source:** Pardey et al. 2006

Pardey et al. (2006) concluded their investigation of global agricultural research and development:

‘Developed countries will no longer provide the same levels of productivity-enhancing technologies, suitable for adaptation and adoption in food-deficit countries, as they did in the past. ... These changes mean that developing countries will have to become more self-reliant in the development of applicable agricultural technologies. To achieve complete self-reliance will be beyond the ability of many countries, especially given recent and ongoing structural changes in science and scientific institutions—in particular the rise of modern biotechnologies and other high-tech agriculture, ... The issues are large-scale and long-term, and they demand serious attention ... The benefits from effective policy research will come not only



from increasing the agricultural R&D effort and making it more economically efficient.’

The global food crisis may have initiated a move toward increased public and private expenditure on agricultural research. However, in the public sector there will be other demands for public funds. On the surface it would seem that there may be considerable gains from coordinating, or at least facilitating coordination, public research across APEC economies.

Innovation through research and development, sustainable production systems and the resilience of production systems to changes in climate and outbreaks of pests and diseases are linked. In some instances the links are complementary. Research that promotes sustainability will increase food security as it is almost axiomatic that unsustainable production practices will eventually lead to reduced productivity. However, in some instances resilience may come at a cost in terms of productive capacity. That is, a more resilient system, one for example that is less likely to suffer a major disruption, will often have lower levels of expected output (Ben Heim, 2008).

### **1. Innovation: Research and development**

Given agricultural and food research and development is concentrated in a few economies with relatively large domestic food production sectors, many APEC economies rely on spillover benefits of public research or commercial access to proprietary inputs such as hybrid seeds.

Large developing economies and developed economies do have an advantage in establishing critical mass in terms of public research funding. Developed economies tend to have stronger systems for protecting intellectual property rights, which creates the incentives for more effective and productive private research.

One of the key challenges for smaller developing and even developed economies like Australia and New Zealand is to be able to access the results obtained by the broader international research community and to adapt those findings, where appropriate, to local conditions. This may take the form of adapting the way in which inputs are applied to manage local soil conditions or pests and diseases. It may involve the adoption of breeding techniques to crops that are significant locally but not internationally, at least in terms of the returns to research and development.

The research and development areas that have and are likely to continue to have the greatest potential to increase productivity are highlighted here:

- Plant breeding;
- Biotechnology;
- Agrichemical and pharmaceuticals; and
- Precision farming systems.

### **2. Plant breeding**

Improved plant varieties have been responsible for major increases in crop yields on a global scale. In the US over the last 60 years corn yield has increased nearly sevenfold, cotton yield

fourfold, soybean yields threefold and wheat by 250 per cent (US Department of Agriculture, 2004). The productivity gains associated with livestock breeding are more difficult to estimate than the productivity gains from improved production practices and pharmaceuticals. However, slower rates of productivity growth have been observed for livestock as opposed to cropping. Given we can expect roughly equal rates of return across cropping and livestock industries the cost of achieving increased livestock productivity are higher.

Access to new plant varieties may be limited for a number of reasons, the first of which may be cost, which is the focus of this section. The other limiting factor may be that the benefit of the adoption of new varieties may be low when new varieties are not well adapted to either local environmental conditions or markets.

The genetic information in a new plant breed is a form of intellectual capital. This intellectual capital may be embodied in the variety itself or serve as the basis for ongoing development of new varieties. As the cost of this intellectual capital is largely sunk, transferring the intellectual capital through, for example, the propagation of seed through cultivation, involves little or no direct costs. This has two implications. The first is that private firms have little incentive to develop new varieties as they may not recover their investment in intellectual capital and the second is that there would be little reason to restrict access if new varieties were developed from public supported research.

The development and use of hybrid varieties in the 1930s has provided plant breeders with a way to protect their capital investment, as hybrid varieties either cannot be propagated through saved seed or can be done so only with substantially reduced yields. This, coupled with a strengthening of firm intellectual property rights (referred to as plant breeders rights) that cover plant breeding and genetics, has led to a major shift in public versus private research in seed development in APEC economies.

There is a relatively clear division between the varieties of plants where genetic research is conducted by the public and private sectors, with this division becoming more pronounced over time. Private sector research is focused on the major field crops, excluding rice and wheat, as well as on high valued fruit and vegetable crops. Market concentration in private sector development is evident and increasing in the US, especially with respect to corn and cotton varieties, and to a lesser degree sorghum varieties. Public sector research is focused on rice, wheat, and field crops with lower total values of production.

While the development of hybrid varieties creates a mechanism to protect plant breeders rights, hybrid varieties themselves must be produced and distributed efficiently to increase primary production (as farmers need to purchase seed input for each crop). Given the involvement of governments in seed research, commercialisation can face a range of impediments that need to be identified and addressed. An example drawn from rice production in Viet Nam is a case in point (see Box 4).

**Box 4 Hybrid rice in Viet Nam**

Tran and Nguyen (2008) reported that the use of hybrid rice varieties is relatively low, with fewer than 8 per cent of all farms using hybrids in 2006. The use of hybrids is concentrated in the north where the majority of farm households plant both hybrid rice and rice produced from the retention of seed. Over 80 per cent of hybrid seed was imported from China. The Cultivation Department of the Ministry of Agriculture and Rural Development (MARD) says that support for each hectare of hybrid rice stands at VND 4 million (US\$250) in the southern delta region and VND 6 million (US\$375) in the north. Locally produced hybrid varieties are less susceptible to disease during the summer season and uptake of locally produced varieties has been increasing at a substantial rate since they were first introduced.

The south has a more market driven and export-oriented rice industry. However, until recently the uptake of hybrid rice varieties has been low and the share of domestically produced hybrid seeds was very low. The hybrid seeds developed by government sponsored research in southern Viet Nam were developed to match local conditions. Tran and Nguyen state that one reason was that the production of hybrid seed was small and fragmented and unable to meet demand. In addition, a large percentage of hybrid rice seed samples did not meet quality standards.

The Viet Nam Government recognised that the problem may have been due to the lack of incentives to produce hybrid seed. It recently set up commercial arrangements which allow the Institute of Policy and Strategy for Agricultural and Rural Development to sell seed. Within three years, adoption rates increased from around 10 per cent to about 30 per cent (IPSARD 2009).

The importance of private and public research in a developing economy context is highlighted in a case study on rice research in Thailand in the following section.

### **3. Case study: Returns to research and development in Thailand**

In Thailand, agriculture plays a crucial role in contributing to overall economic growth using fewer resources. Thailand's agriculture is a major producer of agricultural exports, thereby being an important contributor to rural incomes and world food supplies. Sustaining agricultural growth is important for maintaining export competitiveness and improving the living standards of the majority of people residing in rural areas and directly involved in agricultural production (Warr, 2004).

Agriculture in Thailand is facing a number of challenges including declining areas of arable land, pressures on water supplies and natural resources, concerns over climate change and environmental degradation and high fuel and fertiliser prices. Research-induced productivity growth offers a promising solution to the challenge of maintaining a continuous increase in agricultural output in while reducing input use and protecting the natural resource base (CGIAR, 2009).

This case study draws on an empirical study by Suphannachart (2009) on the linkage between agricultural research and productivity as well as measuring the social rate of return on public

research investment in Thailand's agriculture. The study has broader implications for agricultural R&D policy in developing APEC economies.

The focus in the study was total factor productivity (TFP) growth in the crop and livestock sectors over the period 1970-2006. TFP is essentially a measure of the level of output that that can be achieved by the technically efficient use of inputs, where all inputs are considered.

TFP growth has been shown to contribute significantly to output growth in Thailand's agricultural sector and its contribution was substantially greater than in the non-agricultural sectors (Chandrachai et al., 2004, Tinakorn and Sussangkarn, 1996, Warr, 2006, Poapongsakorn, 2006). If agricultural research is essential to raising productivity growth in Thailand, the recent decline in public investment in agricultural research represents a threat to long-term growth.<sup>12</sup> It is also of public interest to determine the payoffs to society from past investment on public agricultural research and whether or not making additional investment is worthwhile.

Moreover, there has been a declining trend of productivity-enhancing agricultural R&D in developed economies, which has in the past been the main source of worldwide agricultural technology advances (Pardey et al., 2006a). Developing economies, including Thailand, that have relied on R&D spillovers from developed economies may therefore have to become more self-reliant (Pardey et al., 2006b). Falling agricultural R&D investment, from both domestic and foreign sources, poses a concern for long term growth and food security.

Suphannachart (2009) looks at the role of public, private and international research in achieving the relatively high growth rate of TFP that has been observed in Thailand's agricultural sector. The key findings and their implications are highlighted below. This is followed by a brief discussion of the data and methodology.

### **Key Findings**

The results of this study indicate that public, private and foreign research have been major driving forces behind productivity growth. The general findings conform to the evidence from other case studies that agricultural research is a prime source of technical change that improves productivity (Griliches, 1998, Ruttan, 2002, Thirtle et al., 2003, Fuglie and Heisey, 2007).

Public agricultural research affects both crops and livestock productivity. International research spillovers also contribute to productivity gains, notably in the crops sector. This finding conforms to a priori expectations that modern rice or other crops varieties developed by CGIAR-supporting centres (IRRI, CYMMYT and CIAT) positively influence crop productivity in Thailand. For the livestock sector, foreign research also contributes to TFP growth but local private research plays a more important role, which is consistent with the general belief that large private companies, notably the CP Group, have played an important role in developing agricultural technology in livestock production. The interaction terms between domestic and international research variables do not appear to be statistically significant in any cases.

Apart from agricultural research, there are other economic and non-economic factors that also contribute to TFP growth. Infrastructure, as represented in the study by rural roads, appears to

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<sup>12</sup> The declining trends in public crops and livestock research expenditure, measured in real terms and as shares in agricultural GDP, have been observed from the mid-1990s.

have a positive and significant impact on agricultural productivity. Agricultural extension services are also important in disseminating research results to farmers for adoption.

The estimated social rates of return on crop and livestock R&D were also high, as has normally been found in case studies in other economies. The marginal internal rate of return for research in Thailand's agriculture (combining crops and livestock together) is estimated at 35.2 per cent, which is well above the opportunity cost of public funds. The rate of return is high enough to justify continued public investment in agricultural research in Thailand.

Rainfall is, of course, a significant influence on measured TFP growth. In addition, the 1972-74 world commodity boom increased productivity of crop production by encouraging farmers to grow more crops and to use existing inputs more intensively to make the most of a surge in agricultural prices, which in turn increased output and hence productivity. The avian influenza outbreak negatively affected livestock TFP. There was no evidence that other potential factors like resource reallocation or trade openness were significant. Degradation of environmental and natural resources associated with agricultural production can be an unmeasured input that has been ignored in this study that might be important and is an area for further investigation.

### **Implications for agricultural R&D in Thailand and other developing APEC economies**

The empirical evidence shows the longstanding public investment in agricultural R&D has contributed significantly to the growth of TFP in Thailand's agricultural sector. Since the majority of agricultural research is conducted by the public sector, tracking the government budget allocated to agricultural research is a good indicator of the likely future trends in TFP growth.

The high measured rate of return implies underinvestment in agricultural research. The probable cause is related to the public good issue, market failure and government failure. The public good characteristics, together with time consuming research with no certainty of successful results that requires large funding reduces the incentive for the private sector to increase participation or the government to conduct the productive research themselves.

Given the limited government budget and scarce public resources, the amount of government spending on public R&D does not necessarily need to be raised but the government can change the incentives for others to increase investment in agricultural research. There are a variety of policy tools to induce more investment. These include greater protection of intellectual property and the provision of subsidies. If the significance of agricultural research is well recognized and is used as a policy tool to maintain agricultural output using fewer resources then a serious and consistent policy commitment is necessary.

The findings also have implications for research collaboration and local research capacity. The positive and significant impact of major types of research spending – public, private and foreign research – suggest that additional investment and increased research collaboration should produce agricultural productivity growth.

The significant role of foreign research spillovers on productivity suggests public resources could be saved if Thailand is able to choose what will be most useful to borrow from the international research system. Public or other types of local research could be strengthened in a way that makes it capable of adapting and able to make efficient use of foreign technology. The insignificance of the interaction term in the estimated model between domestic and foreign

research seems to signal weak collaboration. The government could play a more active role in encouraging increased collaboration among major research performers.

Given the slowdown in productivity enhancing research investment in developed economies, the results of this study suggest that Thailand should continue to develop its own agricultural science capacity and demand for more effective research planning and management.

Similar implications can be applied to agricultural R&D in other developing APEC economies, especially in the Southeast Asian region, where the majority of agricultural R&D activities have been conducted by the public sector and underinvestment in agricultural R&D has been observed (Evenson and Pray, 1991). The research system in many developing APEC economies has relied on imported technology and the spillovers of research results from other economies (Pardey et al., 2006a). Continued public support on agricultural research is necessary, especially in providing basic research activities that complement private research conducted by both domestic and foreign companies. Strengthening the research system and research collaboration is strongly encouraged.

## **Data and Methods**

Economy-level time series data for the period 1970-2006 were used for this study. Agricultural output and input data are mainly obtained from the National Economic and Social Development Board (NESDB) and the Office of Agricultural Economics (OAE). The data for explanatory variables in the TFP determinants models are obtained from various official sources.

Public agricultural R&D is measured as real government budget expenditure on R&D activities conducted by the Ministry of Agriculture and Cooperatives (MOAC). Under the MOAC, the Department of Agriculture (DOA) is responsible for crop research and the Department of Livestock Development (DLD) is responsible for livestock research. The budget data are from the Bureau of the Budget under the office of the Prime Minister. The local private R&D is measured as real expenditure by major subsidiaries under the Charoen Pokphand (CP) Group, the leading agribusiness company in Thailand. The budget/expenditure data are deflated by the implicit GDP deflators.

International research spillovers in the crops sector are measured as total research expenditure by three major centres under the CGIAR (IRRI, CIMMYT and CIAT). As the spillovers of research results from international research centres are not relevant in the case of livestock the import value of livestock breeds, expressed as a share in livestock value added, are used as a proxy for foreign research. The import data are from the OAE and the livestock value added data are from the NESDB.

TFP decomposition is used to investigate the effect on productivity of agricultural research. First, TFP is measured using the conventional growth accounting method, and is adjusted for input quality changes. Then the measured TFP is regressed on several explanatory variables including agricultural R&D. The TFP measurement and the estimation of TFP determinants functions have been conducted for crops and livestock separately as well as the two sectors combined. The elasticities of TFP with respect to public agricultural R&D, obtained from the TFP determinants models, are used to compute the social marginal internal rates of return (MIRR) on public investment in agricultural R&D.

For the TFP determinants model, agricultural R&D consists of public R&D, domestic private R&D and foreign or international R&D spillovers. Other explanatory variables are agricultural extension, infrastructure (represented by irrigation and rural roads), trade openness, resource reallocation<sup>13</sup>, weather condition (a proxy for the occurrence of flood or drought), amount of rainfall, and the dummy variables capturing the world agricultural commodity boom during 1972-1974 and the Avian Influenza outbreak that took place in 2004. The interaction terms between domestic and foreign R&D are also included in order to allow for research collaboration.

Error correction modeling (ECM) is employed as the estimation method because it offers an improved method to estimate the long-run dynamic relationship among time series economic variables. ECM does not impose any restrictive form of lags and allows for both short- and long-term relationships among variables. It also guards against the possibility of spurious regression commonly found in time series data (Hendry, 1995).

#### **4. *Biotechnology research***

Biotechnology is technology based on biology. It involves the use of plants, animals and micro-organisms such as bacteria, as well as biological processes, to create new products or processes. Biotechnology incorporates genetic engineering and other cell and tissue culture technologies. Biotechnology or genetic modification has a largely untapped potential to increase agricultural productivity. The list of benefits is extensive:

- Increased yields;
- Reduced reliance on herbicide and pesticides;
- Reduced development time for new plant varieties;
- Targeted change to plant genomes; and
- Reduced seed costs.

The strength of genetically modified (GM) technologies is in the savings in development costs (due to reduced development times compared to traditional breeding methods), as well as the capacity to target specific traits. The ability of primary producers to access GM plant varieties would appear to be essential in any consideration of food security in the longer term. The FAO (2005) has noted the potential importance of GM for the future of aquaculture as well as agriculture.

Biotechnology is also highly politically controversial with only a limited number of economies developing and trialling the use of biotechnology in food production systems. Fewer economies have allowed the commercial adoption of genetically modified crops.

Current research expenditure is in the order of US\$3 billion in developed APEC economies, the great majority of which is privately funded in the US (Rozelle 2007). In China, publicly funded GM research has increased rapidly over the last decade (Huang 2008). However, the

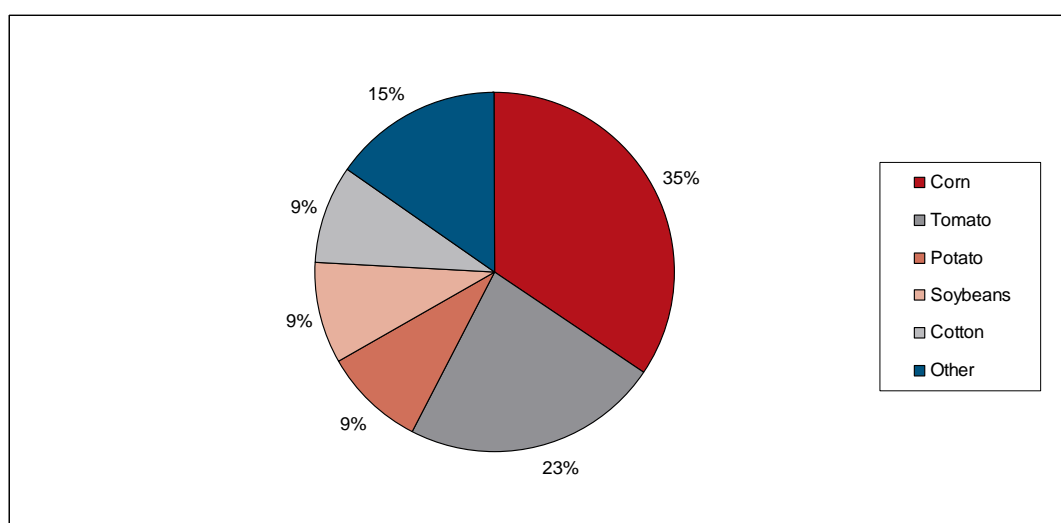
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<sup>13</sup> Previous studies showed that TFP at an aggregate level can increase because of the movement of resources from a lower productivity subsector to a higher one (Warr, 2006).

commercialisation of GM crops in the APEC region remains limited both in terms of plant industry coverage and the number of economies that allow GM crops.

Commercial use of GM crops in APEC economies is limited to the US, China, Canada and Australia. Field testing has been permitted in Thailand. The range of commercial GM crops is also restricted in the US, which has by far the largest adoption rate of GM crops. The Virginia Polytech Institute (2001) reported that corn and tomato varieties accounted for over 50 per cent of all varieties approved for release (see Figure 14). The limited range of GM research is seen as a potential problem by some observers.

**Figure 14 The shares of new GM approvals by crop in the US, 2001**



**Data source:** (Virginia Polytech Institute 2001)

The private-sector GM market is concentrated. The top four firms in the US have an aggregate market share in excess of 50 per cent and on a crop by crop basis, the concentration is much higher – ranging from around 80 per cent for corn and soybeans, to over 90 percent for cotton (USDA, 2004). Empirical evidence that concentration has led to higher prices is, at best, limited. Shimmelpennig et al. (2003) provided some empirical evidence that concentration in the biotechnology industry had led to lower levels of research activity than would otherwise have occurred. However, this may be the result of firms having incurred large sunk costs that they are attempting to recover by exploiting their comparative advantage in a particular research area. A more important question may be whether the government should play a greater role in funding GM research and why the incentives for GM research have not led to a broader research base. Both may be a result of a perceived lack of public acceptance of the technology.

While the decision to allow or disallow the commercial use of GM crops is one that APEC economies will take independently, there may be justification for broadening the scope of trials. Huang et al (2008) reported that one of the limitations on the development of GM crops has been the difficulty in obtaining permission for trials. This type of impediment has an additional cost imposed in that in situ trials provide information on how well adapted new varieties are in different locations and helps to identify ongoing research needs.

The value of allowing trials may be seen more as a safety net, and a means to address food security problems in the future. This appears to be the approach taken by China. China has a major research program on genetically modified rice that has been funded by the government



and been field tested extensively. Huang et al. (2008) reported that the trial showed that costs declined because of increased insect resistance and a lesser need for pesticides, and that yields either increased or at least did not fall. The government has not approved the commercial release of GM rice. Work has also been done on wheat, maize and soybeans in China as well as on a number of fruit and vegetable crops.

Greater coordination and transparency of regulatory arrangements for developing GM plant varieties across APEC economies is one means of increasing food security in the region.

## **5. *Agrichemical and pharmaceutical research***

Bijman (1999 and 2001) argues that the combination of very competitive markets and the need to achieve a high level of research and development capability has led to consolidation and globalisation in the agrichemical sector. Mergers and acquisitions have generated higher sales, broader product portfolios and greater research and development efficiency, with the seven largest companies now accounting for 85 per cent of the world market. In addition, companies have expanded their international activities by setting up subsidiaries in other economies, by acquiring local companies, and by engaging in marketing alliances with local companies. However, mergers and acquisitions cannot be fully explained by developments in the crop protection market itself. Agrichemicals are produced by companies that are also involved in the production of pharmaceuticals and other chemicals. This tendency - for firms to be engaged in both the agrichemical and the pharmaceutical industry for animals and human use - is a reflection of economies of scope and what is called the life sciences strategy. Commonality in research and development generates costs savings through agglomeration of intellectual capital. This tendency is highlighted in the expenditure patterns of firms.

Phillip McDougall (2005) reported survey results from the ten leading agrichemical research firms. Total research and development outlay was in excess of US\$2 billion and represented about 7.5 per cent of sales revenue. The majority of expenditure was in new product discovery (31 per cent) with most of that expenditure concentrated in chemical synthesis (55 per cent) which is where most of the intellectual property is patented. Expenditure on product development accounted for around 22.5 per cent of expenditure, with over one quarter of that expenditure going to human health and environmental risk assessment. Regulatory related expenses accounted for 12 per cent of expenditure excluding the costs of assessment.

The cost of regulatory compliance, excluding health and environmental risk assessment, is a substantial component of overall research and development costs. Developing clearly targeted and transparent regulatory systems in developing economies will be important in attracting research investment that meets the specific need of developing economies, especially as the productivity of primary food production increases more generally.

## **6. *Precision farming systems***

The development of precision farming of agriculture began in the US and has spread to other developed economies with the availability of adequate geographic positioning systems (GPS). Precision farming combines GPS technology with information regarding soil nutrient and weed density levels to position machinery accurately. Precision farming is not a single technology, it is a term applied to various activities that relate to the precise management of individual land units and the ability to more efficiently use machinery.

The advantages of precision farming systems include more targeted and ultimately lower application rates of fertilisers, herbicides and pesticides. These benefits are greater when there is greater heterogeneity in the landscape being farmed (Srinivasan, 2006). More precise monitoring of machinery movements can reduce fuel usage and avoid problems with soil compaction. The ability to operate more effectively in darkness has advantages in terms of being able to increase capacity utilisation, and helps to limit the vulnerability of farmers to short crop harvesting and planting windows. For example, greater advantage of rainfall can be taken at the time of planting and rainfall damage can be avoided at harvest.

The costs of precision farming include the direct costs of guidance systems and variable applicators for fertilisers and agrichemicals and the need to collect and maintain information on relatively small land units. The adoption of precision farming techniques is associated with increased scale of operations (Srinivasan, 2006).

Pinstrup-Anderson (2009) highlighted the importance of precision farming for world food security:

Precision farming as practiced in the United States and Europe is inappropriate for small farmers in developing countries because it relies on capital-intensive equipment used on large farms, but the principle is highly applicable. In fact, it should be an integral part of sustainable farming practice for small farmers because it increases the efficiency of plant nutrients and other inputs, while protecting the environment ... If appropriate small-scale and inexpensive equipment were developed, GIS, GPS, and remote sensing could help small farmers get the information they need to apply the principles of precision farming.

Doberman et al (2003) argued that the fundamental approach of precision farming is based on spatial information, and greater use the approach in developing economy agriculture is possible without high-end technologies such as GPS and geographic information systems. Nevertheless, investments in GPS infrastructure will allow greater real time geographic coordination. In developing economies the benefits to agricultural production may be limited in the near term. However, the benefits that may be realised in terms of the procurement and transport of products from a highly geographically dispersed production system may be quite substantial.

## **ii. Productivity growth over the long run and government policy**

The drivers of productivity growth will change over time. For example, as an economy develops the opportunity cost of keeping labour in primary production increases. As this opportunity cost of labour increases, labour exits the agricultural sector and non labour inputs are substituted for the loss of farm labour. The rising opportunity cost of labour relative to other inputs encourages the adoption of technologies and farming methods that save on labour. As the cost of non labour inputs increase over time, there is likely to be a shift to new technologies that save non labour inputs as well as labour inputs. For example, new farm chemicals can decrease input requirements without decreasing output. Changes in the amount of output produced relative to a single input factor, such as land, labour or capital, reflected in estimates of partial factor productivity growth, shows the changing efficiency with which farms use certain inputs.

Policies that affect the long run rate of productivity growth are important for the long run performance of the agricultural sector. Productivity growth is affected by innovation (such as

new technologies), economies of scope and scale, educational levels of labour, the regulatory environment, resource availability (such as land and water) and managerial ability. Hence policies that: encourage new investment; encourage agricultural research and innovation, improve allocative efficiency of inputs within the economy; and improve the education of the labour force will have a positive influence on agricultural productivity growth. For example, Coelli et al. (2004) conducted a study of cash crop and coffee production in Papua New Guinea and found substantial technical inefficiency. Given that the education of the male household had a significant affect on technical efficiency this highlights the importance of farmer education as a potential method to increase crop production without greater use of factor inputs or the introduction of improved production technologies.

In addition to research and development and the adoption of new technologies, the governance framework within which the agricultural system operates can have a significant influence on agricultural productivity. Governance infrastructure refers to the institutions and policies affecting economic performance of an economy. Lio and Liu (2008) conducted a study of 127 economies for 1998, 2000 and 2002 to examine whether differences in the quality of governance infrastructure, as measured by the World Bank's six aggregate governance indicators, can explain differences in agricultural productivity between economies. They found that given the same amounts of agricultural inputs, the same education level, and the same climate conditions, an economy with better governance can generate more agricultural outputs, or, in other words, become more productive. They also found that better governance brings about higher agricultural labour productivity and that it also indirectly enhances agricultural productivity by driving the accumulation of agricultural capital stock.

An OECD report (2008) noted that the performance of the fresh fruit sector in Chile has been enhanced by coordination and logistics along the whole agrifood system that has allowed for better quality control. Coordination has taken place through cooperative arrangements among farmers and between farmers and the industry. Contracts between industry and farmers have protected the latter from strong price fluctuations while assuring the industry of access to suppliers and allowing quality control of production. The governance infrastructure within which this has occurred has facilitated the successful use of contracts and improved coordination.

Policies aimed at improving agricultural productivity in developing economies should address inadequacies in governance infrastructure in addition to the development of infrastructure, education and technologies. Governance infrastructure may be improved through increased protection of property rights and enforcement of contracts and reduced corruption. It should be noted that such change can take a long time and involves major reform. The process of reform is considered further in Chapter 8.

### ***1. The management of pests and diseases***

Plant and animal protection inputs into food production are important in developing and developed APEC economies. Although the protection of agricultural and fisheries resources from pests and diseases might be seen as simply an ongoing cost of food production, management of endemic pests and diseases is the last of four elements used to manage the threat of plant and animal diseases. In order of importance, the components of government pest and disease control policy include:

- Border control;

- Monitoring;
- Eradication or control of a particular pest or disease; and
- Endemic management.

Governments have a role in the first three of these areas through:

- Regulation and enforcement of the movements of plants and animals, as well as vehicles used for transportation and farm machinery;
- Monitoring and inspection to detect pest and disease incursions;
- Educating producers to recognise the symptoms of an outbreak; and
- The destruction of affected crops and livestock to limit the spread of pests and disease.
- Governments also maintain stocks of pharmaceuticals, principally vaccines, and subsidise their distribution and use in designated areas.

In general, management practices for animal disease incursions are more advanced than for plants. One reason for this is the greater number of different varieties of cultivated plants as well as plant pests and diseases. Other reasons include the range of vectors for transmission and the number of potential hosts and habitats that can support a particular plant pest or disease. All of these factors contribute to higher costs of, and lower probabilities of, successfully managing an incursion. However, developed APEC economies do actively pursue programs to control plant and animal incursions.

Developing APEC economies can face substantial impediments to implementing these strategies. Production is often spread out across remote areas. Remote borders are shared with economies that are not actively seeking to control the disease. Economies that do not export affected products may not have a sufficient incentive to implement control programs even though the pest or disease may reduce domestic productivity. A short case study on animal disease control in Viet Nam illustrates that effective control programs can be still be successfully introduced.

## **2. *Case study: Foot and mouth disease and avian influenza in Viet Nam***

Foot and Mouth Disease (FMD) is a highly infectious disease of cloven hoof animals, including beef cattle, oxen, pigs and sheep. The disease is present, though not always active, in a number of APEC economies including Chinese Taipei, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. The disease is temporarily debilitating and results in a loss of condition but it is not generally fatal and does not pose a human health threat. The costs of the disease in term of lost animal productivity are not well established. The costs vary between the types of animal infected. Animals that are primarily used for meat will take additional time and feed to finish. The loss with animals used for cultivation will depend on the timing of an outbreak.

For economies that export beef and pig meat, the presences of FMD precludes market access to markets in which the disease, or particular strains of the disease, is not endemic. APEC

economies that have restrictions on imports from economies that are not FMD free include Australia, Canada, Japan, Mexico, New Zealand, Korea, the Russian Federation and the United States. A number of studies have examined the losses associated with the loss of market access due to FMD. For economies that export large volumes of beef and pig meat, such as Australia, Canada and the United States, the costs are well in excess of containing and eradicating an outbreak. Abdalla (2005) estimates that in Australia the costs associated with loss of market access due to an FMD outbreak would be in the order of A\$800 million, while the costs of eradication were around A\$40 million.

In contrast, economies in Southeast Asia export a small amount of beef and pig meat. Poultry is the major meat export from the region. However, livestock production in the region has been expanding rapidly and export opportunities will increase if FMD free zones can be established and internationally recognised (Thorpe et al 2007).

Viet Nam, which is currently a small exporter of pig meat, is in the middle of a five year program to control FMD that involves:

- The establishment of FMD free zones;
- Buffer zones that are actively kept free of the disease but for which disease free status is not established; and
- Control of livestock movement through both international and regional borders.

The FMD free zones are in the delta regions of the Red and Mekong rivers where animal populations are relatively high. The regions are seen as future export zones (Ha 2008). The program has received international support from the FAO, the Office International des Epizooties (OIE) and the Australian Government. The control strategy is based on an number of elements, including:

- The destruction of infected animals and disinfecting areas where livestock have congregated;
- Vaccination of non-infected animals in the affected areas and buffer zones;
- Surveillance and movement control; and
- Education of producers.

The potential for expanded exports appears to be substantial. According to Ha (2008), cattle numbers in Viet Nam increased by over 25 per cent and pig numbers by 28 per cent between 2001 and 2005. However, the costs of control are considerable. There are three FMD strains present in Viet Nam: types O, A and Asia 1. Type O was the only strain present prior to 2004, with type A detected in 2004 and type Asia 1 detected in 2006. The type A strain was thought to have originated in Thailand and the type Asia 1 in Myanmar (Ha, 2008).

Multiple strains increase vaccine costs. The cost of covering all three strains is around \$US 0.08 per unit compared with \$US 0.03 per unit for type O vaccine. The government pays for vaccination in infected areas and in buffer zones. Producers must fund their own vaccination programs in other areas.

Detection is also difficult given the remote and difficult terrain in which many animals are located. Animals kept in open pastures in infected areas are difficult to monitor and systematically vaccinate. Producers and traders often do not have a strong incentive, and perhaps a disincentive, to self report.

One of the largest problems is movement control – which is made difficult by very long borders with a number of economies in which FMD is also endemic. However, there has been an effort to coordinate the control of the FMD region. Similar commitments to control FMD have been made by Malaysia, Indonesia, the Philippines and Thailand as well as Cambodia, Lao and Myanmar. The overall program is coordinated through the OIE Regional Coordination Unit in Thailand and has received ongoing international support.

Ha (2008) indicated that the program in Viet Nam has an impact on FMD. In 2006, when the program started, there were outbreaks in 46 of 64 provinces. In 2008 Ha found there were reported outbreaks in only six provinces.

The experience with FMD in Southeast Asia highlights the importance of international coordination. Expanding the level of cooperation and coordination throughout APEC will be an important aspect of managing animal pests and diseases for a number of reasons, including:

- Cross border compliance in terms of certification, inspection and traceback;
- Common monitoring and reporting schemes;
- Sharing of information on the eradication of exotic pests and diseases, as well as their impact on crops, livestock and the environment; and
- The sharing of resources (such as vaccines and animal health experts) to control an outbreak.

### **iii. Sustainability**

Issues regarding the sustainability of food production systems due to the degradation of productive assets such as land, native forests, and fisheries are found in developing and developed APEC economies. However, the source of the problem and the appropriate policy solution can be quite different. This difference is largely because the highest priority problem in developing economies is to increase output and improve returns to primary production. Policies aimed at promoting longer term sustainability also need to be able to address this short term goal as well. These ‘win-win’ opportunities tend to be limited and policies should not be guided by wishful thinking.

Much of the push for more sustainable agricultural production systems in developed APEC economies is derived from broader public concerns about issues such as water pollution and biodiversity. Despite these differences there appears to be the capacity or the transfer of useful knowledge between developed and developing APEC economies. The longer term implications for world food supply of these policies in major exporting economies, such as Australia and the United States, may be an area worth further investigation. For example, the Australian Government intends to continue to purchase a substantial proportion of irrigated water entitlements for environmental use. This is not to say that environmental demand for water

should not be met, but that consequences in terms of the affect on food production need to be understood.

### ***1. Sustainable food production: a developing economy perspective***

While not a problem restricted to developing economies, agricultural production systems with low incomes are a major impediment to more productive and sustainable agricultural systems to sustain food supplies or to produce cash crops. At the extreme, subsistence production and very low producer income levels can lead to the mining of soil nutrients and other productive assets.

Low incomes may limit the choices that producers have to increase the longer term sustainability of production. Building human capital through education and the reform of land and water rights is potentially a reasonably low cost alternative for smallhold producers. Well defined property rights and tenure over these rights promotes investments that increase the production of food and food security. Poorly defined rights and limited or uncertain tenure is a clear impediment to increased food security. How developing economies choose to address this issue is important.

One of the objectives of the Australian Landcare program is to promote greater awareness of the problems caused by land degradation and to build human capital through education and the creation of producer networks. The program has been exported to Indonesia and the Philippines by Australia as a part of its aid program.

The Landcare program in Indonesia is relatively new and being trialled in a limited number of areas (Landcare International Newsletter, 2009). The Philippines program has had more time to develop. Cramb et al. (2006) conducted a survey in southern Mindanao and reported that the Landcare program had been associated with the rapid adoption of conservation practices with both welfare and environmental benefits, by maintaining the productive and habitat capacity of the land.

Land tenure and the tenure of access to other resources such as water and fisheries is an important prerequisite for sustainable use. The best and least cost incentive for stewardship of land and other resources is self interest. The ability to sell or pass a secure land right creates a strong incentive to maintain productivity. The fact that controlled access to a fishery can reduce costs and increase output, by increasing fish stocks and limiting the rush to fish, creates strong incentives for cooperative management. Some examples are discussed in the next section.

### ***2. Sustainable food production: A developed economy perspective***

Agricultural land degradation can occur for a number of reasons. Low incomes and a lack of information can result in situations where farmers do not have the means to address problems, such as soil erosion. Government input and output subsidies can lead to the exploitation of marginal land resources that are not well suited for sustained production. For example, public investment in irrigation infrastructure on poorly suited soil has led to salinisation in several economies.

Land degradation in developed economies is also often seen as a failure of land markets due to asymmetric information. Land owners, as opposed to land buyers, are more likely to be aware of degradation due to erosion and soil compaction, or the accumulation of salts and residues in

the land and local ground and surface water systems. As buyers are unaware of emerging land degradation problems sellers have less of an incentive to mitigate land degradation problems. Different approaches have been adopted to address the problem. In Australia and New Zealand, research and community awareness programs, funded for the most part through public funds, have formed the basis of the policy response. Surveys conducted by ABARE (2000) have indicated that the program has increased awareness and recognition of land degradation problems. While publicly funded research and extension in Land Grant Colleges in the United States is quite significant, the United States also maintains a Conservation Reserve Program. In the Conservation Reserve Program farmers receive rental payments for land taken out of production and placed into the reserve. Eligibility is based on a wide range of factors but generally requirements target soil erosion, nitrification and habitat preservation.

That the Conservation Reserve Program has evolved to take on a greater role to protect environmental as opposed to just productive assets is a reflection of increasing environmental weight being placed on the external costs imposed by agricultural production systems in developed economies more generally. While eligibility requirements are specified it is not clear that these requirements generate the best trade-off between environmental and food production outcomes as farmers have a strong incentive to retire their least productive land. How governments choose to address this issue has important consequences for food security insofar as inefficient regulation can reduce output and impose greater cost. In Australia, land use restrictions are commonly used. Restrictions apply to the clearing of vegetation and the use of irrigation on inappropriate land forms.

There has been an increasing focus on market based instruments in developed APEC economies. Tradeable emission permits are seen as a more efficient means of addressing environmental externalities than taxes, subsidies or output controls on individual producers. They allow the market to identify those producers with the highest and lowest costs of abatement, allowing output constraints to be met at minimum cost. A number of tradable emissions permit schemes have been implemented on a regional scale to address nutrient runoff in the US (OECD 2007). These have met with, at best, limited success. The key problem is that without extensive monitoring, nutrient runoff and other forms of agricultural pollution cannot be identified at the source, making property rights difficult to enforce.

Until low cost monitoring systems can be developed, environmental regulation in agriculture is more likely to be focused on input use through subsidised programs, like the Conservation Reserve Program, input restrictions and taxes. The inherent inefficiencies in these mechanisms will add to the burden of meeting environmental objectives in agriculture.

### **3. *Property rights – some examples from fisheries management***

The enhanced definition of property rights to address market failure is sometimes an alternative form of market intervention to regulations, subsidies and taxes. Property right solutions to market failure allow the market to help minimise the cost of meeting policy objectives. They work by revealing the preferences of individuals to give up or acquire a property right in the marketplace. Their use is relatively new and their effectiveness depends, in part, on the ability to establish appropriate and well defined rights that can be cost effectively enforced. The benefits will tend to be greater when the information needs of regulators and costs of acquisition from individual producers are high. However, they can often be tailored to address specific issues in local economies. They can also be self enforcing when they generate greater



productivity and consequently higher incomes. The application of property rights in fisheries provides some useful examples that may offer a template for addressing other problems

A number of developed APEC economies have moved away from this approach to output controls in the form of individual tradable quotas (ITQs) (OECD 2004). An ITQ is a property right to a share of an allowable catch. The allowable catch is typically set by an executive or regulatory government agency. ITQs have generally been regarded as an economic and environmental success story (Costello and Deacon 2007, Heal and Schlenker, 2008). Examples include:

- Halibut Fishery, Alaska: ITQs were introduced to increase returns in a highly over-capitalised fishery that had seasonal closures in force 363 days per year. The implementation of ITQs improved fishing safety and made fresh fish available for consumption throughout most of the year;
- New Zealand; ITQs were introduced in a number of New Zealand fisheries in the 1980s. There have been a number of studies that have highlighted the learning experience and success of the approach. Arbuckle (2004), in discussing the success of the ITQ system for scallops, noted that the supporting legislation was flexible and the government's approach to its implication was not highly prescriptive.
- Southern Blue Fin Tuna, Australia: ITQs were introduced in 1984 in the largest Australian Commonwealth fishery with total allowable catches set by international agreement, and led to extensive structural adjustment. The fishery is now highly profitable and supports, through the provision of juvenile stock, an aquaculture industry that adds around three times the value of live caught fish (ABARE 2008a).
- Costello and Deacon (2007) also noted the importance of local cooperation or cooperatives in the implementation of ITQs and the benefits of coordination and shared information that can occur with an ITQ framework. ITQs can serve to reduce the gains from hiding information and acting independently, relative to the gains from sharing information and coordinating activities. The caveat to this is that participants in the fishery believe that they will be able to make full use of their quota. The examples Costello and Deacon cite are regionally based and appear to have led to successful models in developed and developing economies:
- Geoduck Fishery, British Columbia: The fishery is co-managed by the Canadian Government and a local fisheries cooperative. It is widely accepted that the successful implementation of ITQs has depended largely on the coordination provided by the local cooperative.
- Salmon, Chignik, Alaska: The fishery was managed under an ITA system. The majority of local fishers decided to form a cooperative and coordinate harvest activities. A survey of member and non-members in 2002 indicated members had higher returns from reducing fishing costs and improving harvest quality.
- Abalone, New Zealand: The fishery was managed under an ITQ system but stakeholders in the Christchurch area implemented a scheme of voluntary area closures and minimum harvest sizes. Stakeholders also share information of stock condition and enforce poaching regulations.

- Multi-species, Baja California, Mexico: The Mexican Government allocated exclusive harvesting rights to remote fishing communities who in turn formed cooperatives to implement ITQ schemes for pelagic fish, lobster and abalone. Coordinated harvest programs have reduced search costs and improved the efficiency of processing with better controlled throughput.

Underpinning each of these examples is the fact that institutional frameworks have been put in place that establish well defined property rights over allowable catch. It is also essential that stakeholders have confidence that they will be able to exercise those rights. The last three examples in particular suggest that once overall catch rights have been established less formal institutional arrangements may be sufficient to underpin property rights systems at a local level – a finding similar to that reported for the New Zealand scallop fishery previously.

Establishing well defined and secure property rights is far from a universal solution to developing more productive, sustainable and resilient agricultural systems. However, where applicable, the approach has the capacity to provide a more informed approach to resource management and to assist primary producers to access and implement strategies to increase productivity and sustainability.

#### **4 Resilience**

The resilience of food production systems may be considered from two perspectives:

- The capacity of systems to limit production and income losses due to severe or catastrophic events; and
- The capacity to adapt to persistent changes in the environment by maintaining a wider range of production options or lowering the cost of adaptation.

Diversity is strongly linked to resilience. However, diversity can come at a cost. Producers may be able to generate more stable incomes by planting a greater range of crops and keeping a variety of livestock but this may not maximise their net revenue. Regional diversity reduces susceptibility to the impacts of major crop failures and maintains a wider range of viable production alternatives.

Pray and Knudson (1994) found that genetic diversity in major US field crops is an important defence against disease epidemics. They noted that in hybrid crops, such as corn, susceptibility can be passed on, and concentrated use of particular varieties or genetic strains can put crops at risk of large scale failures. They cite a case of corn leaf blight in which US corn yields dropped by up to 20 per cent. They went on to report that the US introduced breeders' intellectual property rights in the form of the Plant Variety Protection Act, in part, to stimulate greater genetic diversity. Based on their analysis they concluded that while the Plant Variety Protection Act had increased the level of private sector breeding of wheat varieties this had not contributed to the goal of increased plant diversity. They found that the observed increase in diversity was largely attributable to publicly funded research. Presumably this may be because the cost of seed derived from public research was lower, due to the absence of licence fees, and some growers saw a favourable tradeoff between lower seed costs and reduced or nearly equivalent yields.

In Viet Nam, most of the hybrid rice imported from China is susceptible to Blast disease. With 80 percent of hybrid rice imported from China, there is a threat of a large scale reduction in rice production in Viet Nam if there is a Blast disease outbreak. The risk is increasing as the use of non resistant hybrid varieties is increasing. The government's response has been to promote the development and production of local hybrid varieties that are resistant. At this point in time, constraints on the supply of the local hybrid varieties appear to be the major impediment to adoption (IPSARD, 2009).

### **C. MARKETS FOR INPUTS**

Farm production systems differ substantially in factor intensity between developing and developed economies. The path of development has often been characterised by the ongoing substitution of capital and purchased farm inputs for labour.

Farm production systems in developing and developed economies also use different mixes of externally, locally and internally sourced inputs. While this is partly a reflection of the relative importance of labour in agriculture within an economy, it can also be driven by access to markets for, and prices of, purchased inputs, as well as the availability of information regarding different production systems. Governance issues are likely to arise with access to land and water. For example, the lack of secure land tenure can serve as a disincentive for making fixed capital investments that would increase the productive capacity of the land.

Farming in developing economies tends to rely more on locally and internally sourced farm inputs. Examples of internally sourced inputs may include livestock waste (as fertilisers for crops) and family labour. The transition from locally and internally sourced inputs to externally sourced inputs in developing economies remains critical to increasing food production and increasing the incomes of primary producers. There are a number of potential issues that may need to be addressed during transition, as identified by Ellis (1992):

- The physical capacity to deliver inputs;
- Geographically isolated markets that are non-competitive;
- Regulation and monitoring to prevent the spread of diseases, pests and weeds; and
- The indirect issue of access to the financial resources needed to purchase farm inputs.

Farming in developed economies tends to be characterised by the use of more externally sourced inputs, principally machinery, fertiliser, herbicides and veterinary chemicals. There is relatively widespread use of proprietary plant varieties that are licensed or unable to be effectively propagated from harvested seed.

However, just as external inputs, such as fertiliser, are widely used in developing economies internally sourced inputs are still important in developed economies. The obvious examples are livestock breeding and the use of internally produced feed. Also, crop rotation, minimum tillage and inter-row cropping practices are examples of internally sourced nutrients that are commonly used as a substitute for fertilisers and herbicides in developed economies. These practices increase the flexibility of farm enterprises to respond to changes in input prices and may increase the longer term productivity and resilience of the farm production system.

Nevertheless, from both an agricultural development and a reform perspective, purchased farm inputs are a key area of focus in APEC economies. It is important to distinguish between those inputs that can be applied at or near the scale of existing primary production enterprises and those which require significant increases in scope and scale. The transitional costs of labour displacement are likely to be greater for the latter, with for example, inputs such as farm machinery or the plant required for extensive livestock.

#### **i. Purchased farm inputs**

The earlier section on productivity highlighted the importance of getting the efficient input mix. Purchased inputs of seeds, agrichemical and pharmaceuticals, fertiliser and machinery are a large part of that mix and tend to embody the majority of innovations that have driven, and are likely to continue to drive, increasing global food production. The green revolution was largely founded on the adoption of new hybrid cultivars and the application of nitrogen fertiliser. Improved plant genetics, agrichemicals and pharmaceuticals and advanced plant and machinery continue to push productivity in primary food production.

The adoption of variable inputs such as seed, herbicides and pesticides can be quite rapid. Technical information is relatively easy to distribute and effectiveness is relatively easy to demonstrate in situ. The payback on the financing required is relatively quick, making it easier to obtain finance. In developing economies, the large number of small farms and relatively low education levels can impede adoption. Product certification can also be a problem, especially with respect to seed.

Concerns regarding market structure, particularly in the context of barriers to entry, are raised in the literature in the areas of plant breeding and genetics, herbicides, pesticides and pharmaceuticals. The concern is due to what appears to be the minimum efficient scale of entry. These farm inputs are sometimes referred to as life science industries and firms have adopted strategies that promote the creation and exploitation of intellectual capital within and across related areas such pest control and human and animal health. There are synergies and economies of scope in research into plant and animal bio-chemistry and chemical synthesis, as well as common problems in product development and regulatory compliance. Pooling and sharing of information has clear advantages in terms of efficiency benefits, especially given that intellectual property rights are often necessary to provide the incentive for the desired level of private investment in the development of these inputs.

The adoption of capital intensive technologies is generally much slower. The adoption of large scale and precision machinery can often require significant changes to the size and layout of enterprises. Increased scale is needed to ensure that capacity is adequately utilised and factors such as the slope of the land and the size of contiguous planted areas will affect efficiency. Access to capital and training are also of concern in developed economies but are much more pronounced in developing economies. In developing economies land tenure and poorly operating land markets may also be a problem for the adoption of capital based technologies.

The second area where market structure can be a concern is in the supply of purchased agricultural inputs where markets are geographically isolated and may not be able to support the entry of more than one or two competitors. However, this in itself is not sufficient to raise competitive concerns. When primary producers have access to internally sourced inputs or may be able to change the composition of their enterprise, that is, they have options to substitute away from purchased agricultural inputs, suppliers are less able to exert market power.

Additionally, when these agricultural input markets are trade exposed, competitive pressure is created through the potential entry of competitors into the geographical market.

### ***1. Seed and other genetic resources***

Purchased seed is an important input in primary production in APEC economies. The three largest markets for purchased seed globally are in the APEC region: the US, China and Japan. Chile is a significant seed exporter and Mexico imports substantial volumes of seed. However, imports and production of proprietary seed inputs in developing economies are generally limited. The exceptions are Thailand, which began importing seeds in the 1980s (USDA 2004) and northern Viet Nam, which began importing hybrid rice seeds in the 1990s (IPSARD 2009). Given the importance of genetic improvement for increased yield and quality, and resistance to pests and diseases, improved access to new plant varieties may be a priority for developing APEC economies, especially when improved plant varieties can be adopted with minimal changes to farm enterprises.

Concerns regarding market power have been raised about the market for proprietary plant varieties. The USDA (2004) summarised a number of empirical studies that show, that at least with traditional breeding methods, there have been substantial cost reductions in the production of commercial seed associated with the strengthening of plant breeding rights and the number of acquisitions and mergers that have occurred in the industry. Barriers to entry in traditional plant breeding are unlikely to be high so long as there is adequate access to the pool of genetic resources, as the direct costs of research and production are relatively low. This is reflected in the fact that government and non-government agencies have well-established breeding programs in developing APEC economies, as for example, rice in Viet Nam and maize in Mexico.

There appears to very little concern with respect to market structure with regard to genetic resources in livestock industries. This is a reflection of two related factors. First, it is difficult to protect genetic capital derived from traditional breeding programs once it has been sold. What is actually traded is a breeding animal or its genetic material. Second, traditional livestock breeding programs can be conducted effectively on a small scale. These factors may change with the introduction of commercially accepted genetically modified technology for livestock.

Economies that purchase, as opposed to save, a large share of their seed can be vulnerable to market conditions. Tran Duc Vien and Nguyen Thi Duong Nga (2008) reported that a tightening of the supply of seed from China occurred in the winter-spring crop in 2005 and summer crop season of 2008. The price of Chinese hybrid seed in Viet Nam in 2008 more than doubled from the previous year, and many farmers in the Red River delta were not able to buy hybrid seed. This should not in itself be seen as an impediment to the adoption of purchased varieties, as using a mix of purchased and saved seed may be a good risk management strategy, and is one that is common in Viet Nam. However, governments may seek to increase the security with which farmers may access seed by promoting hybrid seed production or creating seed banks.

While access to international markets for improved genetic materials and the development of local varieties to meet local conditions is likely to become increasingly important, effectively operating markets for distribution of seed and other genetic material are also necessary. There is a need to consider regulations that will ensure genetic quality, given the asymmetry of information that can exist between buyers and sellers regarding seed quality.

Seed quality is one of the major factors limiting the adoption of hybrid rice in most Asian economies (Dat 2002). Tran Duc Vien and Nguyen Thi Duong Nga (2008) stated that seed quality is not ensured, especially in times of limited supply and excess demand when traders can make profits by importing and selling poor quality seed. Poor quality seed results in low yield, lower returns and potential economic loss for rice farmers – and in the longer term discourages farmers from adopting hybrid varieties. In Hung (2007) it was reported that only 84.9 per cent of imported seed in 2006 was quality seed, and 74.4 per cent of imported seed was certified to meet the requirement of purity.

The labelling of seed with counterfeit labels is seen as an impediment to the adoption of new varieties in China and Viet Nam. The names of successful varieties in the previous season are often used to label other, often inbred seeds, in the following season. This forces the successful seed company to change names and growers have little, if any, reliable information on the expected quality of seed that they may purchase (Huang, 2009).

With breeding livestock there is even greater information asymmetry between buyer and seller. This arises, in part, because the parental genetic makeup is not very well specified by appearance alone. Certification of origin and, for higher valued animals, lineage may be the only real option available. As the expressed genetic characteristics of the parent cannot be assured to be passed on to the progeny, testing would in most cases be prohibitively expensive.

## **2. *Agrichemicals and pharmaceuticals***

Chemical fertilisers are the most extensively used purchased farm input in developing as well as developed APEC economies. The use of fertilisers in developing economies is often cited as a major reason for observed increases in crop production worldwide. Excessively high fertiliser prices and transport costs or the lack of financial resources to purchase fertiliser inputs would be a significant threat to food security in developing economies. Increased fertiliser cost will reduce output and trade, resulting in higher food prices and lower cropping returns. While increased use of fertiliser is to a large extent inevitable given the response in plant yields to fertiliser, there are cultivation practices, referred to as low input technologies, that for example, limit the loss of soil fertility (IFPRI, 2008).

The rapid expansion of fertiliser use in developing APEC economies, particularly in Asia, occurred in the 1980s and early 1990s. Fertiliser use in China increased 96 per cent, Viet Nam 239 per cent, Thailand 170 per cent, Malaysia 141 per cent, Indonesia 67 per cent, while the Philippines recorded a more modest growth of 37 per cent (Ahmed, 1993). The FAO (2007) reported that East Asia now accounts for over 37 per cent of global fertiliser consumption. Consumption is expected to increase by over 2 per cent annually with most of the growth taking place in Indonesia, Malaysia, the Philippines, Thailand and Viet Nam.

World trade in fertilisers is extensive and there is little concern expressed in the literature, in either developing or developed economies, that fertiliser markets are impeded by excessively high market concentration, even though there are several large firms – the largest of which controls about six per cent of the global market. It appears that fertiliser prices are likely to be reflective of production costs, that distribution costs are not generally prohibitive, and that the benefits are clearly recognised by agricultural producers in terms of increases in output and returns. There is a concern that fertiliser has been overused in Japan and Korea (Ahmed 1993) and China (Qiao et al. 2006). One reason cited for fertiliser overuse is that farmers often try to maximise physical, as opposed to true economic, yields. However, this may also be due to

subsidies that may increase the use of fertiliser to the point where the increase in yield is worth less than its true economic return.

It was noted above that a high degree of reliance on purchased chemical fertilisers may lead to increased food prices and volatility, particularly in developing economies. Recently, upward pressure has been put on fertiliser prices due to increased demand for fertilisers – resulting from subsidies on biofuels and export restrictions. Because energy and oil products are, in terms of cost, a major input into fertiliser production, fertiliser prices will move in line with often highly volatile fuel prices. However, volatile fertiliser prices must be weighed against what has been a very substantial increase in both average yields and returns.

### **Plant and animal protection**

Agrichemicals to control plant diseases, pests and weeds, along with veterinary pharmaceuticals have also made a very significant contribution to increased food production and lower food costs. The global market for agrichemicals for use in protecting crops is around US \$28 billion (Bijman 2001). While publicly available figures for the pharmaceuticals market for agriculture and aquaculture are more difficult to find (as they are hard to separate from their use on domestic animals and pets), the value could be expected to be of a similar order of magnitude, with pharmaceuticals such as those used for parasite control and vaccines for infectious diseases (such as foot and mouth) as well as growth promotants and sub-therapeutic antibiotics.

As discussed previously, agrichemical and pharmaceutical production is largely conducted by large multinational firms. The implications of the globalisation of agrichemical markets for competition in the industry are unclear. However, attempting to mitigate the potential impact of global market structure on cost is not within the scope of individual APEC economies.

The extent of uptake of agrichemicals by primary producers in developing economies is a reflection of costs, access to finance and the information needed to use and assess the expected benefits of products, developed in and for other environments, under local conditions.

Access to agrochemicals and pharmaceuticals is important in developing APEC economies, in part, because the use of agrichemicals and pharmaceuticals does not require any underlying adjustment in the physical scale of most farm enterprises. Agrichemical and pharmaceutical use may still be more efficient in the longer term when used in conjunction with more land and less labour. However, the use of agrichemicals and pharmaceuticals does increase farm incomes when there is limited flexibility in labour use due to adjustment costs. In turn, this may promote the broader adoption of more efficient practices.

### **Market access**

The need to finance the purchase of inputs while having limited access to credit is commonly portrayed as a trap for some farmers in developing economies. It is a justification for input subsidies or subsidised access to credit. The logic being that as producers take on new production methods, incomes rise and financial liquidity is improved. Ellis (1999) notes that there are inherent inefficiencies in the use of input subsidies but they have been an effective “second best” policy in some economies, as for example, in increasing rice production in Malaysia. However, Ellis goes on to note that even when successful, input subsidies should have a limited life as the distortionary effect of subsidies tends to increase the longer they are in

place. Government subsidies that target the use of specific inputs, such as fertilisers, can lead to inefficient combinations of inputs in production. Non target subsidies may be a more efficient alternative.

It is unlikely that subsidising access to purchased inputs will transform agricultural production systems in their own right; however, they can be an important part of a coordinated program to increase food production and rural incomes in developing economies. Clearly with agrichemicals and pharmaceutical there is a need for information and education to ensure their efficient technical use and to limit health and environmental risks. However, there may be other constraints, such as storage and transport infrastructure, that limit the ability of producers to achieve the level of income needed to establish financial self reliance.

Government intervention in input markets may also be a response to market failure that typically arises in regards to managing the risks of and response to pest and disease outbreaks. Governments typically take responsibility for acquiring and distributing vaccines, containing and eradicating highly infectious diseases, such as avian influenza and foot and mouth disease. A case study of the control of foot and mouth disease in Viet Nam is presented in this chapter.

An impediment that may exist with respect to the uptake of agrichemicals in developing economies is that some of the diseases and pests may be unique to particular crops and climates. Government assistance and programs may expand the market for these products in developing economies to some degree, attracting more investment on crop and livestock protection products. However, this comes with a considerable degree of sovereign risk and ultimately, producers need to be able to generate the income needed to sustain demand for plant and animal protection inputs.

### **3. *Plant, machinery and other capital investments***

In contrast to the purchased farms inputs considered so far, the exploitation of modern cropping machinery, grain storage facilities, livestock pens and auto feeders tends to require levels of scale and scope to be cost effective.

While this has been largely an incremental process in developed economies it is a major structural adjustment issue in developing APEC economies. For example, if farm sizes in China tripled the average farm would still be only around two hectares per farm. Scale and scope economies can be achieved by three basic means:

- The acquisition of additional land or production facilities in the case of intensive livestock and aquaculture;
- The formation of cooperatives; and
- The provision of contract services.

The acquisition of additional land will, in most instances, be necessary to achieve economies of scope and scale. While the formation of a machinery cooperative or the provision of contract services do not necessarily force the scale of farming operations to increase, they will tend to be less effective if enterprise scale is not expanded. This is because capital inputs such as tractors and harvesters require a minimum level of operating scale to be profitable and the underlying trend is that minimum efficient scale has been increasing. Share farming or contracting, for



example, across smallholder farms may generate returns to scope but is unlikely to generate returns to scale. In addition, sharing of machines can create problems with respect to the timing of access, as for example when there is a short planting or harvest window. Such problems are internalised by a single owner but can lead to conflicts between competing users that may be costly to resolve.

The change in enterprise scale that needs to occur when adopting capital intense farming and fisheries production systems in developing economies is ultimately orders of magnitude above what can occur in the short to medium term. The shift to modern feeding regimes in intensive livestock production and aquaculture tend to lead to many fold increases in production. This is, in part, due to the fact that expansion does not require substantial increases in land area.

### **Protection of domestic farm input supply industries**

Indirect problems can also arise from protecting industries that supply agricultural inputs. Studies in the Russian Federation highlight some of the indirect problems that can arise from protecting industries that supply agricultural inputs.

Serova and Shick (2005) reported that the farm machinery industry in the Russian Federation is highly concentrated. There are five plants that produce nearly 90 per cent of tractors and two plants that produce 95 per cent of grain harvesters. While the Russian Federation imports a large proportion of its farm machinery, the cost and quality of imported machinery is well above what is produced domestically.

Serova and Shick reported that 75 per cent of the farm machinery market was controlled by a single firm operating in cooperation with regional governments in 2000. Since 2000 the firm, formerly a State owned monopoly, has continued to lose market share, falling to 55 per cent at last report. Further, government subsidies are only available for purchasing domestic produced farm machinery sold by approved dealers and suppliers.

## **ii. Credit markets**

While access to credit can be a concern for primary food producers in all APEC economies, it is a critical issue in developing economies. Smallholder primary producers often do not have the financial reserves needed to purchase inputs and limited capacity to service debt. There are three key problems:

- Cost of credit;
- Limited time frame to repay loans (which reduces marketing options); and
- Exposure to broad macroeconomic settings (which affects real rates of interest and inflation).

Smallholder primary producers are likely to attract a risk premium for borrowings, regardless of the source of funds. Production risks are typically high given exposure to weather, pests and diseases. While prices for products on local markets may be inversely correlated to production, which may limit price risk, many are exposed to international prices for production such as maize, rice or wheat.

Subbotin (2005) reported that farm profitability was a critical factor in determining whether farms were able to borrow from financial institutions in the Russian Federation. Land endowments and capital stocks had little influence owing to the low collateral value of the assets. Subbotin's conclusion would appear to be a transitory problem resulting from the privatisation of large but relatively inefficient cooperatives. The problem with the low collateral value of land may create problems in land markets. Shagaidia (2005) reported that the high transactions cost of registering land and other bureaucratic restrictions were a major impediment to land trade.

Smallholder primary producers often lack access to formal credit markets and may have to borrow informally at higher rates than could be obtained from banks or other financial institution. Loans repayments may fall due immediately after harvest. In the southern delta regional of Viet Nam, growers are commonly required to pay back loans within 20 days of harvest. This can limit their marketing options and reduce their bargaining position with local regional traders (IPSARD 2009).

The provision of access to low cost, subsidised loans in developing economies is one approach used in developing APEC economies. Low cost loans have been a central aspect of rural policy in Thailand over the last 10 years (Warr, 2008). The loans are not directed toward any particular use but rather to improved access to finance more generally. Warr indicated that the program appears to have been reasonably successful, but noted that this policy was implemented together with other policies, such as the removal of import taxes on fertiliser. Warr also noted that this was an uncommon intervention when compared to direct intervention in commodity markets in developing economies.

OECD (Anderson et al 2008) identified a success story in Chilean aquaculture. After an initial phase of technical support from Canada, Japan and the US to develop salmon farming techniques in Chile, the government introduced loans to local firms to demonstrate commercial feasibility in the early 1980s. The industry grew, with declining public support, to be the largest exporter of farmed salmon in 2003.

However, Subbotin (2005) reported that in the Russian Federation interest rates subsidies were introduced to allow large former collective farms to increase efficiency. The program did not increase access to credit markets as financial institutions still determined access on the basis of risk and credit-worthiness in a way that has limited access to producers on large, but low returning farms. The problem may be traced to the inability of farms to use land as collateral, owing to poorly operating land markets. While the best option would appear to be whether the issue may be resolved through land market reform, it still highlights the point that the use of loan subsidies still needs to operate through well functioning financial institutions and product markets.

Setting up the right institutions to improve access to credit by smallholder producers is a challenging problem. Promoting a shared understanding of the issues and performance of alternative models could be a useful area for further explorative research in an APEC context.

### **iii. Land and water reform**

Land and water policy reform is an issue for both central and regional governments. Governments intervene in land and water allocation in very substantial ways. Land use

planning often defines land that is available for food production and industrial use. Water allocations serve the same basic role.

In terms of land and water reform there are three central issues from a public policy perspective:

- The rules that establish tenure and any covenants over that tenure;
- The facilitation of trade through the enforcement of property rights and maintaining a registry of transactions; and
- The conditions under, and the process by which, the state of land and water access may change.

These issues have been dealt with to a much greater extent with respect to land, particularly in developed APEC economies, although the process of land use planning is still contentious. However, land reform is an important issue in developing economies, such as China.

The capacity to amalgamate land holdings in China is seen by the central government as central to increasing the productivity of grain farms. This has led to changes in land tenure arrangements. Regional governments have also sought to increase farm sizes to increase the overall efficiency of local farm production and distributions systems. This has led to a trial program that provides subsidies for land rentals and the creation of farm business registries to accredit suppliers and improve access to credit. The land reform agenda in Viet Nam is discussed in Box 5.

**Box 5 The land reform agenda in Viet Nam**

Kompas et al. (2009) estimated that between 1985 and 2006 the productivity of rice production increased between 33 per cent in the Red River delta to over 100 per cent in Mekong River delta. They found that land use reform in Viet Nam has made a substantial contribution to this growth in agricultural productivity. They also found that productivity growth has declined since 2000.

Collectivization of agricultural land in Viet Nam began in the late 1950s and continued to the late 1970s (Marsh and MacAulay 2002). The initial break up of farm collectives led to a high degree of land fragmentation. Land holders were given rights to small non-continuous parcels of land in the interests of equity (Kompas et al 2009). Hung et al. (2007) estimated that there around 7 to 9 plots per household prior to the introduction of reforms.

Land use policies began to shift in the 1980s when land once owned by cooperatives could be subcontracted (Marsh and MacAulay, 2002). Land reform became a cornerstone of Doi Moi policy that began in 1986. Private land rights were strengthened under the land law of 1993 and subsequent amendments, the last of which was made in 2003. Decollectivization, land allocation and land titling to individual farm households for long term use aiming to strengthen land use rights of farm households have been economy-wide (Marsh et al. 2007). These rights are transferable through inheritance, lease or sale. However, they are subject to government approval.

Since the introduction of land reforms this has dropped to around five plots per household. Kompas et al. (2009) argued that land tenure is still too short to provide secure rights for land amalgamation and that further amalgamation will lead to further productivity gains. They cite a study by Thanh (2008) who estimated that the embankments that separate land plots reduce cultivatable land by between 2.4 to 4 per cent.

Water reform has attracted increased attention in most, if not all, APEC economies. For example, the redistribution of water from agriculture to manufacturing and urban uses is an issue in both China and Indonesia. The centralised reallocation of water from local communities has been raised as a problem in Chile and Peru. Addressing problems associated with groundwater access have received considerable attention in Australia, China and Mexico. Reforming water propriety rights to promote the efficient and equitable redistribution of water has been a major policy goal in Australia and the western US.

The main and non exclusive issues in water reform relate to:

- Security of access where it is recognised that a pool of available water resources is often highly variable;
- The introduction of tradable water rights to facilitate the reallocation of water in the short and longer term; and

- The over-allocation of water resources, particularly groundwater resources which from a practical perspective, are often being mined.
- However, with land, it is the reallocation of water resource from agriculture to industrial and urban use that presents the largest policy issue in developing APEC economies. The issue extends to environmental use in developed APEC economies. To a large extent this change is inevitable. However, in contrast to land it is more difficult to substitute other inputs for water. Increased efficiency of irrigation delivery systems may help but often the water saved in one location results in an equivalent loss in water availability downstream due to a decrease in return flows. Ultimately it comes down to improving the efficiency with which plants use water. This will present an expanded set of challenges in the area of plant genetics and may be another focal point for coordinated research across APEC economies.

#### iv. Other issues in the market for inputs

Growers can contract with agrifood firms such as food processors to gain access to capital, legal expertise, transport, and technical know-how. Given that the contractor has a strategic interest in the outcome of the contract, the agrifood firm often monitors input use and crop management. Additionally the contractor can assist smallholder farms to obtain credit through contracting rather than through traditional lending and capital markets.

The government of Viet Nam has encouraged the formation of rice grower cooperatives in the south to purchase pesticides, as well as seed and fertiliser, by providing access to low cost loans (IPSARD 2009).

Foreign direct investment is another source of capital. Anderson et al. (2008) stated that foreign direct investment was an important contribution to increased productivity in primary food production in Thailand. However, they also noted that spillover of technical expertise may have been the most important driver of these trends.

Warr (2008) pointed to the fact that the capacity to shift labour in and out of agriculture can determine how developing economies are able to respond to a sharp economic downturn. In Indonesia during the Asian financial crisis of the 1990s, the excess labour that resulted from reduced employment in the manufacturing and services sectors was absorbed into the agricultural sector. However, in Thailand, where agricultural production had become considerably less labour-intensive, the capacity of agriculture to absorb labour was limited, leading to greater levels of underemployment and unemployment. During the current global financial crisis, there has also been a substantial shift of labour back to rural areas in many developing economies. The extent to which these resources have been effectively redeployed is not yet known. Surveys in China indicate that the global financial crisis has slowed but not reversed the trend in labour movement.

#### D. MARKETS FOR OUTPUTS

There are two main problems in the markets for farm outputs that are highlighted in the literature with respect to developing and developed APEC economies:

- Exposure to market power in downstream markets; and

- Government intervention in the form of taxes, subsidies, output controls and price stabilisation schemes.

In developing economies where primary food production makes a large contribution to the overall economy, efficiency in marketing at, or immediately after, the farm gate can also substantially reduce the cost of food.

In terms of the exercise of market power, the general concern is that demand for primary food products will decline and that both food production and the prices received by primary producers will be lower, and the prices paid by consumers will be higher. In the longer term, lower producer prices and incomes will limit, and potentially impede, the adoption of more efficient production practices.

The empirical literature on this subject is extensive and is generally focused on what is referred to as the farm-retail price spread. While some studies have found isolated incidences of market power influencing the price between consumers and producers, a large number of studies have found that there is no evidence of market power influencing price spreads. A survey of the Australian literature is provided by Oczkowski (2004). A discussion of these issues in the United States is provided by Sexton (2000).

From a theoretical perspective there are two interesting considerations that relate to the short and long run responsiveness of food supplies to price. In the short term, food supplies are not very responsive to price. Given the highly seasonal nature of food production, supplies of many commodities are essentially fixed. While the exercise of market power can have a large impact on price it will not have much, if any, influence on the quantity of food supplied. In the longer term production is more responsive to price. While this might appear to imply that the influence of market power is greater in the longer term, this is not the case, largely because the reduction in primary production reduces throughput for downstream participants that offset the gains they may see from lower input prices.

The potential issues faced by smallholder producers in developing economies may be seen in this context. Smallholders will tend to have more limited marketing opportunities. This can be the result of high costs of transport, the inability to store product, limited market information or the need to repay short term loans. As a consequence they can be exposed to trade in relatively thin local markets. In the short term, they may be exposed to intermediaries and processors that control local markets. However, it would be difficult for this to persist if producers have the capacity to take on off farm employment, change crops or engage in collective marketing activities. A problem could persist for smallholder farms with limited flexibility.

While the issue of market power receives much attention, most of the evidence is anecdotal. The export rice industry in Viet Nam has a limited number of rice millers and polishers and only eight State approved exporters. Farm gate prices rose in response to world prices during the global food crisis, however, they did not fall to the full extent that world prices fell after the crisis eased (IPSARD 2009).

Primary producers often attempt to address perceived problems in both downstream and upstream markets through the formation of cooperatives. The potential to develop market power through the formation of cooperatives would seem to be limited, given both the size of the cooperative that would need to be formed and the incentive to market privately given that a cooperative may attempt to restrict supply.

Hueth and Marcuoul (2006) show that in the presence of oligopolistic competition in downstream markets, the formation of a cooperative to share information and increase bargaining power can increase the overall return to both producers and consumers. However, it is not clearly in the interests of all participants to join, especially those with better information, so the preconditions regarding the effectiveness on information sharing within the cooperative are not met. While Hueth and Marcuoul suggest there may be advantages of introducing compulsory price reporting, it would seem a more appropriate policy response to reduce the costs of acquiring market information. Just having the capacity to obtain a range of quotes at a low cost would act as a partial deterrent to downstream buyers attempting to price discriminate.

However, the primary benefit of forming a cooperative may not be with respect to forming market power but with increasing the scope and scale of marketing operations and reducing transaction costs, as illustrated by the case study on the emergence of agricultural cooperatives in China.

### **i. Case study: The re-emergence of agricultural cooperatives in China**

The rapid emergence of modern food processors and retailers in China, catering to increasingly affluent consumers that seek safety and quality assurances, is raising the demand for more vertically integrated food marketing. The development of vertically integrated markets, however, has lagged behind the growth of the processing and retailing industries. Nearly all farm production in China is still sold directly to small traders, though products sold directly to agribusinesses and wholesale markets and larger intermediaries are slowly increasing. In the case of ‘strategic’ crops, such as grains, cotton and oilseeds, the small traders sell much of their inventory directly to large, publicly-owned marketing companies. These companies tend to pool their purchases and lack strong incentives to segregate their products according to quality or other criteria. For the wide variety of horticultural products, local traders typically sell their purchases to larger traders or on nearby wholesale markets. The products are then usually resold to other traders or on more distant wholesale markets. Urban retailers purchase food products from suppliers or local wholesale markets and the products have likely changed hands several times since the original sale at the farm level. Livestock has traditionally been produced on household farms and marketed similar to horticultural products, but production is shifting toward larger and more modern facilities that can establish more direct linkages with suppliers and retailers.

A number of institutional issues confront the development of vertically integrated markets in China. China’s land tenure system results in small, fragmented land holdings that increases the costs of pooling land together for more unified production. Moreover, with hundreds of farm households harvesting the same crop at different times, and a range of different crops within any given village, the traditional production system in China lends itself to a system of small traders transacting with farmers harvesting crops. Establishing integrated production monitoring systems and enforcing production standards are likely to be costly by comparison, particularly when institutions to enforce contracts and settle disputes are relatively undeveloped. This may change as communication systems and institutional arrangements improve but this will require time and coordinated investment.

China has established a variety of policies to promote more integrated production and marketing. Chief among these are farmers’ professional associations (FPAs) and farmers’ specialized cooperatives (FSCs). FPAs and FSCs are ambiguously defined and sometimes

overlap, but in general FPAs are set up to provide technical assistance and facilitate information sharing among members and do not own fixed assets, whereas FSCs are set up for profits through agri-processing and marketing activities and own fixed assets (Hu, et al. 2007). These organizations can help member households acquire market information, develop channels to sell their products, establish standards for uniform quality, and improve farming technologies such as seeds, breeds, fertilizers, and pesticides. Farmer cooperatives can also facilitate the pooling of assets – primarily land and capital – to take advantage of scale and to expand the agricultural value chain. According to China's Ministry of Agriculture (MoA), the number of FSCs reached 150,000 with 38.8 million member households by the end of 2006, accounting for 15.6 per cent of all rural households in China (MoA, 2007).

The extent to which the recently established farmer organizations have helped to address the problems in developing vertically integrated markets in China is unclear. While officially membership in these organizations has expanded rapidly, many of these organizations are not effective, and some were established at the behest of local officials rather than with the full support of the member farmers.

Nevertheless the establishment of FSCs has been particularly rapid in the east-coast region and neighboring provinces such as Anhui and Jiangxi, by and large due to the support of local governments as well the central government. A new law effective on July 1, 2007, formally established a legal framework for these institutions and is expected to increase their popularity and effectiveness. If farmers start to realize increased returns from collective marketing, this will be a likely source of innovation that will complement the developments in other parts of the food distribution and marketing system.

## **ii. Marketing orders and boards**

In developed economies primary producers have also sought to generate market power through institutional arrangements, such as marketing boards and marketing orders.

Marketing boards are usually single desk sellers. Examples include the Australian Wheat Board, the Australian Barley Board and the Canadian Wheat Board. The transition from centrally controlled to market based agriculture has also left behind a number of large trading firms in some economies, with mandatory power of acquisition, as for example with rice exporters in Viet Nam. There is no clear evidence that marketing boards have increased prices received by producers, which may be largely due to the fact that marketing boards do not control supplies. There were concerns in Australia that marketing boards could exploit market power in domestic markets – as a consequence, domestic grain marketing was opened to free trade.

Marketing orders are government executive orders that set minimum prices, quality and/or quantity for agricultural products. The motivation for these arrangements was to promote the orderly marketing of products.

A crop marketing order may include a provision for the one or many of the following:

- specification of grades;
- advertising, promotion, market development and research;



- allotment of the amount each processor may handle or purchase;
- establishment of how much may be marketed during a set period;
- establishment of methods for determining surpluses and their control and disposition;
- inspection of the product;
- prohibition of unfair competition and unfair trade practices; and
- requirements that processors file their selling prices and do not sell below prices filed.

Market orders are used in the US for the marketing of dairy, fruit and vegetables. They are prohibited in grains and livestock. Clearly marketing orders have the capacity to increase food prices in markets where prices are set domestically. Against this must be weighed the benefits of a more coordinated marketing system. The literature in the US is mixed. Chouinard et al. (2009) found that milk marketing arrangements in the US adversely affect nearly all consumers. Thompson and Lyon (1990) found that market orders for oranges reduced the retail farm price spread while Powers (1991) found that this was not the case. On balance, the most compelling argument against marketing orders, as they are implemented in the US, is that they control output and they are compulsory.

Output controls are not limited to marketing orders. Similar sorts of arrangements are and have been, in place in the sugar industry in Australia. Some elements of these arrangements facilitate processing, such as scheduling the sequence of fields to be harvested. Scheduling helps to maximise the extraction of sugar with high reflectance, increasing overall grower returns. The formula used for sharing revenue, given that some growers will have harvest delayed, takes into account both incentives to promote efficiency and equity. However, acreage restrictions on a traded commodity were clearly not efficient (Productivity Commission 1992). The acreage restrictions were removed in 2004.

Gervais et al. (2008) found that production controls at the farm level in the Canadian dairy industry adversely affected production costs. This was because allocations were not based on costs of production and were not tradeable. The total output at the economy-wide level is allocated to provincial marketing boards, who subsequently allocate production to dairy farmers according to their individual share of the market sharing quota. These shares were determined by a centralised process involving historically based, plant level quotas.

### **iii. Price stabilisation schemes**

There is a long history of commodity price stabilisation schemes in agriculture. Williams and Wright (1991) provide a comprehensive discussion of the issues especially as they pertain to storable commodities such as cereal crops.

Williams and Wright point out that the welfare effects of price stabilisation are not readily generalised. They depend on the responsiveness of demand to prices at different price levels, the responsiveness of supply to prices, and the nature of sources of disturbances to supply. They also explore the benefits and costs of buffer stock schemes with various pricing strategies, such as floor schemes and price bands noting that, in practice, the differences are largely superficial.

Williams and Wright also note that as economies become increasingly open to trade the benefits of price stabilisation schemes can, in part, be exported. They cite this as why the US shifted away from storage based schemes to price supports in the 1980s.

Storage is discussed further in Chapter 0.

#### **iv. Government intervention**

The use of subsidies in agricultural output markets has been a contentious issue in the context of promoting free trade. There has been a strong push for using decoupled or less distortionary means of supporting producer incomes. Subsidised and preferential market access is still seen as justified in some developing APEC economies, and in both Japan and Korea. In Japan and Korea the stated motivation is cultural, that is, to preserve rural landscapes and values. In developing economies the motivation is, as with input subsidies, to increase production and producer income. They should ultimately be seen as transitional. However, the transition to producing food at prices dictated by world markets will ultimately involve adjustment costs that are an impediment to their removal. If successful, output subsidies reduce the incentive for producers to compete effectively with either other exporters or importers – which is not in the longer term interests of food security.

The removal of taxes on agricultural outputs will clearly lead to higher prices received by primary food producers and increased output in the medium to longer term – regardless of whether the domestic industry supplies export or purely domestic markets.

Export taxes can meet short term food security goals by diverting product back on to domestic markets. This imposes two obvious costs. First, primary producers will receive lower prices and will not expand production to meet the global increase in demand. Second, it increases the perceived risk of relying on food imports that in term undermines competitive advantage of lower returns to exporting economies – a situation that is not in the interests of food security in the longer term.

#### **E. KEY MESSAGES**

In the context of developing APEC economies there are six key messages that have come from this review of primary food production:

- The expansion of output by, and improved returns to, primary food producers will depend to a large extent on their capacity to access farm inputs that increase yields and allow better management of pests and diseases. These inputs tend to be traded on international markets. The issues at a domestic level relates to the capacity of producers to access these markets on a basis that requires diminishing levels of government support.
- To make effective use of these inputs producers need information. This may include information on new technologies and how to make use of them. It also includes having markets that provide assurance as to the products they purchase.

- There appears to be a general trend toward declining per capita public expenditure on agricultural research and development. Regardless of whether this trend begins to reverse due to the recent global food crisis – greater coordination and exchange between public research agencies in APEC economies may generate significant returns. In particular, it may increase spillover benefits by allowing individual economies to better adapt research to their own conditions.
- Private research and development is also conducted on a global scale and can have a limited focus on important crops and growing conditions. As producer incomes improve, the market potential for commercial products will expand. A consistent approach to regulation across developing APEC economies that share common problems may also help. However, there appears to be a strong role for publicly supported research and extension to adapt innovations worldwide to the needs of specific APEC economies.
- The formation of collectives based on taking advantage of economies of scope and scale, as opposed to social incentives, has the capacity to reduce marketing costs in both input and output markets.
- Last, the capacity of an economy to manage the transition of labour away from primary production as the scale of agriculture increases, and towards other areas of the agrifood system to meet the rapidly changing demands of consumers will be an overall focal point of improved food security.

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## 5. FOOD PROCESSING

The fundamental characteristics of the food processing sector across APEC economies are similar, sharing characteristics found worldwide. Although most food processors are small to medium size enterprises, there are a relatively small number of large – often multinational – firms that are dominant in the sector. In 2000, the world's 200 largest food processors accounted for an estimated one third of the total value of global processed food production (Henderson 2000).

Efficiencies of scope and scale are the driving force of concentration in the food processing sector. Increased efficiency through horizontal and vertical integration tends to lower the cost of processed food. The division of fixed costs is spread over a greater level of output allowing for greater investment in modern processing technologies and logistics. Coordinated sourcing of food and non food inputs can facilitate more consistent throughput – as for example, by reducing the impacts of seasonal variation in local agricultural product – providing greater capacity to meet the demands of wholesalers and retailers in different geographic markets and at different times of the year.

However, concentration may potentially lead to issues of non-competitive conduct in some markets. Having only limited numbers of buyers (processors) in markets for primary products may give rise to competition characterised as monopsony or oligopsony, which, in turn, can lead to lower prices for suppliers in those markets and importantly, less throughput. A limited number of suppliers in downstream markets (wholesale and retail markets) can give rise to monopolistic or oligopolistic competition with lower levels of production and higher processed food prices for consumers.

While increased concentration may appear to be a potential threat to the goal of increased food security, this is not necessarily the case. First concentration in the domestic food processing sector does not equate with market power. For example, in processed food markets, trade exposure can curtail the ability of a firm to increase prices. The ability of farmers to divert production to the fresh or export market will impede the ability of processors to lower prices on inputs markets. Second, cost decreases due to increased efficiencies may dominate any effects of non competitive market behaviour. The capacity to source input and distribute output more efficiently can increase the reliability of supply to consumers, reducing price variability and the likelihood of sharp price increases.

Nevertheless, market structure and conduct in the food processing sector can be an important issue for developing and developed APEC economies. The key issue examined in this chapter is whether the cost savings are more or less likely to reduce food prices to consumers and increase overall demand for primary food products. The factors that will determine the outcome of greater integration of the food processing sector with the rest of the agrifood system will differ between developing and developed economies.

In developed APEC economies, competition policy and regulatory legislation may serve an important role given the large scale and strong vertical integration of food processing firms in these economies. It should be noted that the ongoing implementation of competition policies in developing economies is not a costless approach, both in terms of costs of compliance and potential regulatory failure and error. Competition policy approaches in developing APEC

economies needs to be considered carefully, especially given that lower food prices can have a substantial effect on real incomes in these economies and that substantial cost and food quality benefits can accrue through vertical integration. It may be more appropriate to initially focus more on basic issues of market access of both upstream primary producers and consumers, as for example, through better transport and information systems. The approach to foreign direct investment can also be an important consideration, as can increased exposure to processed food imports. The competitive effects of improving access to inputs, foreign direct investment and trade exposure may limit the need for exercising competition regulation in the shorter term, and in the longer term, will improve the effectiveness of competition policy.

The food processing sector also faces regulations that relate to product safety, packaging and labelling. Compliance to these regulations can be costly. Conversely, economies may lack the necessary regulatory systems that favour quality assurance, and instead allow markets to manage risks more efficiently in the absence of the requisite regulatory systems. The net benefit of regulations needs to be considered, especially where they are highly prescriptive, or subject to capture by vested interests or unduly vague. This must be balanced against a real need to increase food safety and inform consumers about nutrition.

With growing population, incomes and urbanisation in developing APEC economies, the demand for processed food products can be expected to grow rapidly. This will also lead to new export opportunities where packers can meet quality and safety standards through better handling, packaging and timelier shipping. A competitive and innovative food processing sector will ensure domestic processors will become an increasingly important part of the agrifood system.

An overview of the impediments to efficient production of processed food is set out in the remainder of the chapter, with the discussion organised around impediments in:

- The markets for inputs;
- The efficiency of processed food production; and
- The markets for outputs.

#### **A. FOOD PROCESSING ACROSS THE APEC REGION**

Food processing covers a number of activities. On the one hand processors of fresh produce keep products fresh and transfer them quickly from the farm to the shelf in a minimally transformed way. On the other hand, processors of frozen meals also coordinate a number of supply inputs and processes to provide a highly transformed product. Packaging, preparation and innovation adds value to primary product input, with packaging and handling practices having a substantial effect on wastage and food quality.

Summary statistics for the food processing industry across the APEC region are presented in Table 4, Table 5 and Table 6. The first two tables provide information for two food processing sectors: processed meat, fish, fruit, vegetables and fats; and grain mill products and starches (including animal feeds). Table 6 contains information on all food products for China, Hong Kong, China and Chinese Taipei, as the same breakdowns of the food processing sectors were not available for these economies.

It is evident from the tables that up to 10 to 50 per cent of the output price of food is due to the value added at the food processing stage. Of this value added, labour accounts for a significant share, reflected in the share of wages in value added. The value added per employee is higher for grain processing activities than for fresh meat and vegetable processing, reflecting lower labour intensity in grain processing.

**Table 4 Processed meat, fish, fruit, vegetables and fats, various years**

	Year	Value add share of processing sector in output price (%)	Processing sector share of all manufacturing (%)	Value add (in \$US million)	Value add per employee (US\$)	Share of wages in value add (%)	Number of employees	Wages per employee (US \$)
Australia	2001	39.5	nr	4,170	54,534	27.9	76,467	15,225
Brunei Darussalam		na	na	na	na	na	na	na
Canada	2002	26.5	4.0	5,748	43,880	37.5	130,997	16,445
Chile	2005	44.4	6.2	2,952	43,689	17.3	67,564	7,559
China <sup>a</sup>								
Hong Kong, China <sup>a</sup>								
Indonesia	2003	23.1	4.8	1,827	7,894	12.0	231,435	943
Japan	2004	31.3	2.1	19,576	66,676	23.9	293,600	15,929
Korea		na	na	na	na	na	na	na
Malaysia	2004	10.5	4.0	1,442	24,588	19.3	58,630	4,753
Mexico	2000	25.6	2.7	1,620	21,550	26.0	75,153	5,612
New Zealand	2004	20.6	25.4	3,422	83,027	54.7	41,210	45,390
Papua New Guinea		na	na	na	na	na	na	na
Peru	2005	31.3	15.5	1,857	10,330	32.3	179,757	3,334
Philippines	2003	29.4	5.8	781	13,949	16.3	56,000	2,267
Russian Federation		na	na	na	na	na	na	na
Singapore		na	na	na	na	na	na	na
Chinese Taipei <sup>a</sup>								
Thailand		na	na	na	na	na	na	na
United States	2004	34.9	3.6	73,990	117,747	23.9	628,379	28,142
Viet Nam	2000	10.9	4.2	183	1,627	39.2	112,573	638

<sup>a</sup> China; Hong Kong, China; and Chinese Taipei report manufacturing under different industry code classifications and are reported in Table 6

**Note:** na means not available (the industry code was not contained in the economy's statistical tables) nr means not reported (the industry code was contained in the economy's statistical tables but no value was reported for that field and year).

**Source:** UNIDO 2009

**Table 5 Grain mill products and starches (includes feed grains), various years**

	Year	Value add share of processing sector in output price (%)	Processing sector share of all manufacturing (%)	Value add (in \$US million)	Value add per employee (US\$)	Share of wages in value add (%)	Number of employees	Wages per employee (US \$)
Australia	2001	40.7	nr	1,140	80,044	23.8	14,248	19,022
Brunei Darussalam		na	na	na	na	na	na	na
Canada	2002	28.9	1.3	1,899	90,575	26.9	20,964	24,373
Chile	2005	28.8	1.0	478	38,937	28.4	12,279	11,070
China <sup>a</sup>								
Hong Kong, China <sup>a</sup>								
Indonesia	2003	19.7	1.1	435	6,067	16.1	71,736	978
Japan	2004	20.0	0.5	4,668	161,827	14.1	28,843	22,752
Korea	2005	26.7	0.9	2,731	164,496	15.1	16,603	24,818
Malaysia	2004	12.2	0.6	226	20,965	34.5	10,795	7,240
Mexico	2000	31.8	3.1	1,887	47,136	18.0	40,041	8,459
New Zealand	2004	nr	nr	nr	nr	nr	1,370	nr
Papua New Guinea		na	na	na	na	na	na	na
Peru	2005	14.6	2.3	277	0	0.0	0	0
Philippines	2003	16.9	1.4	192	18,777	14.1	10,200	2,642
Russian Federation	2005	21.9	0.7	900	7,554	33.5	119,120	2,531
Singapore	2004	14.6	0.0	11	30,703	85.3	373	26,189
Chinese Taipei <sup>a</sup>								
Thailand	2000	28.6	1.7	38,939	2,310	28.6	38,939	2,310
United States	2004	45.1	1.4	27,938	351,510	12.8	79,480	45,068
Viet Nam	2000	10.6	4.6	200	6,489	12.5	30,781	808

<sup>a</sup> China; Hong Kong, China; and Chinese Taipei report manufacturing under different industry code classifications and are reported in Table 6

**Note:** na means not available (the industry code was not contained in the economy's statistical tables)

nr means not reported (the industry code was contained in the economy's statistical tables but no value was reported for that field and year).

**Source:** UNIDO 2009



**Table 6 China; Hong Kong, China; and Chinese Taipei food processing, various years**

	Year	Value add share of processing in output price (%)	Food processing share of all manufacturing (%)	Value add (in \$US million)	Value add per employee (US\$)	Share of wages in value add (%)	Number of employees	Wages per employee (US \$)
China	2005	27.2	6.8	47,768	13,902	nr	3,436,000	nr
Hong Kong, China	2005	36.1	10.3	625	28,398	50.4	22,000	14319
Chinese Taipei	1996	20.9	4.9	3,710	35,654	40.0	104,044	14259

**Note:** nr means not reported (the industry code was contained in the economy's statistical tables but no value was reported for that field and year).

**Source:** UNIDO 2009

## B. PRODUCTIVITY

Improved productivity in the food processing sector is driven by innovation and increasing returns to scale and scope (both externally and internally). Innovation may lead to improved or increased product ranges as well as decreased costs of production. As with primary production, adoption of new technologies and practices are an important determinant of the rate at which innovation will ultimately lead to productivity gains. Vertical and horizontal integration is driven by the desire to reduce the costs of production, through increases in economies of scale and scope, with integration potentially reducing transaction costs and enabling better risk-sharing and adjustment to demand variability, as discussed in Chapter 0.

### i. Innovation and returns to investment

Innovation is a driver of productivity increases in food processing – varietal, logistical, technical and commercial innovations have led to new and specialised products. Some new products may extend shelf life or meet specific dietary needs or restrictions, while other innovations simply expand the range of consumer choice. As a consequence the need to innovate can be seen as an ongoing part of a firm's business strategy. Innovation and technology have also been important for reducing costs and hence decreasing the cost of food to consumers. Examples include labour savings through automation of processing, and the minimisation of wastage through improved cold storage and more rapid processing. However it should be noted that consumer acceptance is far from guaranteed and can be transitory.

Firms may gain a comparative advantage when they convert intellectual resources into intellectual property or proprietary assets. Examples include 'hard' assets such as brand names, trademarks, copyrights, patents, and 'soft' assets such as production reputation, trade secrets, consumer loyalty, and special relationships with suppliers. Importantly, when international firms expand into new developing markets they need to be able to assure the value of these assets.

Firms have an incentive to make investments in intellectual capital and innovate if the returns to such investment can be captured. Sometimes the benefits are captured by being the first into a new market, and in those cases the protection of a firm's brand names and trademarks is particularly important, as are copyrights and patents. Innovations in processing methods are more likely to offer a longer term comparative advantage but require considerable capital investments in research and development. Food processors will be encouraged to invest in

economies that provide intellectual resources (such as those offered through agglomeration and labour market pooling) and where their intellectual property is afforded legal protection from encroachment by imitators. However, from a public policy perspective it is important that protection is not so great that the firms then become immune from competition.

Limits on the life of some protections (such as patents) foster new innovation. The level of protection should allow the recovery of a return on capital that has been sunk in product development. This can be difficult to achieve with *ex ante* restrictions, as for example, on the role of a patent. At the same time overly exclusive rights may restrict entry by others (Lemley and Shapiro 2007). Elhague (2008) argues that patent arrangement can lead to royalties that are either too high or too low, but points out this can be difficult to determine *ex post*. While intellectual property rights can impose costs, Meres (2005) argues that in addition to providing incentives for innovation they also reduce the transactions costs of contracting by setting out rights and privileges and that to some extent this may reduce the need for horizontal integration.

Research and development is key to innovation in the food processing sector. It is common to see higher levels of private R&D investment in the food processing sector than in most other sectors of the agrifood system because firms are able to differentiate their product through labelling and other forms of marketing. However, taxpayer funded research and development investment may be desirable where firms may not be able to adequately capture the returns to investment or where the returns from investment (in terms of spillover and productivity increases) are greater than the cost. This may be more likely when research and development expands markets generally, rather than benefitting a single firm. In this case, there may be free riding, both in respect to expenditure by other processors and also by governments or industry boards (Sexton 2000).

In developing economies, foreign direct investment and the accompanying transfer of knowledge has been important in developing the food processing sector. For example, an OECD Development Center working paper (2005) noted that the positive spillover of foreign direct investment in Thailand's seafood industry was more important than the modest share of foreign direct investment in total investment suggests. In recognition of this, the Thai Board of Investment now defines its role as a facilitator of investment rather than as a regulator (its original role), with an emphasis on promoting investments with potential for research and development and technology transfers rather than just attracting high quantities of investments. Knowledge resources make an important contribution to food processing. Knowledge resources are, in part, the products of educational institutions, both domestic and international. They can also be embodied in corporate experience and proprietary information. Arms-length market transactions may not always be an effective mechanism for transferring these resources between firms in some economies. This highlights the fact that vertical coordination through foreign direct investment, partnerships and mergers can be an important aspect of developing an efficient food processing sector.

In Thailand, for example, internal knowledge resources and knowledge resources within each firm's coordinated partners are important. Siriwongwilaichat and Winger (2004) conducted a study of 62 food processing companies and 43 technical information producers in the Thai food processing industry to identify the main technical knowledge sources used by Thai food processors to support the development of new branded food products. Internal technical staff were the major source of technical knowledge for food product development. Food ingredient suppliers were the most important external provider of knowledge to these technical staff. New

products that were radically innovative required greater input from external technical knowledge sources than products that were incrementally innovative.

A new driver of change in the food processing sector is improved quality and the development of standards as a strategic tool to deliver quality and food safety (Vagneron et al. 2009). A key part of delivering quality is the establishment of tracking and tracing capabilities throughout the agrifood system, discussed further below and in Chapter 8.

### ***1. Quality and the costs of governance***

Food quality characteristics desired by consumers can be costly to provide and difficult to verify. Markets for these goods will emerge only if supplying firms can be trusted (Carriquay and Babcock 2007). To ensure quality, governance is required. The complexity of information, the extent to which this information can be codified, and the competence of suppliers determine how food processors govern the provision of quality. This is likely to be quite problematic in developing APEC economies with large farm sectors. In the absence of sufficiently sophisticated quality classification systems provided publicly, there will be an increase in private standards focusing on the quality and safety of products (Vagneron et al. 2009). The cost of coordinating spatially dispersed activities when suppliers have limited knowledge and confidence increases the cost of governance. In a number of economies, standards from the International Organisation for Standardisation (ISO) are used when domestic standards are perceived to be inadequate. For example, in the absence of stringent domestic standards for food safety in aquaculture in Chile, international buyers demanding quality standards has led to the acquisition of ISO 14001 certification in aquaculture in Chile (UNIDO 2009a).

Tracking and tracing capabilities are used to deliver food safety, food quality, product liability, sustainability and consumer transparency (Fritz and Schiefer 2009). The tracking capability allows the identification of any product within the agrifood system at any given time. Tracing capability allows for any product to have its initial source identified at any stage within the agrifood system. The identification of the initial source is a prerequisite for the subsequent identification of product batches at later stages of the agrifood system, which may have been affected by a contamination or deficiencies at the initial source. Tracking and tracing systems facilitate the recall and destruction of potentially dangerous consumer products. The systems can be particularly important in food processing given that a range of products are often combined to produce a product, for example, frozen vegetables that are sourced both locally and internationally. Monitoring the results of tracking systems will also help to identify local hazards and priorities for introducing process standards.

The spatial distances between rural areas of production and urban areas of consumption, the need for continuous delivery of products to consumers and the perishable nature of many food products, puts especially high demands on the organisation and efficiency of logistics and communication within the agrifood system.

To be efficient, changes in the costs of the quality of a tracking and tracing system must be at least offset by the willingness of consumers to pay for the changes in quality. That is, given the quality innovation is being driven by consumer demand, the increase in the price of food products must be less than the increase in value to the consumer from improved quality. The benefits of improved food safety and quality may not be as readily perceived as an increase in price. In some instances this may require educating consumers as to the benefits of higher quality food.

Tracking and tracing systems beyond the firm require agreements and coordination between downstream and upstream participants that may be difficult to secure. Insofar as quality problems generated by one firm may negatively affect the market as a whole, the enforcement of quality standards is difficult without integration or coordination of the agrifood system for a particular product – unless individual firms can cost effectively assure their product through their own system.

Individual firms face costs when overall confidence in a product is lost or an increased health risk is perceived. However, as individual firms in the agrifood system usually consider the probability of needing to recall a product to be relatively low relative to the actual, empirical probabilities (Fritz and Schiefer 2009), the cost of market breakdown is not considered in the firm's decisions to invest in tracking and tracing systems. Further, firms that do not differentiate their product on quality do not face the same incentive to invest in tracing and tracking systems. This can increase the cost of ensuring quality in the rest of the system.

Once a sufficient number of firms demand improved quality systems, the incentive for supplying firms to improve quality will lead to an overall increase in food quality. There may be external economies of scale to quality increases in the sense that once they are devised and adopted by some firms, they can generally be adopted at less cost and with less risk by other firms as well. This suggests that government may have an initial role in promoting the development of quality assurance systems, especially in developing economies.

## **ii. External economies of scale and increased efficiency**

Agglomeration or clustering of firms may result in external economies of scale and make individual firms more efficient than an individual firm operating in isolation. External economies of scale may be due to: the ability of a cluster to support specialised suppliers; the way that a geographically concentrated industry allows labour market pooling; and the way that a geographically concentrated industry helps foster knowledge spillovers (Gervais et al 2008). Downstream processing firms may benefit from locating close to firms in upstream input supply industries so that transportation costs are reduced (for example, agglomeration of the feedlot industry may occur close to a source of grain). There may be a role for government in removing impediments to the formation of agglomeration of industries in certain locations, for example, through planning reform. However, it is not for the government to 'pick winners' within a cluster.

Agglomeration facilitates learning and spillovers because when firms in the same industry are located close to each other it is easier to monitor neighbours and learn from their successes and mistakes and, along with the competitive pressure of the cluster, may lead to innovation and increased productivity (Porter 1990). Details of the effect of agglomeration and spillover in salmon processing in Chile are contained in Box 6.

**Box 6 Salmon processing in Chile**

The Los Lagos region in Chile accounted for 75 per cent of domestic production in 2006. Commercial cultivation of salmon began in Los Lagos in the early 1980s with regional and economy-wide support and foreign technical and financial assistance. By the end of the 1990s the small group of salmon farms had grown into a large processing cluster with suppliers of feed meal, nets, boats, processing equipment and machinery, and other components located in Los Lagos (UNIDO 2009a).

The diffusion of production knowledge across firms has been the main driver of productivity improvements in the cluster – with the public-private partnership, the Funacion Chile, leading the effort to adopt and adapt global best practices in salmon production. Close horizontal links between firms, suppliers and the Funacion Chile resulted in a strong flow of information and knowledge among firms.

The cluster provided the minimum efficient scale for the development of new knowledge and the provision of common services. For example, firms coordinated efforts to source technical assistance. As processed salmon is a knowledge intensive food product, owing to the complexity of logistics and the environmental and food safety standards involved, the industry in Chile benefited from the spatial concentration of firms.

The theory of external economies indicates that when external economies are important, a region or economy with a large industry will, other things being equal, be more efficient in that industry than an economy with a small industry. That is, external economies can give rise to increasing returns to scale at the level of the domestic industry. When the learning curve for the accumulation of knowledge is costly to begin with and decreasing over time, economies that develop the industry first may develop a ‘first-mover’ advantage. This first-mover advantage may lead to government facilitation in developing new industries. Infant industry protection, as it is known in trade policy, may, however, be used as a trade barrier and must be a temporary policy measure to assist with the development of external economies to reduce costs and improve the efficiency of the industry.

### **iii. Internal economies of scale and increased efficiency through coordination and integration**

Many firms horizontally or vertically integrate to reduce transaction costs or reduce externalities that are associated with buying from or selling to other firms (Bhuyan 2005). Transactions costs are largely about the risks of transferring economic assets from one business to another (Elhague 2008). Increased efficiency through horizontal and vertical integration tends to lower the cost of processed food. Integration offers a number of benefits:

- The per unit value of fixed costs or overheads is lower as they are spread over a greater level of output, allowing for greater investment in modern processing technologies and logistics;
- Coordinated sourcing of food and non food inputs can facilitate more continuous throughput (for example, by reducing the impacts of seasonal variation in local agricultural production); and

- The capacity to meet the demands of wholesalers and retailers in different geographic markets and at different times of the year can also be improved.

As considered in Chapter 0, it is important to weigh the benefits of cost reduction against any price impacts that result from the exploitation of market power. In developing economies costs savings from increased efficiencies are likely to be substantial and may easily outweigh the potential to exploit market power. However, in developed economies where returns to scale and coordination have been extensively exploited, further gains in efficiency may not outweigh costs from the potential exercise of market power.

Competition policy is a set of policies and laws aimed at ensuring that competition in the marketplace is not restricted in a way that is detrimental to society (Motta 2004). All APEC economies have policies on competition. However, a number of economies do not have dedicated competition laws in place (including Brunei Darussalam; Hong Kong, China; Malaysia; Papua New Guinea and the Philippines) (APEC Competition Policy and Law Database 2009). In a number of economies dedicated competition laws have been introduced relatively recently during the last decade, including, Indonesia, Singapore and Viet Nam. In economies without dedicated competition laws or economies that are still gaining experience with full implementation of competition laws, the process for addressing competition concerns in relation to market concentration may not always be clear.

While competition issues may be an important problem to address from an economy-wide perspective, the priority of addressing competition issues in food processing may still be comparatively low given economies have access to a number of alternative instruments to increase competition. These instruments include improving access to inputs for domestic processors, allowing foreign direct investment partnerships with domestic firms and increasing trade exposure to processed food products. Use of these instruments may limit the need for exercise of competition regulation in the shorter term, and in the longer term, will improve the effectiveness of competition policy. In addition, promoting the growth of small and medium enterprises is also an important way to increase competition in food processing.

### ***1. Small and medium enterprises***

Small and medium enterprises (SMEs) account for a large share of food processing firms (see Table 7 for a selection from developing APEC economies). As explained previously, exposure to imports and world prices increases competitive pressure on domestic firms and may lead to dilution of market concentration. As trade exposure increases price and quality competition, firms may need to make investments to increase economies of scale in order to remain competitive. It follows that it is important that SMEs have access to capital so that exposure to foreign producers leads to increases in competition and not displacement of domestic SMEs with new international firms.

**Table 7 The share of SME firms in the food processing sector in selected APEC economies, 2005**

<b>Economy</b>	<b>Share of SME in food processing (percentage of all firms)</b>
	%
Indonesia	70.0
Malaysia	97.6
Philippines	99.0
Thailand	96.8
Viet Nam	90.0

Source: APEC 2008

The required level of capital for SMEs to establish may change as concentration in the food processing industry increases. This is because as the industry concentrates it may increase the minimum efficient scale of operation that allows a firm to be competitive in the market. In this way, increased concentration and increased economies of scope and scale can act as a barrier to entry in the food processing sector. Stiegert et al. (2009) conducted a study of the price cost margins, market concentration and advertising outlay of 48 food and tobacco processing industries in the US during the 1970s, 1980s and 1990s. They found that increased concentration lead to increased entry barriers due to the cost of advertising and higher profits to the industry, thereby making entry by new SMEs difficult.

One advantage in developing economies is that there is a large pool of viable SMEs so that as long as barriers to entry are not too high and they have access to capital there will be firms that can grow and compete with large scale domestic start-ups and multinationals. In the following section there is a case study of the processing sector in the Philippines that looks at these issues.

Another area SMEs may have an advantage in is in exploiting regional markets. SMEs often provide more specialised products and services and may organise and source a product from a group of local suppliers to meet the demands of supermarkets and export supplies – typically the SME will package the product with minimal transformation of the product. In developing economies where there is lack of cold transport, there are likely to be SMEs in each region providing a supply of perishable processed products because transport from distant markets is too expensive.

#### **iv. Case study: Food processing in the Philippines**

The food processing sector accounted for about 10 per cent of total GDP in the Philippines over the period 2001-05, with food processing accounting for just half of all manufacturing activity. In 2005 there were approximately 55 000 food processing firms in the Philippines. Micro firms (those with nine or fewer employees) dominated the sector in terms of number, accounting for approximately 90 per cent of all firms, but accounted for less than half of the employment in the food processing sector. Large firms (with a staff of more than 200 people) accounted for only 0.33 per cent of the number of firms, but accounted for just under a third of all employment in the food processing sector in the Philippines. See Table 8 for a summary.

**Table 8 Characteristics of the food processing industry in the Philippines**

	<b>Staff</b>	<b>Share of all firms</b>	<b>Share of all labour</b>
	Number	%	%
Micro	1 - 9	93	43
Small	10 - 99	6.3	19
Medium	100 - 199	0.29	6
Large	> 200	0.33	32

Source: Mangabat 2008

Large scale food processors tend to be vertically integrated and have better access to capital and skilled labour and technology. Duenas-Caparas (2006) conducted a study of the export performance of food processors and the influence of firm and industry characteristics. Firm size, skilled labour and foreign affiliation had a positive and significant influence on export performance. Foreign affiliation in local firms appears to be the primary source of knowledge and technology transfer, while technical skills acquired through training improve productivity and the quality of goods produced (and hence the propensity to export).

Improvements in the agrifood system may allow SMEs to expand and be more competitive. This would benefit both SMEs and farmers. The Strategic Agribusiness Development Plan (SADP) developed by the Philippines Department of Agriculture (2009) outlines a number of issues that could be addressed and these options are discussed below.

### **1. Market information and product quality**

A lack of product grades and standards leaves farmers with little incentive to increase the quality of their produce. It also increases the search costs of processors to ascertain quality grades. For example, although buying stations are established in major mango producing areas, mangoes are not graded for quality and size. This means that growers are unaware of the requirements of processors and exporters in regards to quality (Mangabat 2008). In addition, seasonal variation in the supply of fruits means that micro and small processors can have difficulty assembling the volume and product standards needed.

Currently only price information at major markets is available to farmers. At crop selection time before planting, there are no production forecasts for other domestic locations. Small and large processors would benefit from receiving more timely and wide-ranging market information, including production forecasts at the village level. Small processors are more likely to lack the resources needed to generate their own market information and some form of market information sharing of public information may be warranted. Development of village-level information networks linked to central information centres through the use of IT communication tools such as wireless technologies would facilitate information dissemination and overcome information asymmetries.

Additionally, wholesale markets could enforce the use of standardised grades and packaging and provide a venue for price information collection. The use of quality standards, an inspection and testing system, and a certification system for farm products would improve quality and safety.

### **2. Post harvest handling, consolidation, grading and transportation**



Inadequate support facilities and infrastructure that result in improper postharvest control and differences in handling practices at each stage in the postharvest and marketing chain affect quality. Efforts should be intensified to improve agricultural and rural infrastructure such as postharvest facilities and farm-to-market roads for farmers. Postharvest losses in the Philippines are large, specifically:

- Total postharvest losses in rice production are estimated at 14.8 per cent of the total rice production every year. A reduction of postharvest losses to eight per cent translates to about 740 000 metric tonnes of rice per year;
- Corn drying facilities are limited, hence corn quality is problematic, especially in terms of aflatoxin contamination;
- Limited or outdated postharvest facilities are reducing fish quality and value after unloading at the ports, and also do not comply with international food safety and quality standards; and
- There are limited slaughter houses in local markets. As a result, live animals have to be transported from production areas to processing and consumption areas with high transportation cost.

Sourcing fresh mangoes continuously in sufficient volume is a concern for SME mango processors. In major mango producing regions, small processors either cease processing operations and resume only during the peak season or shift to processing other fruits such as pineapple and papaya during the mango off-season. Large processors can draw fruits from a wider area, and can assure themselves continuous supply.

The problem is exacerbated because access to markets is still limited for farmers in many places economy-wide. In newly opened production areas, most products have not reached particular supply chains because it is difficult for consolidators to link to institutional buyers and other nonlocal buyers to access the new production areas. If new wholesale markets are constructed in strategic locations, the markets can encourage new production and invite new buyers from wider areas including consolidators or buyers linked to supermarkets. Where construction of wholesale markets is not practical, collection centres could be constructed near where production takes place so that more products from a wider area can join supply chains linked to institutional buyers or local wholesale markets. In collection centres, products will attract a higher value through cleaning, grading, precooling, packaging, and other services. It should be noted that in some places, it may be more beneficial to add value to products by creating cold supply chains than attempting to improve market access.

The corn supply chain has been improved through the introduction of four large-scale pilot corn processing complexes. These are equipped with mechanical dryers, shellers, storage facilities and handling systems. The project is a joint venture by the National Agribusiness Corporation (NABCOR) with both local government units and the private sector. NABCOR will operate the corn processing complexes until the investment costs of the government are recouped. Given the initial success of the project, the Department of Agriculture is planning to establish 50 additional corn processing complexes in major corn production areas to ensure the delivery of good quality and aflatoxin-free corn grains.

The initial success of the corn processing complexes has led the government to duplicate the business model (with some modifications) to rice. In these models, NABCOR maintains ownership even after the turnover to the intended beneficiaries has taken place to ensure the sustainable operation of the project. NABCOR maintains a share of capital, and in the event that the intended beneficiaries mismanage the operation of a complex, NABCOR has the power to manage the operation again. Other developing economies may find it useful to monitor the progress of these initiatives.

### **C. MARKETS FOR INPUTS**

There are a number of inputs into the food processing industry. They can be classified into primary inputs and non-food inputs. Primary input includes all unmodified and partially transformed output from agriculture, aquaculture and fishing. Non-food inputs include capital (such as factories and related plant and financial services), an economy's infrastructure (including systems of transportation, communications, funds transfer and mail delivery), energy (including electricity and fuels) and knowledge resources (including stock of scientific and technical knowledge and skilled labour).

#### **i. Primary Inputs**

Aside from price, the demand for primary food products in an economy or region depends on product quality and availability. Quality has become an increasingly important aspect of the downstream marketing strategies of food processors. It requires highly specific investments for coordination among participants with respect to the definition of detailed quality standards, methods of production, and controls for guaranteeing conformity of products to what is demanded (Mernard and Valceschini 2005). Traditional marketing channels do not typically create a high degree of product differentiation with respect to product quality (Reardon 2009). The exception would be traditional channels that are export oriented.

The increased focus on the quality of primary inputs is strongly related to increasing vertical interdependence through the processing sector. Firms make substantial investments in building brand value for their products – through investments in brand names, trademarks, unique product formulations, advertising and quality control – with the market value of the brand depending upon the consistent and reliable delivery of products to wholesale and retail markets for consumers. The brand acts as an assurance of quality and availability to consumers and hence a disruption to the flow of products that compromises the quality of the products reduces the value of the brand, undermining the firm's investments.

Primary food inputs can have a high degree of variability in their quality attributes, with some products easily segregated and controlled and others being very difficult to control or segregate in supply. For example, grains of different qualities are relatively easy to segregate, partly because they can be stored. In contrast, the handling required to segregate fresh products can be high. As factors such as moisture content, sugar content and size need to be controlled, a lack of uniformity in primary food inputs can add significantly to processing costs, potentially resulting in greater wastage or requiring changes to the configuration of processing equipment.

Being able to access primary food products year-round, or for an extended part of the year, allows throughput to be maintained. This increases the potential for capacity utilisation and decreases the need to store processed products, both of which can generate cost savings.

Firms that have differentiated their products on brand have strong economic incentives to manage supply to minimise the risk of inadequate supply or poor quality. Information asymmetry regarding the quality attributes of primary inputs increases the transaction costs of purchasing them because the processor incurs search costs when they need to measure and sort through the available primary inputs. Quality assurance and certification systems are one institutional adaptation to high transaction costs from measuring and signalling quality (Hobbs 2003). Another institutional adaptation to the high transaction costs of ascertaining quality is to vertically coordinate or integrate to increase the interaction between the processor and source of primary production inputs to better ascertain the presence of desired quality characteristics. While these systems will no doubt play an increasingly important role in developing APEC economies, most are starting from a very low base. Reliance on agents and wholesalers will still dominate procurement and less formal arrangements. A third option is through less formal arrangements, such as lists of preferred suppliers, that are and will become increasingly important. Such lists can be branded as well, back to agents, wholesalers and wholesale markets. These agents and wholesalers will, along with processors, be advantaged by improved telecommunication systems and this is like to be a focal point for innovation in the procurement system more generally. Special mobile phone applications to monitor transactions, track inventories and record faults are becoming increasingly commonplace as economies upgrade mobile data communications.

There are several methods available to firms for sourcing primary production inputs for food processing and the method chosen depends, in part, on the nature of the required input and its general level of availability. Food processors may use spot markets, traders, wholesalers, forward contracts, farm contracts or the acquisition of farms to source inputs. The level of vertical integration varies from non-existent (with the spot market) to full vertical integration (through the acquisition of farms).

Spot markets are often used for sourcing staple crops. Staples, such as grain and rice, are commonly storable commodities which can be segregated with respect to quality characteristics and are traded on thick markets. The cost of price discovery in the spot market is low. Prices tend to be strongly linked between locations, provided that transport systems allow cost effective arbitrage. Risks can readily be hedged on futures markets.

Spot markets are one of a number of buying and selling methods used for the purchase of livestock. Segregation with respect to the quality characteristics of livestock can be accomplished with relatively low costs. Cost effective transport will ensure prices are linked between geographic markets as well as at the farm gate – a common point of sale for livestock. Livestock can also be traded on the basis of carcass characteristics with payments to primary producers determined after the animal is slaughtered. As both buyer and seller are better informed (the buyer of the quality following slaughter, and the seller of quality through feedback following the slaughter), this type of arrangement leads to improved product quality over the longer term.

Additionally, for processed products that face strict quality requirements and specialised products more generally, the spot market may not deliver the required quality and reliability of primary input supply without significant transaction costs (Simmons et al 2005). Perishable or fresh products decline in quality rapidly after harvest. The time required to handle the product can result in significant declines in quality and wastage. Refrigeration and storage can add to

handling costs. As a consequence, it can be quite costly to aggregate the volume of product, at quality standards required by producers, for sale in spot markets.

Regardless of the methods used to source primary inputs, processors often have the advantage of being able to locate operations where the physical costs of sourcing primary inputs are low – which will in turn affect where and what is farmed in a particular areas. This may be quite important in developing economies with highly dispersed local production. As noted in the discussion of SMEs, it may be easier to coordinate suppliers in a relatively small region assisted by the use of contracts. However, the location of processing close to inputs must be weighed against the cost of sourcing non-food inputs and costs incurred in the sale of processed products – such as transport.

Essentially, when market transactions are costly it may be preferable to organise the sourcing of primary inputs within the firm. Longer term contracting appears to be a successful option for reducing transactions costs. Such contracts may be formal or informal. Formal contracts tend to specify a number of aspects of transaction, including:

- The volume, price or future reference price of a commodity (a future reference price usually being a prevailing market price at the time of settlement);
- The delivery point and time;
- Minimum quality specifications; and
- A schedule of premiums and discounts for deviations from the contract conditions, including terms of refusal.

It is important to recognise that many of the characteristics that allow spot markets to operate effectively are the same conditions that make it easy to create contracts. For example, if adverse weather conditions reduce the quality of a farmer's wheat yield, the wheat can be downgraded according to quality standards, with publicly available prices from the spot market used to determine the appropriate discount relevant to the lower quality grade. These conditions are readily integrated into a contract. In contrast, discounts or premiums applied to fresh fruit that is weather damaged are more difficult to determine. This is because fresh fruit is not thickly traded in markets and hence the price of the product with the same quality characteristics may not be easily determined. Furthermore, because fresh fruit cannot be stored for long periods, if adverse weather conditions also significantly reduced overall market supplies, the damaged product may attract a significant price premium.

Incomplete contracts provide a means of flexibly managing the uncertainty associated with contract outcomes and avoid the need to fully specify the terms of a transaction. Incomplete contracts may take many forms. They may be simple business relationships or networks that recognise and follow standard operating practices that arise out of joint problem solving and common training regimes. They may involve cost and revenue-sharing arrangements as opposed to fixed prices, as well as agreements to share information and other forms of collaboration. A strategic alliance is a common form of incomplete contract that defines a working manner, inter-firm relationships, standard inter-firm operating practices (for example, joint development of products and processes, just-in-time ingredient supply, timely product delivery, or cooperative advertising). This embedding of inter-firm relationships and

commitment to transactions through the use of informal contracts effectively mimics the vertical organisation of a single firm. Process standards can reduce costs as well as help to manage supply chain risk (Reardon 2009).

Contracting between primary producers and food processors is often controversial, especially in developing economies. Contracts are perceived as a means by which processors can leverage primary producers in terms of prices, products produced and production practices. That contracts will favour larger scale producers is also a commonly raised concern. There is evidence to support this claim. Stringer et al. (2009) found that for processors and packers in Shandong in China the scale of the supplier and distance from the packing plant were the most important attributes of a supplier. Carter and Mesbah (1993) studied fruit packing and export firms in Chile and found that over 80 per cent of product was sourced from larger farms. Reardon (2009) found that supermarkets in Mexico tended to source from large tomato growers. While Dawe (2005) found that while there has been a substantial increase in farm contracting in Thailand, small farmers were much less likely to enter into such arrangements.

Against the potential costs of contracting there are also potential benefits. Contracting has the potential to reduce the cost of food to producers through improved reliability and quality of supply and increase and stabilise returns to primary producers. Contracting can also provide primary producers with the financing needed to purchase farm inputs and the expertise needed to adopt improved production practices. Resourcing contracts, that generally provide direct access to inputs such as agrichemicals, animal feed, machinery pharmaceuticals and seed, may be of particular benefit to smaller farmers. Use of resourcing contracts is common with food processors and their use not limited to developing economies. Bivings and Ruunstant (2000) report on the use of resourcing contracts with small farmers for frozen vegetables in Mexico. ABARE (2005) reported the use of resourcing contracts between frozen vegetable processors with horticultural farms in Australia. These horticultural farms tended to be smaller than the average. Miyata et al. (2009) examined apple and onion packing and processing in China. How successful these types of contracts might be with specialised wholesalers and retailers remains to be seen. Processors and specialist exporters tend to source from relatively small geographic regions located near their processing facilities and would be more likely to have the expertise needed to manage farm level contracts.

The resolution of the issues associated with contracting in developing APEC economies would appear to a high priority in terms of increasing food security.

### ***1. Upstream regulation, standards and public information***

Reform of regulation in the agricultural sector can be important for the food processing sector. In developing economies the focus of reform may need to be on the creation of grading standards that will increase the efficiency of markets and on facilitating the distribution of market information. The focus of reform in developed economies will more likely need to be directed towards revising or removing outdated standards. This raises the issue of whether it is in the interest of developing economies to harmonise their standards with the standards that currently exist in developed economies.

Outdated grading standards tend to narrow choice for processors (Viatte and Schminhuber 1997). If existing quality measurement institutions provide an imperfect measure of the product quality preferred by consumers then price discovery becomes more difficult and transaction

costs may become higher as the link between product quality and payment is negotiated (Hobbs 2003).

The identification and measurement of individual product characteristics that affect both processing costs and the characteristics of processed food products is more likely to lead to reductions in costs and improvements in food quality. The development of such standards has been well established in a number of product markets, but adoption has been slow in a number of other markets.

Price reporting agencies have traditionally been an important information institution in commodity markets. However, as differentiation on the basis of quality is extended and supply chains evolve to be more vertically integrated, average price information either contains less information or is difficult to collect. This is because if actual quality is not equal to the measured average, then the average prices observed will not correspond to the quality actually being transacted – and hence are not useful as a source of information to reduce search and transaction costs for processors. Nor do average prices provide feedback to primary producers as to the benefits of improved quality. As a result, average price reporting institutions become less relevant when quality attributes vary among different supply chains (Hobbs 2003).

Ultimately it is a question of whether the costs of providing this price information are less than the benefits generated from the increased information symmetry, and whether governments can do it cost effectively. As processors are likely to be more able to pay for private information than primary food producers this issue is likely to favour more public reporting in developing economies where there are a large number of smallholder farms.

## **ii. Non farm inputs**

There are numerous industries that supply the food processing sector with non food inputs, including inputs such as: energy, manufacturing and construction, financial services, marketing services, research and development, health services, and human resources.

Non farm inputs that relate to intellectual or knowledge resources are important for development of comparative advantage and are used for product innovation, efficient production and distribution processes, and merchandising and marketing strategies. The importance of these inputs was discussed in the previous section on productivity.

Financial services and capital are an important input into the food processing sector. Openness to foreign direct investment is often an important source of capital in many economies, particularly in developing APEC economies.

Capital constraints can significantly increase the cost of food processing. Dawe et al. (2008) found that grain marketing margins in the Philippines were over four times greater than in Thailand, and that the largest contributing factor in the difference was the level of interest rates and services provided by financial institutions in each economy. Over the study period, 1994 to 1999, Thai millers and traders faced nominal borrowing rates of 4 per cent per year. In the Philippines the average rate of interest paid by traders and millers was 15 per cent, with many not borrowing from banks because of excessive paperwork for short term loans for working capital. Many traders and millers instead borrowed from moneylenders at a higher interest rate of 24 per cent per year. Lower interest rates lead to lower working capital requirements through

reduced costs of storage and investment capital requirements by lowering the effective purchase of trucks, buildings, sacks and milling equipment.

Part of the explanation for lower storage costs in Thailand than in the Philippines was that greater openness to trade allowed seasonal variation of supply to be absorbed by world markets, thereby reducing the volume of storage capacity needed.

#### **D. MARKETS FOR OUTPUTS**

Output from the food processing sector is sold to wholesalers and retailers for domestic consumption and to traders for export. In developing economies small and medium enterprises account for a large share of the processed food sector, however concentration is rising over time in developing economies (Sexton et al. 2007). In most developed economies the food processing industry is already highly concentrated.

Concentration in one part of the agrifood system can drive concentration in other parts as large processors prefer to deal with large suppliers to decrease costs and increase the likelihood of a continuous supply of inputs of consistent quality. Indeed, when the market structure of the downstream wholesale and retail markets is similar to the food processing sector, that is, it is characterised by concentration with firms possessing market power and not being price takers, the potential for food processors to exert market power is likely to be low. However, market concentration and market power in both sectors may not result in the neutralisation of the effects of market power. Instead, collusion may lead to worse outcomes with lower levels of production and higher prices. Somewhat surprisingly, increasing vertical concentration in the agrifood system, through vertical integration of the food processing and retail sector, may lead to decreased exercise of market power (Sexton et al. 2007). Vertical integration removes the effect of successive oligopolistic interactions that can result from horizontal concentration within each stage of the agrifood system.

Essentially the question of whether market power outweighs efficiency gains is an empirical question. Although there are many studies that note that the concentration of various industries in various economies is increasing, there is often no conclusion drawn as to the effect of increased concentration on prices. This general issue is discussed in Chapter 0 in the context of retail food markets. Often the results of studies are inconclusive, such as the results of two studies from the food processing sector the US:

- Lopez et al. (2002) conducted a study of 32 food processing industries in the US for the period 1972 to 1992 and found that although concentration induces cost efficiency in one-third of the industries, oligopoly power effects dominate cost efficiency or reinforced inefficiency in the remaining two-third of the industries, resulting in higher output price in most industries.
- Katchova et al (2005) conducted a study of oligopoly and oligopsony price distortion in the US potato processing sector, focusing on the potato chip and frozen french fries sector. They found that price distortion in the potato input market is lower than in the output market for potato chips and frozen french fries. The potato processing industry was found to be able to extract lower oligopsony rents from potato growers than oligopoly rents from either potato chip or frozen french fries consumers. The behaviour of potato processing firms was found to be closer to price taking than to collusion – with price distortion from oligopsony being lower than price distortions caused by collusion.

While a domestic market may appear to be concentrated, the exercise of market power is difficult if rivals can contest the market. An economy that is open to foreign direct investment can attract equity from a pool of international firms that have access to financial and knowledge resources that are needed to enter a new market. Moreover, openness to trade in processed food products will limit opportunities to exercise market power for less perishable goods such as cereals products and processed meat products.

## **E. KEY MESSAGES**

The key messages, in a developing economy context, are centred on the potential for increased productivity:

- The coordinated sourcing of inputs can generate substantial cost savings given the fundamental structural difference in scale between primary production and processing in developing economies. How food inputs are amalgamated from a very large number of farms, that are often remote, is critical and is putting pressure on cost savings that can be achieved by dealing with larger farms.
- Innovation is important to increasing productivity. Institutional arrangements to protect intellectual property rights are important especially in a manufacturing process context, but as consumers are becoming better educated and simply more aware, product branding is rapidly taking on a more important role.
- Health and safety standards are still important but branding is becoming even more important. Higher-end processors appear to benefit from higher standards and tighter enforcement as it pushes out low-end competitors. Improved safety will increase cost and consumers may initially need to become better informed of the benefits.
- The effects of agglomeration may be quite important in increasing food quality and safety while keeping costs down. As isolated efforts to increase quality and safety start to gain mass, agglomeration can reduce the costs of acquiring necessary inputs, resulting in a pool of quality knowledge and human resources. Governments in developing APEC economies may have an important role initially in promoting quality assurance systems and the adoption of better processing technologies.
- From a policy perspective, the key concern regarding market structure is the exercise of market power in upstream markets. However, at present this may be an isolated problem given the large number of agents in these markets attempting to source product for export, domestic processing, wholesaling and retailing.



## 6. RETAIL AND WHOLESALE FOOD DISTRIBUTION

In response to the sharp increase in food prices that occurred in 2008, a number of developed economies started inquiries into the operation of major food retailers and wholesalers to identify what role these multinational corporations were having on increasing consumer prices for food stuffs, as well as their role in potentially reducing producer prices. The underlying assumption preceding these investigations was that food retailers and larger supermarkets were gaining significant market power and utilising this market power to the detriment of both consumers and producers.

Part of the reason for this focus on market power in developed economies may be due to the extensive investments that have occurred to increase the scope and scale of operations and to improve vertical coordination. These investments have led to very substantial cost savings. In addition, these investments are largely fixed in nature and marginal returns to further investments are likely to be declining. As a consequence, market concentration and the exercise of market power appear to take on greater importance.

In contrast, the situation in developing economies lies on the other extreme, with investments to expand and increase the efficiency of food distributions systems just beginning. Returns to these investments in large markets with growing incomes and increased urbanisation are commensurately large. The relative influence of market concentration and the exercise of market power are likely to be small when contrasted to the costs saving generated by ongoing investment. That said, the exercise of market power in upstream markets, that ultimately affects primary food producers will be seen as a concern.

One of the key differences in developed versus developing economies is the difference in the way retailing and wholesaling has evolved and will continue to evolve. In developed economies, scope and scale of retailing and wholesaling has evolved at a pace that was, to a large extent, matched by changes occurring in agriculture. The rapid changes that are occurring in retailing and wholesaling in developing economies appear to be greatly outpacing the rate of structural adjustment in agriculture. While this outpacing in itself will create added incentives for structural change, it gives rise to a heightened perception that smallholder farms will face disproportionate adjustment costs. A second point is that a large proportion of the downstream participants in the agrifood system depend on traditional marketing channels such as wholesale markets. There may be a role for government to maintain access to these channels as other channels emerge and expand.

A question in developing economies is whether government should seek to remove any existing impediments to and potentially promote, through better infrastructure and planning, the introduction of modern large scale distribution systems. In part, this decision appears to have already been taken in a number of developing APEC economies. The second issue is the extent to which governments can facilitate structural change that will allow primary producers and consumers to participate in and take advantage of state-of-the-art food distributions systems. A third issue is the extent to which governments may need to intervene to upgrade traditional marketing channels.

IFPRI (2008) made the following recommendations in this context:

‘Governments need to supplement private efforts with public investments in improving farmers' access to assets, services, training, and information. Some of these assets are public goods, such as regulations on retailer-supplier relations to promote fair commercial practices, wholesale market upgrading, market information, and physical infrastructure such as cold chains and roads. Other assets are semi-public or private goods, such as assistance with market linkages between small farmer cooperatives and supermarket chains; training in postharvest handling; and credit facilities for making on-farm investments in assets needed to meet quality and volume requirements.’

## **A. WHOLESALING, WHOLESALE MARKETS AND RETAILING IN APEC ECONOMIES**

The primary functions of wholesaling and retailing are to provide consumers with food that meets their demands at the right time and in the right place. Many of the functions of wholesalers and retailers are similar. Products must be procured from primary producers and processors and consolidated for redistribution. Products need to be handled appropriately and stored to reduce losses and ensure food safety and quality. Both retail and wholesale markets serve an important role in passing information to food producers about changes in consumer demands.

### **i. Wholesaling and wholesale markets**

In developed economies the line between wholesaling and retailing is blurred. Large supermarket chains perform many of the functions of merchant wholesalers that purchase and redistribute product. Retail distribution centres have displaced wholesale markets (Chen and Stamoulis, 2008). Large scale wholesalers are aligned with large numbers of independent grocers, providing not only product but also market information services. Wholesale markets tend to more specialised. The roles of small wholesale merchants as well as wholesale agents and brokers (operating mostly on commission) have been declining (Kohl and Uni, 2002). Chen and Stamoulis (2008) characterise the shift in food distribution systems in developed economies as:

- Increased regional concentration in food production;
- Increased assemblage of product at shipping points as opposed to destinations;
- An expanded network of private distribution centres that optimise the movement of product from shipping points to final destinations; and
- Reduced importance of urban wholesale markets.

Chen (2004) points out that Japan has been slow to adopt this model and notes that urban wholesale markets accounted for 80 per cent of fresh produce movements in 2002. However, this is now starting to change and Chen estimated that this percentage would fall to 40 per cent by 2014. Korea has also retained urban wholesale markets with a large public wholesale market development program (FAO, 2001).

In developing economies the lines between retailing and wholesaling are distinct. Wholesale markets are the major distribution point for food. Large wholesale markets are supplied directly

by small farmers, aquaculturalists and fishers, as well as wholesale merchants. Buyers in wholesale markets include retailers and wholesale merchants that supply to retailers and food service providers. Large supermarket chains use wholesale agents and brokers (Huang, 2009).

In developing economies governments take on a much larger role in wholesale markets in terms of ownership and sanctioning. In part, this is a reflection of the quality assurance function that these markets are tasked to provide. These tasks may be formal or regulatory and informal. Inspectors – whether government inspectors or approved inspectors – check produce, fish and meat to make sure that it meets quality standards. The level of quality testing may vary between checking all products to sampling a selection. For example, in Viet Nam, all pork sold in government-sanctioned wholesale markets is stamped for quality acceptance. In China, sellers' produce is selected and their produce sample tested for pesticide and herbicide residues. Wholesale markets may also maintain lists of preferred suppliers as a means of quality assurance.

## **ii. Informal markets**

Informal wholesale or street markets are still a large part of the food distribution system in developing economies. These markets range from ad hoc establishments of road side stalls, to more permanent markets with individual stalls. The availability of products are seen to be more variable than large scale retailers, with quality assurance reported as the most important perceived difference between food sourced from larger retailers and that sourced from more traditional outlets (Figuie and Moustier 2008).

The higher prices of supermarkets and the reduced level of accessibility to supermarkets in the initial phases of large scale retail establishment were investigated in Viet Nam by Figuié and Moustier (2008). The results of their study indicated that low-income consumers were purchasing very little from the modern retailers, citing accessibility issues that include prices (fresh fruit and vegetables up to twice as expensive as traditional markets) and location (with limited transport options distance is a major factor in accessing supermarkets). Assuming that supermarkets continue their expansion, access to more traditional markets that provide the benefits of price, location and potential flexibility of credit options, will be important for low-income consumers during transition.

## **iii. Retailing**

Supermarkets have established themselves as the predominant means of food purchasing in the developed APEC economies, where up to 90 per cent of household food supplies are purchased (PECC 2006). Growth of supermarkets across the developing APEC economies has emerged more recently, beginning in higher income areas of Asia, including China, Thailand and Viet Nam. Localised expansion within economies appears to follow the same general pattern observed globally. That is, supermarkets tend to establish initially in larger, more affluent cities and urbanised population centres, then move on to middle income, medium sized cities, and finally into smaller, more remote townships. Big box supermarkets are being developed on the rapidly expanding urban fringe of large cities.

Increased demand for the services provided by supermarkets is associated with rising per capita income levels, urbanisation, increased access to private and public transport, and refrigeration facilities – allowing a change in the location and type of food shopping that is under taken – and female presence in the workforce (Reardon et al. 2003).

The introduction of supermarkets is associated with changes in the way food is purchased throughout the food supply chain (FAO 2004). These changes are characterised by:

- more centralised procurement systems;
- greater cross-border procurement;
- the emergence of specialised/dedicated wholesalers and logisticians;
- the use of preferred supplier systems; and
- the use of private standards for fresh produce that are usually more demanding than domestic standards and which invariably include a requirement for traceability.

International investment has been one of the greatest drivers of the increased prevalence of supermarkets and large scale food retailing services. In the decade following 1990, foreign direct investment across Asia and Latin America increased approximately 5 to 10 fold because of relaxed investment regulations. The growth in food retailing services in these regions also experienced similar, if not higher, levels of growth over this time (Reardon et al 2003).

Currently, the food retailing sector of the majority of developing APEC economies is experiencing exponential growth. In 2005, supermarkets accounted for 30 per cent of food sales in China, up from less than 1 per cent in 1992. Annual growth in supermarket food sales increased from an average of 20-30 per cent over the period 1998-2002, to 30-40 per cent average annual growth in 2003-04, and by 2012 supermarkets are projected to account for 50 per cent of China's food sales. In Indonesia, supermarkets are gaining large market share in processed and packaged goods, accounting for 45 per cent of dairy product sales, 64 per cent of canned goods sales and 88 per cent of pasta sales in 2004. A set of indicators for food retailing in a number of APEC member economies is presented in Table 9. These figures show the rapid increase in market share experienced by modern format food retailers over the period 1999-2006, with some economies experiencing a more than doubling of market penetration over 7 years. Mexico and Thailand stand out with growth rates in modern formats between 1999 and 2006 in the order of 150 per cent with an overall penetration rate of over 50 per cent.

**Table 9 Food retail market indicators, selected APEC economies**

	Population in 2005	Per capita GDP	Size of middle class		Penetration of modern format stores	Size of retail food market	Growth in sales of modern format 1999-2006
	Million	\$ per person	Million	% of pop	%	US\$ billion	%
Australia	20.1	28260	18.0	90	64.7	47	64
China	1306.3	4580	274	21	11.2	492	94
Indonesia	242.0	3230	36.0	15	30.4	31	107
Japan	127.4	26940	125.0	98	88.9	320	-17
Korea	48.6	16950	39.0	80	35.6	48	93
Malaysia	24.0	9120	10.0	40	71.0	3	105
Mexico	106.2	8970	40.0	38	57.0	96	144
The Philippines	87.9	4170	22.0	25	16.6	23	100
Singapore	4.4	24040	4.0	90	73.1	3	37
Thailand	64.2	7010	13.0	20	53.2	29	157
U.S.	295.7	35750	257.0	87	91.3	402	24
Viet Nam	83.5	2300	8.0	10	12.0	13	200

Note: GDP per capita based on purchasing power rates.

Source: PECC (2006), page 9.

## B. IMPROVING THE EFFICIENCY OF FOOD DISTRIBUTION

The general incentives that have driven, and are driving, the evolution of food distribution across APEC economies are similar. There is a common emphasis on:

- Improving methods of sourcing food with the aims of lowering transactions costs and increasing the ability to meet consumer demands for quality and range;
- Improving transport logistics that take advantage of improved infrastructure, reducing both direct costs and wastage, and increasing product quality; and
- Developing market formats that exploit larger scale logistics and handling systems and provide a greater range of consumer choice.

The challenge in developing economies is twofold. The first is to find an efficient way to integrate the changes in food distribution systems with the transition from traditional to modern primary production practices. The second is to keep pace with the rapid rates of urbanisation that are fundamentally changing the food distribution task. Food needs to be transported farther and into increasingly congested urban environments. The experience in China shows the problems that can occur with rapid urban growth. In Beijing, increasing traffic and the construction of new ring roads made access to wholesale markets for producers and traders progressively difficult. Markets constructed on the urban fringe, once heavily patronised, lost business as the city expanded (FAO, 2001).

**i. Wholesaling: a developing APEC economy focus**

According to FAO (2001), wholesale markets are an essential component of food marketing systems in most developing economies. Given the generally small scale of production, farmers need a direct point of access to the marketing system and a well-organised place where they can meet buyers.

Reardon (2009) highlights two phases of wholesale market development. First, the upgrading of wholesale markets by government to reduce transactions costs for small producers and improve the reliability of food supplies for urban consumers. The second and more recent phase has been to deregulate wholesale markets and allow greater entry and competition. This is important for the emergence of specialist wholesalers that supply supermarkets.

Given the level of dependence on traditional wholesale markets and marketing in developing economies, these services are set to continue to dominate the development of food distribution systems in developing APEC economies. The most rapid expansion in the number of wholesale market has occurred in Asia, particularly in China. Following the liberalisation of the marketing system, wholesale produce markets have been established in every major Chinese city and town (FAO 2001). In China, Malaysia and Thailand, wholesale markets will remain the primary means of distribution for fresh produce, largely because of a lack of marketing infrastructure in production areas (Chen, 2004).

Chen and Stamoulis (2008) ask whether traditional wholesale markets will continue to be central to this role as retailers and processors look to more direct forms of procurement. They raise the issue in the context of government policy and the need for public support to maintain wholesale markets and the link between smallholder producers and the downstream marketing chain. McCullough et al (2008) see this as a need to publicly upgrade the traditional marketing system. They note that while better functioning traditional market systems are of benefit to processors and retailers, they are likely to realise significant savings by bypassing traditional markets. This may isolate not only primary producers but smaller processors and retailers that do not have the scale of operations to bypass traditional wholesale markets.

Chen and Stamoulis (2008) point to problems in wholesale markets that suggest the upgrading of traditional markets will require significant investments and the adoption of modern handling practices. They state that the lack of cold storage and long exposure of produce to ambient temperatures is a substantial problem, along with the use of poor packaging materials and the extensive use of manual labour. They cite that 60 percent of fresh produce in China is lost between harvest and final delivery to consumers.

The need for government support of the wholesale market system in developing economies is not a foregone conclusion, at least in the longer term. There are many examples of alternative systems existing. Thailand has the most diversified wholesale market ownership and management structure among developing APEC economies, with wholesale markets being owned by the Government, cooperatives and the private sector. The largest wholesale market in Thailand is the privately owned Thailand Thai Market in Bangkok. At the same time, public investment in wholesale markets is not limited to developing economies (FAO 2001). Korea has made extensive investments in public wholesale markets. This may, in part, be due to the desire to preserve traditional farming practices.

There is evidence that private wholesaler markets are seeking to source products from larger scale producers. Dirvan and Faiguunbuam (2008) found that wholesale markets in and around Santiago in Chile tend to source most of their product from large scale farmers. There are wholesale markets in China that maintain a business registration program for smallholder farms with the aim of facilitating and increasing the scale of their operation and reducing the number of small consignments moving through the market.

There have been substantial changes in the role of market intermediaries in food distribution in developing APEC economies – with this trend likely to accelerate. Closer links will be formed between retailers and processors to increase the level of coordination of marketing activities as food leaves the boat or the farm gate. Chen and Stamoulis (2008) state:

‘there has been a huge increase in the number of privately and publicly owned fruit and vegetable distribution centres or companies that link small farmers to modern retail and service outlets. There is a growing use of specialised wholesaler and distributors specialised in a product category and dedicated to the supermarket sector’

This does not imply that the role of urban wholesale markets will become irrelevant, but rather that their function will become more integrated. Chen and Stamoulis go on to note that Thailand’s largest wholesale market has six specialised wholesalers that supply supermarkets.

## ii. **Retailing: a developing APEC economy focus**

Reardon et al (2008) set out four pillars that underpin the increased efficiency or productivity of modern retailing as it is being implemented in developing economies:

- The centralisation and regionalisation of procurement;
- The use of specialised wholesaling and logistics;
- The use of preferred supplier systems; and
- The establishment of private standards.

The cost savings associated with the centralisation of procurement through distribution centres that service a large number of retail outlets is what is driving the expansion of supermarket chains in developing APEC economies. This part of the model differs little from what has occurred in developed economies globally. The other elements of these pillars support the basic model but require adaptation to align with other elements of the food production and distribution systems in developing economies.

Regionalisation of procurement to a large extent implies that it is more efficient to source food from a concentrated point of production and then distribute over a greater distance. That is, it is less costly to arrange with a group of farmers within a region to produce a particular product or limited range of products than it is to source a wide range of products that are near to final destinations. The reasons for this are relatively clear, it allows the more efficient use of marketing infrastructure and transport and reduces the time it takes to bring fresh produce to customers.

There are implications for the way primary production must be organised. Farms that specialise in producing a single product to a particular standard may become more efficient. However, they may need to achieve a level of scale that allows them to generate enough income to no longer consume a large proportion of what they would have otherwise produced. Local regions that produce only a limited range of crops may become vulnerable to relatively large scale shocks due to poor weather conditions or the outbreak of a disease. Initially it may be difficult for low income producers to manage these risks, and governments may need to consider whether safety net policies should remain in place. There may also be some concern that lower-income producers will accept these risks without the ability to manage them in the longer term. However, retailers and other downstream participants have incentives to maintain continuity of supply and to help in managing the risk.

Major international food retailers will generally only expand into fresh fruit and vegetables once they have established stable supply networks with trusted producers, and developed a clientele that is willing to purchase these products at prices that are recognisably higher than the traditional markets.

Reardon et al. (2008) state that specialised wholesalers source both domestic and imported products that meet the specific needs of retail chains, cutting transactions cost and enforcing quality standards. However, one cannot escape from the issue that there are a very large numbers of small farms per capita in developing APEC economies. This suggests that there will still need to be a large number of intermediaries involved in the consolidation of product that meets a particular quality standard.

Huang (2008) conducted a survey of farms outside Beijing and found that despite changes to the urban retail sector and the fresh produce wholesale sector, little had changed at the farm gate. In Beijing, supermarkets source the bulk of their produce from the wholesale markets. The thousands of small wholesalers and brokers in those markets source from thousands of small farmers. Huang noted that in China, this function is to a large extent undertaken by agents on commission.

To the extent that the structural adjustment needed to increase farm scale continues to be slow in many developing APEC economies, the expansion of supermarket chains will be impeded. It may also lead to more regional supermarket chains. Reardon et al note such an expansion of regional supermarket chains in China. However, intermediaries have a strong incentive to acquire the specialised knowledge and skills to match changing and growing demand and supply and are likely to find innovative solutions to sourcing problems.

The third pillar, the use of preferred suppliers, also seems to be a reflection of the large number of small suppliers and the emergence of specialised wholesalers. A list of preferred suppliers is a form of informal contracting. Large scale wholesale markets, such as the Shanghai Agricultural Wholesale Company, maintains a list of preferred suppliers and takes on the liability for products provided by those suppliers. A preferred supplier might then be a larger scale farmer, a farm cooperative or another intermediary. Put another way, efficient procurement is about a very extensive network of intermediaries and suppliers that are linked, in large part, through informal as opposed to contractual agreements.

An interesting question is the extent to which being on a preferred supplier list might give producers or intermediaries lower cost access to financial resources. If this were not the case



then there may be the need to facilitate the creation and enforcement of contracts within the marketing network.

The final pillar is about setting private food standards that exceed public standards of food quality and safety. Supermarkets set private food standards to manage supply costs and risks through the chain of procurement, amalgamation and transport. These often take the form of processing standards as opposed to product standards.

Process management is linked to the use of specialised logistics firms (such as those that provide cold storage and transport) that have their own concerns for brand recognition and protection. These firms are often multinationals that bring expertise to support multinational retailing and food preparation firms or joint ventures.

In addition to providing high quality products to domestic consumers, the strict standards of international food retailers provide the opportunity for domestic producers to supply export markets. For example, the Dutch retail company Royal Ahold entered a joint venture with the Central Retail Corporation in Thailand in 1996 (Buurma and Saranark 2006) with a mandate to transform the Thai supermarket chain TOPS into a high quality food retail outlet. Strict quality assurance programs were developed, including a certification process and the establishment of a preferred suppliers list. While the introduction of this program resulted in a reduction in the number of small holders that were included in the supermarket supply chain, those suppliers that were included gained international accreditation for the quality of their products. Prior to the venture, many Thai food products were unable to access export markets (especially in the European Union), and had high rates of rejection at points of export (Reardon et al 2008).

### ***1. Importance of foreign direct investment and trade liberalisation***

The expansion of international food retailers in many developing economies has been heavily reliant on acceptance of foreign investment opportunities by these economies. Limited access to foreign investment has the effect of placing a constraint on the level of possible domestic investment, as well as introducing a price premium as scarce domestic funds are competed for by a number of industries. In addition, insulated capital markets preclude greater diversification of investment risks, resulting in a further cost premium on the cost of capital. Apart from making more funds available, foreign direct investment is also usually accompanied by the transfer of expertise from foreign lenders to domestic borrowers in areas of procurement and inventory management.

Despite limited data and definitional issues, a tentative conclusion of recent research is that openness of an economy to trade and freer flows of international investment have a significant positive effect on the growth of supermarket shares beyond the effect of increased per capita income and urbanisation (Gaiha and Thatpa 2007). Traill (2006) conducted an econometric projection of supermarket penetration rates in various economies using as explanatory variables economic openness, per capita income, urbanisation rates and other indicators such as female workforce participation and income ratios. Supermarket penetration rates were projected to 2015. Results for China and Mexico are presented in Table 10. While the relative size of the openness indicator is not constant, there is a positive effect of openness on the rate of supermarket penetration.

**Table 10 Projections of the spread of supermarkets to 2015**

<b>Economy</b>	<b>Actual share 2002</b>	<b>Income effect 2015</b>	<b>Urbanisation effect 2015</b>	<b>Combined effect 2015</b>	<b>Openness effect 2015</b>
	%	%	%	%	%
China	11	15	16	23	27
Mexico	45	55	44	54	61

Source: Traill (2006)

Historical observation provides some support to the estimates of supermarket penetration rates and the role of foreign direct investment. Since China's accession to the WTO in 2001 there has been a significant increase in the rate of expansion of supermarkets and foreign investment in the Chinese retail food and distribution market. In the nine months following China's accession it was reported that the majority of new stores opening around the economy (24 of 28) were large scale supermarkets (Hinhua News Agency 2002). Fierce competition between major supermarket chains within China was also attributed to greater openness to international investment and operations, resulting in lower profit margins than elsewhere in the world.

### **Communications and operational systems**

Modern developments in supermarket operations systems were observed in the 1990s. These included the use of processes to reduce the amount of inventory held onsite and the prevalence of electronic and internet based inventory tracking and ordering systems. In addition, increased efficiency at the distributional level, with the establishment of large-scale, single, regional distribution systems to reduce ordering, transport and distribution costs throughout the food supply chain. Following the introduction of these systems in developed economies, multinational retailers turned their attention to introducing these systems to their operations in developing economies in the 2000s. A system of mimicry by those in domestic chains worked to expand the use of modern systems in developing economies (Reardon et al 2003).

### **Labour standards**

Issues with labour standards in developing economies are often raised in developed economy forums. Working conditions, hours and pay are important factors for the image of western companies in most industries. There have been reports that some multinational food retailers in developing economies impose stricter guidelines for the treatment of employees than is required by governments, as well as policing the application of these and other guidelines (for example, in relation to corruption) within the operations of their suppliers (Hahm 2008).

### **Competition with small and medium size domestic enterprises**

Multinational food retailers have a number of advantages over domestic retailers in developing economies, including:

- Access to lower-cost funds, greater equity levels against which to borrow and potentially cheaper credit options;
- Best-practices operations and proprietary information systems; and
- Greater sourcing options through established procurement channels.

However, this is not a unique problem to retailing. Economies have broader programs to support the access of small to medium sized enterprises to resources and technology in order to, for example, develop niche markets. This issue is discussed in Chapter 0.

## 2. *Upgrading traditional retail markets*

The arguments for upgrading traditional retail markets are similar to those made for traditional wholesale markets. While supermarkets may offer lower prices and a wider range of products, people living in remote locations or in highly congested urban areas may not have access to supermarkets and so traditional retail markets are the primary source of food purchases. A major issue in upgrading traditional retail is the large number of small operators dispersed through large and often developed urban areas. Regulations are likely to prove difficult and costly to enforce.

It should not be assumed that competition in traditional markets does not create a strong incentive to maintain food quality and safety as it would be difficult for vendors to maintain a business without repeat customer. However, vendors still face the problem of producing a greater range of quality food products at affordable prices.

Public investment to facilitate competition by traditional markets has been implemented in a number of East Asian economies (Reardon and Gulati 2008):

- Hong Kong, China has implemented a policy of “managing and facilitating change” whereby government assistance is given to modernise traditional markets to prevent their demise, Singapore has a similar policy of “cherish but upgrade and modernise”;
- Many policies are encouraging relocation of traditional markets to fixed locations where hygiene practices and tax collection may be improved as well as providing increased infrastructure to market operators; and
- Hong Kong, China and Chinese governments are experimenting with privatisation of traditional retail markets, improving the institutional arrangements around their operation and providing a profit motive.
- The need to maintain traditional retail market channels while trying to improve food quality and safety is a common problem for many developing APEC economies. It is an area where shared policy experience may inform the extent of the problem faced and options for addressing it.

## **C. MARKETS FOR INPUTS – INCREASING THE EFFICIENCY OF PROCUREMENT**

Increasing the efficiency of food procurement is perhaps one the largest food security challenges faced by developing APEC economies. This challenge starts, and largely finishes, at the farm gate. Developing APEC economies have made substantial investments in improving roads, opening avenues for foreign investment and joint partnerships, and gaining access to state of the art logistics and marketing technologies. This does not diminish the task of sourcing product from a large number of widespread and often remote producers that have limited financial reserves and relatively low education levels.

Reardon et al. (2008) reviewed a number of studies showing that non-land assets of smallholder producers are crucial to be able to take advantage of modern food industry channels. Berdegue et al. (2008) showed that strawberry farmers in Mexico needed to demonstrate investment in crop-specific farm equipment to meet the requirements of processors. Milczarek-Andrzejewska et al. (2007) reported that some dairies in Poland needed to have on-farm cooling tanks before milk producers would invest. To access supermarkets, fresh tomato growers in Indonesia need irrigations facilities and access to roads (Natawidjaja et al. 2008). Supermarkets charged wholesalers with engaging only farmers with such assets.

From these examples it follows that governments may need to explore options to facilitate the access of smallholder producers to the production and marketing assets they require.

### **i. Marketing carriers and cooperatives**

Chen and Stamoulis (2008) note that small farmers are organising themselves into a range of entities called carriers that allow them to compete with larger suppliers. These include private companies, quasi-government agencies, non government agencies, farmer associations and cooperatives. Chen (2005) provides some examples of carriers formed in Shandong in China to export fresh produce to Japan. McCullough et al (2008) pointed to cooperatives as an effective means of pooling investments and information. Bijman et al. (2007) provides a comprehensive discussion of cooperatives in China.

The largest problems faced by cooperatives are, first, to ensure that cooperative marketing strategies are aligned with the requirements of downstream markets as opposed to the short term interests of members. The second is the problem of free riders. Bergdque (2001) found that a large proportion of the cooperatives formed in Chile in the 1990 went bankrupt because they could not manage these problems.

The two problems are not unrelated. Cooperatives that are formed to increase bargaining power by controlling supplies are open to free riders and are not aligned with meeting the demands of modern procurement systems. However, managing incentives within a cooperative more generally can be problematic and it needs to be supported with appropriate institutional arrangements. If a cooperative has a contract with a wholesaler or retailer, individual members may still have an incentive to sell into other channels when the opportunity arises. The quality assurance provided by a cooperative may be undermined by individuals who perceive there is a high enough probability that an inferior product will escape detection.

Government based marketing orders are used in the US to attempt to address these types of problems. Marketing orders provide an enforceable set of regulations for industry members and oversight of potential issues of market power should they arise. However, compulsory membership is heavy handed in that it does not allow for a cost-benefit evaluation of the institutional arrangements even by members. Alternatively if a cooperative is successful, membership is a valuable asset and opens up the potential for self regulation.

### **ii. Contracting**

There may be an advantage for smallholders to become specialised providers of produce for a given supermarket chain or specialised wholesaler. This specialisation allows the establishment of economies of scale or the use of specialised labour. The logistical and transport costs for

wholesalers and retailers may be lower when many smallholders in a particular region are producing similar products.

The existence of contractual agreements can connect output and credit markets, solving what Reardon (2009) refers to as an idiosyncratic market failure faced by smallholder farms in terms of access to finance. Where there are contractual obligations in place, banks and financial institutions are more likely to provide financing for expansion and upgrading facilities. This, in turn, allows for smaller and medium-sized land holders to improve their efficiency, quality and reliability of production (through the use of fertilisers, irrigation practices and packaging and handling facilities). These benefit both producers and wholesalers (Swinnen and Maertens 2006).

Some smaller scale producers perceive that the risk of specialising to supply a large scale retailer or wholesaler is lower than diversifying to supply traditional markets despite potential price and production risks (Reardon et al. n.d.).

Contracts for outputs can also serve to provide price incentives for product quality and safety that are not found in traditional market channels, as shown by Natwdijaja (2008) in Indonesia.

When specialist wholesalers and retailers attempt to source products directly in developing economies they face another problem of scale. There are a very large number of small producers. Initially transactions costs may be low as there will be a number of larger scale producers located near adequate infrastructure. However, transactions cost will increase as when it becomes necessary to contract with more marginal producers.

In the near to medium term it is more likely that intermediaries will fill this function with informal contacting. It is common for agents to source products on behalf of supermarkets. In China agents acquire and sort products and receive a commission based on the volume of product delivered that meets the supermarkets quality standards (Huang, 2009). However, in the longer term, direct contracting with primary food producers is likely to play an increasingly important role as it has in developed economies.

The establishment of commercial contracts in developing and transitional economies suffers from a number of problems, mainly associated with the enforceability and policing of commercial agreements. The advancement of regulatory controls in contract negotiation and contract enforcement will obviously improve the working of these markets and the inclusion of smaller and medium land holders<sup>14</sup>. As farm sizes increase and or producers make greater use of marketing cooperatives the potential for contracting will increase.

### **iii. Infrastructure**

Market accessibility is obviously a critical factor in developing economies and efficiently operating food markets. Where suppliers have poor accessibility to consumers and vice versa, the level of competition, pricing arbitrage and even innovation is exceedingly limited. In the extreme, poor transport infrastructure can result in rural areas operating in autarky, having to manage food availability and pricing issues within the region.

<sup>14</sup> It is noted that even in developed economies there are complaints that such idealistic regulatory and contractual protection do not exist, given the relative market power of large scale food retailers (see submissions from the Australian Competition and Consumer Commission grocery price inquiry).

Poor infrastructure and isolated farming areas present a major hurdle to the development of isolated rural economies as well as to the expansion of large scale food retailers. With positive social implications (such as increased integration of rural communities and economies with urban centres) and business profitability (through lowering of transport costs and increased access to domestic producers) there is an opportunity for reducing the costs of procurement for retail and food processing while helping to meet the policy objectives of reducing rural policy and improving access to services.

Partnerships could evolve through shared funding of road expansions and upgrading of facilities that benefit both private food retailers through reduced transportation costs and access to new supply areas, and developing economies more generally through increased integration of regional and rural areas.

#### **iv. Training and extension programs**

Food safety and quality concerns are often acute when considering fresh and even processed food products from developing and transitional economies. These concerns are raised in the developed world when considering sourcing and eating cheaper food products and can have a damaging effect on the growth of food export markets in developing economies.

With the private profit motive driving food retailers to maintain internationally recognised safety and quality standards to protect their brand, there is an opportunity for governments to facilitate and further expand the use of best practice (or at least better practice) production and handling processes within the domestic farming sector. Such a joint program would allow for extraction of benefits by private companies through the use of preferred contractors, as well as potentially at an economy-wide level with greater international recognition of safety and quality standards of exported food products.

Such a joint public private partnership would build on spillover effects of education in the farming sector (for example, observation of project operations) and economies of scale in training programs targeting a region or farming community. Opportunities would exist to upgrade human capital in traditional marketing channels for food processing, wholesaling and retailing. Improved handling would reduce waste and improve food security and quality for those unable to access changing market channels.

### **D. MARKETS FOR OUTPUTS AND INPUTS – WORKABLE AND OTHER MODELS OF IMPERFECT COMPETITION**

The question of whether the dominance of supermarket chains in retail food distribution has given rise to the excessive use of market power and higher food prices to consumers has been an ongoing and a much contested issue in developed economies for number of years. The sharp rise in food prices that occurred in the latter half of 2007 and the first half of 2008 heightened the intensity of the debate.

The priority, as opposed to the importance, of introducing competition policy in developing economies is even harder to judge given the limited amount of empirical analysis that has been done. Most of the information in developing economies relates to market penetration by supermarkets. However, increasing market concentration is not in its own right a cause for competitive concern. While there are dangers of simply extrapolating the experience of APEC developed economies, the approach taken here is to conduct a case study on some key findings

regarding supermarkets and retail competition in Australia, Canada and the US (see following section i). These findings are then placed into a developing economy context.

**i. Case study: Supermarkets and retail competition in Australia, Canada and the United States**

The key policy question that needs to be addressed is whether the increasing importance of supermarkets in retailing has, or may, lead to excess profits. That is, whether large retailers are able to raise prices without losing customers and hence increase prices above long run marginal cost. If so, the empirical questions put forward by Wen (2001) is whether these returns are the results of successful product differentiation (such as increased quality, safety or a greater range of supporting services) or whether there is market power in retail or upstream markets and does this arise from:

- Concentration of sellers or buyers;
- Longer term barriers to entry due to vertical coordination; and/or
- Bilateral monopolies between retailers and processors or other participants along the food marketing chain.

Wen (2001) also sets out three empirical approaches that have been used to address these problems:

- Structure, conduct, performance (SCP) models which attempt to link measures of market structure such as concentration to, for example, a typical basket of prices or firm profits;
- New industrial organisation (NIO) models that use theoretical and game theoretic models of competition to establish testable hypotheses that would imply the presence or absence of market power. These models attempt to examine how the behaviour of one firm influences another; and
- Vertical restraint studies that attempt to examine whether vertical relationships are primarily to reduce costs or to impede competition. These studies tend to focus on specific market activities such as payments by manufactures to retailers to carry new products.

SCP is a useful starting place as it is linked to observable market structures and is closely aligned to what is seen as an acceptable or workable definition of competition in a food marketing context. Kohls and Uni (2002) outline these principles from a US perspective. In summary:

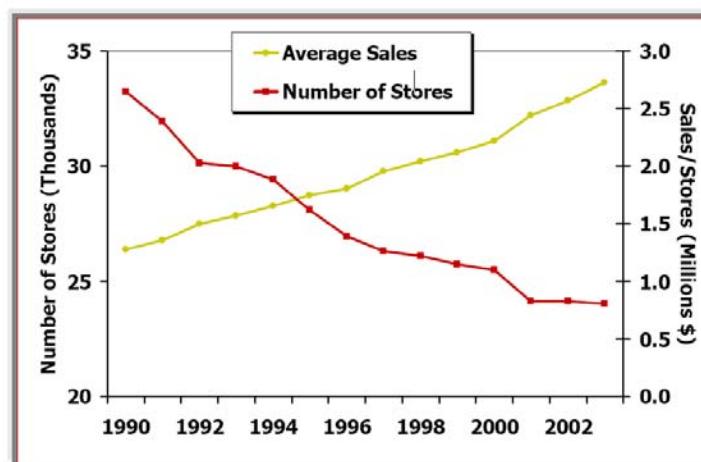
- There should be an appreciable number of buyers and sellers, so many that no individual firm may have an effect on market outcomes but that buyers and sellers have real choices;
- No one firm should have the ability to coerce other market participants to take a position in the market which is not to their advantage;
- Firms should not be in a position to ignore factors that influence the profitability of upstream supplies or the welfare of consumers in the longer term;

- Entry and exit should be free enough to allow rivals to contest each other for markets;
- Buyers and sellers should have access, unimpeded by factors other than cost, to other buyers and sellers; and
- Rival firms should not be able to collude to achieve the non competitive outcome implied by the points above.

The level of retail food market concentration in developed economies has given rise to a popular concern that there is not an appreciable number of rivals in retail food sales. The Australian Competition and Consumer Commission (ACCC, 2008) in its final report on an inquiry into the grocery market in Australia stated that one criticism of Australia's grocery retail market is that it is too concentrated with regular statements being made by industry commentators that the two largest retailers control too great a share of the market. The report went on to state that the market share of the four largest food retailers in Australia was 70 per cent, a level the ACCC saw as concentrated but not a structural issue that warranted reform.

Concentration in food retailing in Canada is on a par with Australia. Supermarkets account for about 80 per cent of food retailing. The top five supermarkets had about 60 per cent of the total market in 2005 (Zafiriou, 2005). The trend toward increasing concentration in Canada was associated with a decline in store numbers and increases in sales revenue per store as seen in Figure 15.

**Figure 15 Retail food marketing in Canada**



**Note:** From Zafiriou 2005

**Data source:** Statistics Canada and Agriculture and Agri-Food Canada

Overall concentration in the United States is less than in Australia and Canada with the top five food retailers holding a combined market share of about 35 per cent in 2005. However, this is partly a reflection of the overall size of the US market. At the regional level greater concentration is evident. Agriculture and Agri-Food Canada (2008) has conducted a number of international retail concentration studies in the US. These studies were conducted at regional and city levels. In the south central states of the United States (Arkansas, Kansas, Louisiana, New Mexico, Oklahoma and Texas) three chains accounted for 52 per cent of the retail grocery market sector in 2004. The state of Texas has approximately 22 million people and similar



transport demographics to Australia with the top three supermarket chains accounting for 60 per cent of the supermarkets.

The two largest cities in the Pacific Northwest of the United States are Seattle in Washington and Portland in Oregon. Seattle had a population of about 570 000 in 2004. Supermarkets accounted for around 84 per cent of the retail grocery market sales. The top two supermarket chains accounted for 52 per cent of the market and independents accounted for 13 per cent of the market. Portland had a population of about 533 000 in 2004. Supermarkets accounted for around 80 per cent of the retail grocery market sales. The top two supermarket chains accounted for 55 per cent of the market and independents accounted for 12 per cent of the market.

It is of interest to note that concentration levels in the United States appear to be quite similar at a regional and metropolitan level.

Agriculture and Agri-Food Canada (2007) also examined retail food concentration in Hong Kong, China and Japan. Supermarkets are expanding their market presence in Hong Kong, China growing from 61.2 per cent of retail food sales in 1999 to 69 per cent in 2004. Supermarkets in Hong Kong, China are also expanding their range of products and one-stop shopping alternatives. They are also offering a greater range of convenience items. Two firms, Wellcome and PARKnSHOP, account for 80 per cent of supermarket trade.

Retailing in Japan is highly constrained by store format restrictions. Nevertheless, large scale 'hyper' markets are the most rapidly expanding food retailing format, albeit from a low base. Supermarkets and convenience stores are expanding slowly and independents are declining. Supermarkets and independent grocery stores account for 53 per cent of retail food trade. Within this segment, supermarkets account for 82 per cent of the market and independents 18 per cent.

### *1. Concentration versus market power*

Market concentration may be a prerequisite for firms to be able to exercise market power, but the level that is sufficient is open to question. Even if concentration were sufficient, firms may not exercise market power for reasons that extend beyond regulation. While the number of rival supermarket chains may be limited in a given region, large international regional chains based in other areas have the scope and scale required to contest almost any geographic market. Concern would arise if supermarket chains that lack a domestic or regional presence do not have the knowledge and skills to enter a given region.

The literature on the effect of concentration on food prices is mixed. In Australia, Walker (2006) found that in Melbourne prices were higher where there were a fewer number of retail food outlets. However, Smith (2006) concluded that:

“The structural characteristics of the grocery industry are conducive to market concentration and it is often assumed that as a consequence there is a competition problem. However, given the presence of two national supermarket chains that appear to be competitive with one another, it is not evident that this alone gives rise to a competition concern. Indeed, consumers may be net beneficiaries. “

Again in Australia, Griffiths (2004) noted that the empirical literature does not provide any specific indications about whether increasing concentration in food retailing adversely affects farm suppliers. Beare and Szakiel (2009) found that there was very little geographic concentration or clusters of individual supermarket chains in Queensland. That is, rival chains tended to compete for locations that were adjacent to competitors.

Wen (2001) provided a detailed review of the literature in North America (Table 11).

**Table 11 Is there market power in food retailing?**

<b>Approach</b>	<b>Studies Indicating Market Power</b>	<b>Studies Not Indicating Market Power</b>
SCP	Cotterill (1999) Marion (1998) Binkley and Connor (1998) Farris and Ailawadi (1992)□ Cotterill (1986) Marion et al. (1977, 1979a,b) Lamm (1981) Hall, Schmitz, and Cothorn (1979)	Kaufman (1999)* Connor, Rogers, and Bhagavan (1996) Kaufman and Handy (1989) Newmark (1990)
NIO	Schroeter, Azzam, and Zhang (2000) Kadiyali, Chintagunta, and Vilcassim (2000)	Park and Weliwita (1999)
Vertical Restraint	Bloom, Gundlach, and Cannon (2000)	Sullivan (1997) Mixon and Upadhyaya (1996) Sass and Saurman (1993)

**Source:** Wen (2001)

**Note:** NIO is New Industrial Organisation, and SCP is Structure, Conduct, Performance. Both are approaches to measuring market concentration.

Aside from the obvious conclusion that the empirical evidence is mixed, Wen set out a number of reasons why the problem of establishing whether there is market power in food retailing is difficult. In SCP models it is difficult to tell if the relationship between market prices and concentration is the result of attempts to secure a market advantage, the costs of supply or market demand. In NIO the problem is largely with the fact that the theoretical model relates directly to firm behaviour but what is observed is aggregate market behaviour. To put it simply, our inability to demonstrate whether or not there are empirically supported claims regarding market power should not be confused with whether the problem itself is significant and would warrant further investigation. However, it should not be understated that excess profits, which are at the heart of competitive concerns, attract competition.

## **ii. A developing economy context**

While the types of data used in the studies cited are difficult to find for many developing economies, and in most cases are not collected, government and international agency reports have stated that the expansion of large scale food retailers in many developing economies has resulted in reductions in food costs, improvements in safety and quality and increased accessibility to a diversity of food products (PECC 2006).

This may be a reflection of where the move to modern retailing systems in developing economies has started from. It is clear from Table 9 and Table 10 that the level of penetration of supermarket formats in developing APEC economies will continue to be well below that seen in developed APEC economies. What has been achieved to date also needs to be seen in the context of what the wide scale adoption of the supermarket format will imply for the agrifood systems in developing economies more generally. What can be learned from early adopters can be difficult to apply on an economy-wide scale.

Nevertheless, the benefits of the shift to vertically integrated systems are being felt. Continued incentives to expand will see expansion of supermarkets and supporting procurement systems. The importance of monitoring and regulating competition is likely to become more important.

Motta (2004) defines competition policy as a set of policies and laws aimed at ensuring that competition in the marketplace is not restricted in a way that is detrimental to society. The need to clearly articulate and implement such policies and laws with respect to retail food markets is perhaps not an immediate priority for developing economies. There may still be a considerable opportunity to draw on international experience in developed economies and to adopt a considered approach that draws on what has been learned. In part this is because competition policy has evolved with a legacy of patchwork reforms to address problems that emerged largely in the practice of competition policy. A second reason is that competition policy needs to be placed into a developing economy context, that may be forward looking in the context of where food distribution systems are moving toward but still reflect what are unique institutional and cultural considerations and constraints.

It is also important to note that concerns regarding market power and food prices in developed economies are unlikely to have the same weight in developing economies. The discussion in Chapter 0 of this report shows why food price increases in developing economies have a larger proportionate effect than in developed economies. Chapter 4 highlighted the need to maintain smallholder producer incomes. Maintaining a workable level of competition in developing economies is likely to be more important than in developed economies where food demand is more strongly driven by factors such as convenience, nutritional standards and varieties.

## **E. KEY MESSAGES - POLICY SETTINGS FOR FOOD DISTRIBUTION**

The incentives to reduce final consumer prices and improve product quality originate in the wholesale and retail food distribution sectors. These incentives are transmitted to other parts of the chain. The key messages are:

- That larger scale retailing and demand for product and services to conduct these operations are in place and expanding in growing economies in the developing APEC region.
- Wholesaling, including the activities of agents who work on commission as opposed to direct purchase, is likely to remain the primary point of contact between primary producers and downstream consumers. Wholesaling in developing economies is highly competitive. This is, in part, because of the large number of intermediaries needed to source food products from such a large number of widely dispersed producers.

- The expansion of multinational food retailers into developing and transitional economies presents both large opportunities and policy challenges for food markets in these economies. Governments of developing economies may have initially adopted a cautious approach to their expansion. However, the movement towards modern food procurement and distribution systems seems set to accelerate.
- The private profit incentives of specialist wholesalers and large scale retailers may not align with higher level economic objectives of preventing the isolation of small rural farm holdings from the domestic food market. Given the relatively large proportion of farmers in developing, transitional and middle income economies, the rapid expansion of major food retailers and the corresponding move toward a smaller number of larger scale farms could potentially result in an extended and costly adjustment phase where small scale, poorer land holders are excluded from the domestic food market and need to find alternate places in the economy. Low-income consumers in urban areas may be disadvantaged if they lose access to well functioning traditional market channels.
- Producers will need to adapt to procurement systems that require greater volumes, increased quality of food products and greater levels of accountability. This will be achieved through increased production volumes and improved marketing from the farm gate. The balance between the two will largely be a reflection of how quickly agriculture is able to structurally adjust.
- The need to upgrade traditional wholesale and retail market channels is still a very relevant consideration to avoid isolating small producers and disadvantaged consumers. However, the transition to modern food distribution systems is likely to disenfranchise a significant number of people. Smallholder producers that are no longer viable will become more dependent on the food distribution system. The need for safety net programs to assist those with poor access to secure food sources may decline overall but there is likely to be an increased need for such programs in rural areas.

## 7. TRANSPORT AND STORAGE

### A. FOOD TRANSPORT

Food transport has many common features with the transport tasks of other sectors of the economy. However, the agrifood system has a number of specialised transport needs:

- Food production tends to be geographically dispersed through regions dominated by a single or limited number of food products;
- The transport task is varies from season to season; and
- Products are often bulky, perishable and may require specialised equipment, as for example, with live animals or milk.

There are a number of ways in which improved food transport can increase food security. Some of these rely on improved infrastructure. Improvements to road and other transport networks allow larger load per vehicle which, in turn, increases the efficiency of transport. Centralised transport hubs support a greater use of containerisation. Some of these improvements rely on technological innovations, such as real time monitoring of truck performance and fuel consumption. Improved loading practices, better containers and improved refrigeration can reduce wastage and damage. Improved logistics also improve capacity utilisation.

The largest differences between developing and developed APEC economies in terms of the transport task are that developing economies have:

- A greater level of geographic dispersion in food production, often in remote areas with poor transport infrastructure;
- A smaller stock of refrigerated trucks and specialised livestock carriers; and
- Larger, more densely populated urban areas with highly congested transport infrastructure.
- In addition, the rate at which transport infrastructure, particularly road transport, is being expanded is much faster in emerging APEC economies – this, in turn, is creating incentives to rapidly modernise transport logistics.

In developing economies, the evolution transport systems can reshape food marketing. In developed APEC economies, increased efficiency of food transport is important but gains in these economies tend to be incremental.

### B. FOOD STORAGE

Food storage occurs at every level of the food marketing chain, from farms and fishing vessels to households. Storage may be in ambient temperatures, chilled or frozen, in vacuum containers or under gas – depending on the product and the infrastructure available. One of the largest differences between the agrifood sectors of developing and developed APEC

economies is in food distribution systems and the level of investment in storage infrastructure throughout the agrifood system. Improved storage facilities can substantially reduce wastage and improve food quality and safety. From a food security perspective the policy question is whether private sector investment will be adequate to meet food reliability needs.

Governments may wish to pursue policies to increase food storage so that the reliability and quality of food supplies is increased. Economies that are net importers may elect to expand storage infrastructure at port facilities. Economies that are net exporters may elect to expand regional storage facilities that are well situated with respect to transport infrastructure.

However, it is not just a question of whether there is adequate storage of corn, rice and wheat to meet staple food requirements due to shortfalls in domestic and world food production. The following are also important:

- do farms have adequate storage facilities to hold stocks to wait for better prices?;
- do processors have adequate working inventories to avoid disruptions to input supplies?; and
- do wholesalers and retailers have access to cold storage facilities to maintain food quality and safety.

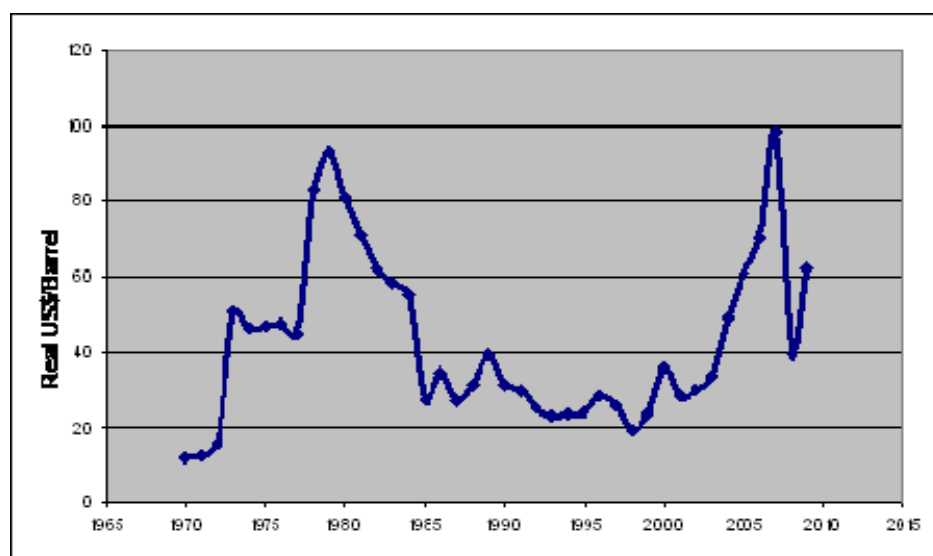
It is important to identify where private incentives for storage are inadequate.

### **C. TRANSPORT AND TRANSPORT INFRASTRUCTURE**

While high fuel prices and transport bottlenecks have been cited by the FAO and the UN as an important contributor to the global food crisis in developing economies, there is little detailed information on food transport costs in developing economies.

In the US, Kohls and Uhl (2002), reported that in 1997, long distance food transport costs amounted to nearly 100 dollars per person, per year, on average. Penn State University (2005) estimated that transport costs, exclusive of labour, account for about four per cent of the consumer's food dollar (with off farm labour accounting for about 37 per cent of each dollar). Transport's share of consumer food expenditure in developing economies may be even higher given differences in wages rates, even though the overall transport task is not as great.

Transport costs are strongly linked to world prices for oil which have been volatile over the past 40 years (Figure 16).

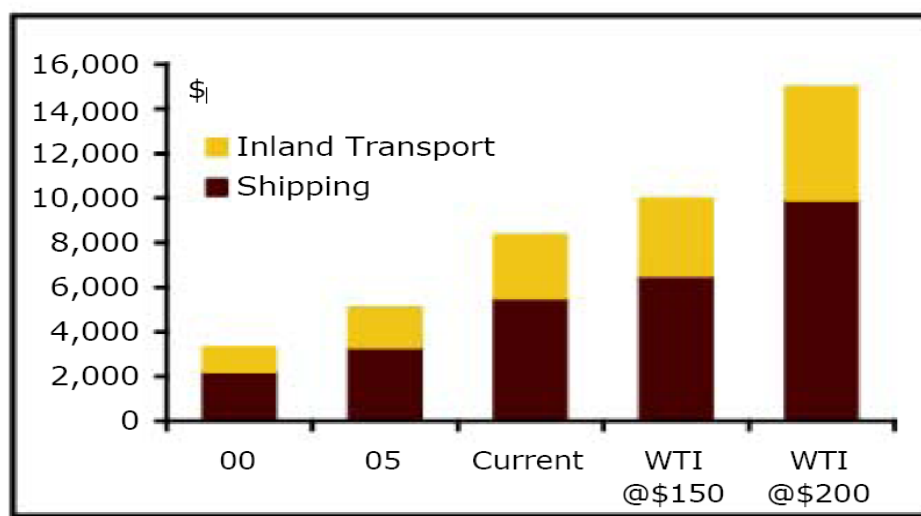
**Figure 16 Retail US oil prices**

Data source: Forbes 2009

Ruben and Tal (2008) estimated that when oil prices reached their peak in 2008, fuel prices accounted for 50 per cent of transport operating costs and that a US\$1 increase in the price of oil would increase the cost of freight by one per cent. Extrapolating this relationship to the Penn State University and Kohls estimates, the recent oil price peak of about \$US120/barrel would have increased the transports cost to more than eight per cent of the US consumer dollar for food. Long distance transport costs in the US would have been in the order of \$400 per person, per year, on average.

Expectations about fuel prices in the longer term will have a significant influence on food security strategies. Sustained increases in oil prices will shift the comparative advantage of local and imported products. This is a driver of both international and inter-regional trade. Higher transport costs will favour domestic goods that are produced more closely to their final destination. It also implies that reliance on trade to maintain the reliability of food supplies is a more costly option. The cost of shipping a standard 10.6 metre container from Shanghai to the east coast of the US at different oil prices is shown in Figure 17. Since 2000, the costs have roughly tripled. With a \$US150 oil price, the increase would be about fivefold.

For economies that are net food importers or net importers of important food commodities, increased fuel costs will lift import parity prices. For exporting economies increased fuel costs reduce export parity prices. A widening gap between import and export parity prices will mean that efficient domestic food production and marketing will be an increasingly important determinant of domestic food prices in trade exposed economies. The same would be true for regions within an economy.

**Figure 17 Transport costs for a standard container from Shanghai to the US east coast**

**Note:** Current date corresponds to June 2008, WTI is world trade weighted index price of oil in US dollars

**Data source:** From Ruben and Tal (2008)

Increased productivity in transport, both domestically and internationally, is fundamental to both lowering average food prices and creating greater security of supply. In addition to the upgrading of transport infrastructure, the adoption of more efficient transport technologies and coordination of transportation across jurisdictional borders, both within economies and between economies, can significantly decrease the cost of transportation.

#### **i. Transport productivity**

There are few, if any, market-based impediments in accessing new transport technologies. The adoption of these technologies does require, or will at least be facilitated by, a well-integrated transport policy. The policy issues rest primarily in two areas:

- Transport planning, regulation and public expenditure; and
- Transport coordination across regional borders.

In order to assess the potential gains from increased productivity of the transport sector on the food sector the general equilibrium model, GTAP, was used to simulate the long run impact of a one percent increase in productivity on the transport sector in APEC economies. The efficiency gain was simulated by increasing the efficiency of capital used in transport under the following conditions:

- Fixed total availability of labour and rate of return on capital;
- Mobile labour and capital between sectors of an economy; and
- Limited mobility of land and other fixed resources between sectors of an economy;

The increase in productivity has two key effects. First, it lowers the cost of distributing inputs and outputs (thus lowering their price). Second, it increases income and therefore increases the



demand for food and other goods. This increase in the level of goods and services demanded is offset, at least in part, by the reduction in the cost of delivering goods. However, both the effect on the price of food and other consumption goods and the effect on income will in turn increase the affordability of food.

The simulations were restricted to those APEC economies with relatively large transport sectors. The results of the simulations are shown in Table 12. In the developing economies, the combined effects of income growth and falling prices is substantial in Chile, China, Peru, the Philippines and Thailand – with income growth ranging from 7 per cent for Chile to 2 per cent in Peru, with average price falls of 2 per cent. The effect is moderate to small in the balance of the developing APEC economies. This may, in part, be due to the productivity shock being applied to capital, and that transport may be less capital-intensive in these economies. It should also be noted that the GTAP model database is derived from national accounts data that are more difficult to collect in developing economies. In the developed economies with extensive transport systems, income growth ranges from 1.3 per cent in the US to 3.0 per cent in Australia, while price falls of around 0.5 per cent. The gains are higher in Japan and Korea. While the scale of the transport task may be relatively small in terms of distance, the transport task itself is costly due to high population densities. Overall, the results suggest that the efficiency gains in developing economies are greater than in developed economies.

**Table 12 The effect of a one per cent increase in transport efficiency in selected APEC economies**

Economy	Real GDP	CPI
	%	%
Australia	2.8	-0.5
Canada	2.0	-0.6
Chile	7.0	-3.1
China	4.7	-0.5
Indonesia	2.4	-0.3
Japan	3.1	-1.3
Korea	3.6	-1.0
Malaysia	1.3	-0.3
Mexico	0.1	-0.1
New Zealand	2.5	-0.6
Peru	2.0	-1.2
Philippines	5.1	-1.9
Thailand	4.1	-1.4
US	1.3	-0.4
Viet Nam	0.3	-0.1

## ii. Increasing the productivity of transport infrastructure and services

The demand for transport infrastructure can be considered in two contexts. One is the demand for particular infrastructure investments, such as a major highway or a rail link. The second is based on the need for a coordinated network of transport services, including seaports, rail and road.

Lee and Hine (2008) emphasise the need for having an economy-wide transport planning strategy. They set out a framework for the issues that need to be clearly delineated:

- Institutional
  - The respective roles and limits of government and the private sector in developing and operating transport infrastructure and services;
  - The respective roles of central government, other levels of government, and public authorities;
- Planning and investment
  - The economic, environmental, planning and safety criteria that are used to prioritise public investments in transport infrastructure;
  - Controls over private and foreign investment;
- Regulation
  - The role of regulation, and what regulatory or licensing controls should be imposed over transport infrastructure and service operations;
  - The enforcement of regulations in a way that is effective, minimises costs to transport operations, and eliminates or reduces corrupt practices;
- Pricing and cost recovery
  - The level of cost recovery for public infrastructure investments required; and
  - The principles that should govern tariff setting for publicly and privately owned transport infrastructure and services.

Estache and Ginés de Rus (2000) state that the most common justification for public provision of transport infrastructure is to ensure that people have access to markets. They also note that the provision of transport services by governments is the ultimate form of regulation and is often associated with excessive costs and services that do not meet the demands of users. They point to the increasing importance of private sector investment.

Lee and Hine (2008) emphasise that a move toward more competitive markets changes the role of government from one of providing infrastructure and services to one of monitoring and regulating the performance of other service providers to secure the interests of users and the general public. The move to more competitive markets can be facilitated by separating the government functions of planning, regulating, coordinating and monitoring from the functions of developing and operating infrastructure or services. More autonomous agencies and enterprises can manage publicly-owned commercial assets more efficiently and can ultimately facilitate the transfer of these assets to a regulated private sector.

### ***1. Transport planning, investment and regulation: A developing economy focus***

High transportation costs can result from difficult terrain, poorly developed infrastructure and capital constraints limiting market participants' access to transportation equipment.

Dawe et al. (2008) found that higher marketing margins for rice in the Philippines compared to Thailand was, in part, explained by higher transportation costs. Trucks in the Philippines tend to carry rice in trucks that are 70 per cent full, compared to in Thailand where trucks travel full

most of the time. The underutilisation in the Philippines appears to be due to a very high number of marketing agents that makes it difficult to optimally coordinate transportation. Additionally, trucks in the Philippines tended to have half the load capacity of the trucks used in Thailand. This is because large trucks are impractical in the Philippines because the quality of roads is considerably worse than in Thailand, with roads having more potholes, passing through more urban areas and having fewer lanes. Transportation labour costs were also higher in the Philippines despite a lower hourly wage. This was because the use of smaller trucks travelling at less than full capacity increased the per ton labour cost of grain hauled.

Higher transportation costs may discourage market integration. Higher transportation costs may also be a factor in sustaining buyer market power because they deter farmers from seeking selling opportunities beyond their immediate location or from integrating into downstream markets by transporting their own production to central markets (Merel et al. 2009). This enables local buyers to remain attractive to primary producers even though they may offer a price that is lower relative to what is offered by distant buyers or is available in central markets.

Investment that reduces the cost of transportation may lead to intensified competition between traders and offer overall benefits that are greater than the direct effect on transportation costs. The optimal level of transportation investment due to competition effects may be greater than the optimal level of investment due to the direct cost reduction effects on the cost of transportation. The effect of transport cost on competition, the initial value of transportation costs and the efficiency of transportation technology are important determinants of how great the competition effects of transportation infrastructure investments will be (Merel et al. 2009). In the development of the fresh fruit industry in Chile, access to international distribution networks seems to be one of the most important benefits of foreign direct investment (OECD 2008). In terms of technological transfer, the presence of foreign direct investment helped facilitate the adoption of the most recent technologies. Foreign direct investment also played a role in infrastructure investment and the quality of public services – including transportation systems, logistics systems and communications services.

### **Logistics and multimodal transport**

Improved transport infrastructure drives and supports improved logistics and more efficient use of multiple transport modes. Food distribution logistics in developing economies is about improving the connection between geographically dispersed production regions and an increasingly urbanised population and making the best use of existing transport capacity through, for example, the use of supply and distribution centres and the efficient selection and movement between transport modes. Modes with high fixed costs but low variable costs, such as rail and sea freight, have a comparative advantage over long haul road trucks, but this must be weighed against the costs of transferring product to and from these modes. A short example is provided in Box 7.

**Box 7 Multimodal transport in Viet Nam**

A recent study in Viet Nam found that multimodal transport and logistics services were in their infancy, as in many other developing economies. Customers were not fully aware of their benefits; they focused on reducing transport costs but did not realize that higher-quality, more reliable transport would open new markets, improve export prices, reduce losses and damage to goods and enable reductions in inventory costs. Operators of individual services did not see themselves as part of an integrated logistics chain. Multimodal transport services were mainly provided by freight forwarders; with only a few specialized third party logistics providers. New and revised laws governing trade, customs, competition, investment, enterprise reform and management of transport modes provided a better facilitating environment, but their implementation mechanisms had shortcomings.

Efficient multimodal services could be established under existing laws but modal laws and regulations (governing road, rail transport and so on) needed updating and there were inconsistencies and overlaps in existing regulations. The study recommended placing all regulations governing multimodal transport in a new decree and gave guidelines to help ensure consistency in policy on matters affecting multimodal transport and the economic regulation of individual modes.

Source: Ministry of Transport and World Bank

**iii. Developed economies: Public investment in transport infrastructure**

Positive returns and improved food security from public investments in transport infrastructure are not limited to developing economies. They have been and will continue to be an important avenue to reduce the cost of food and improve the reliability of food supplies for all economies. See Box 8 for an example from Canada and the following case from Australia.

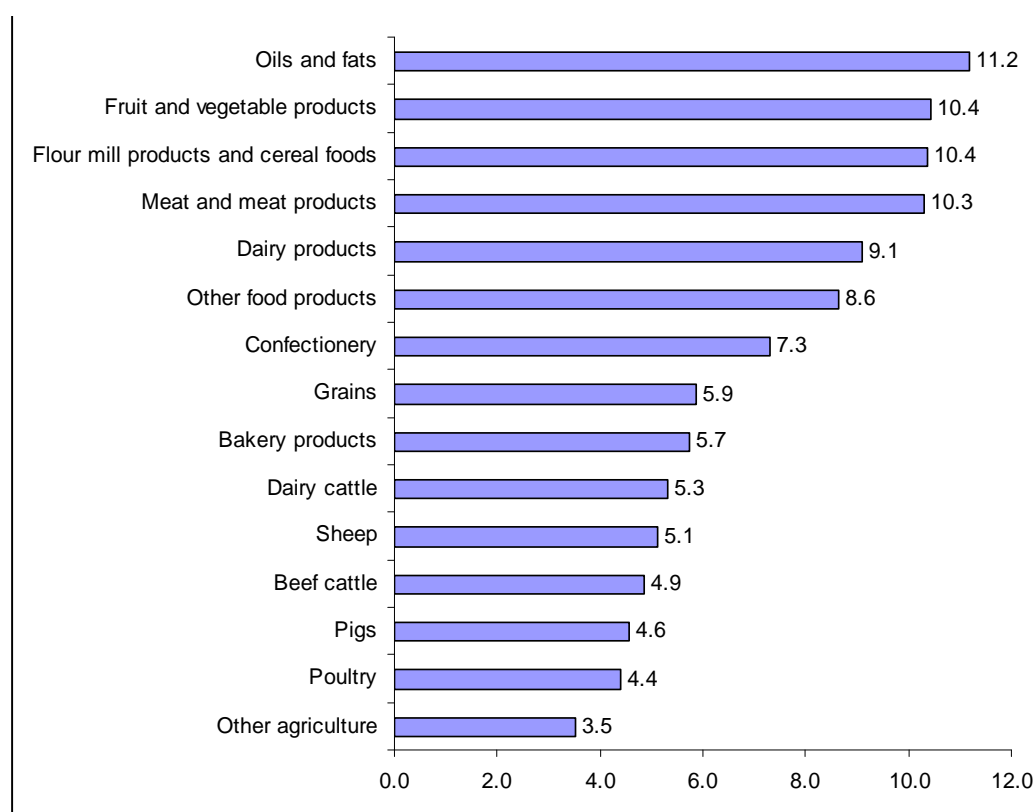
**Box 8 Returns to public infrastructure in Canada**

Bernstein and Mamuneas (2008) conducted a study of Canadian food processing to measure the effects of public infrastructure provision on production techniques, the cost of production and productivity growth of Canadian food processors. Over the period 1964 to 1996 levels of public infrastructure investment were found to reduce the cost of food processing in Canada, in particular, by decreasing the requirements for labour and intermediate inputs. Although the cost reduction is modest – a one per cent increase in public infrastructure was found to decrease production costs by 0.16 per cent – Canada has a relatively high accumulation of public infrastructure capital and hence the growth in infrastructure investments is expected to be greater in developing and transition economies that have much lower accumulation of public infrastructure capital.

Investment in public infrastructure capital reduces production cost as inputs are more effectively transformed into outputs, which subsequently enhances productivity performance. Indeed, Bernstein and Mamuneas (2008) found that public infrastructure capital was a major contributor to total factor productivity over the study period – contributing an average annual of 0.5 percentage points to total factor productivity growth in Canadian food processing.

**1. Case study: Livestock transport in Australia**

As noted by the Australian Productivity Commission's Chairperson, 'efficient freight transport is vital for Australia's relatively small, trade-dependent economy, especially given [its] geography and widely-dispersed population and industry' (Banks 2006). Reflecting this widely-dispersed population and industry, transport plays a major role in the production of Australia's output and particularly agricultural products and food products (Figure 18). Almost 80 per cent of these transport requirements are supplied by the road transport sector.

**Figure 18 Total requirements of transport used to produce food products (\$/\$100 final demand 2003-04)**

Inefficiencies in the provision of road transport services can impose significant impediments to the efficient production of agricultural commodities and food products within Australia. As noted by the Australian Livestock Transporters Association (2006) in a submission to a Productivity Commission inquiry into road and rail pricing, such inefficiencies can result from so called 'non-price barriers' including:

- the failure of some state governments to adopt best-practice regulation of road users; and
- the failure, at all levels of government within Australia, to provide appropriate infrastructure, mainly roads, that would allow the efficient transport of agricultural commodities.

These non price barriers to efficiency could significantly add to the price of food products in Australia because modern livestock transport vehicles require more advanced road infrastructure to operate because the vehicles are heavier, longer, may have slower acceleration from a standing start and require a greater area to undertake turns (Blanksby et al. 2008). However, where the required road infrastructure is available modern multi-combination vehicles offer substantial improvements in the transport efficiency of livestock.

Woolnough and Zeitsch (2008) compare the productivity gains of the following combinations:

- B Double, which has the equivalent of three decks of carrying capacity for cattle;
- B Triple, which has the equivalent of four decks of carrying capacity for cattle; and

- BAB Quad, which has the equivalent of six decks of carrying capacity for cattle (see Box 9).

A distinguishing feature of these trucks is that the prime mover pulls more than one trailer using a ‘B coupling’ to link the trailers. The coupling allows the second trailer to sit on a turntable fixed to the lead trailer. Because the following trailer is directly coupled to the leading trailer, the stability, braking and overall road performance of B coupled trailers are far superior to other long truck combinations such as a road train.

B Doubles and B Triples can operate in areas where a road train could not operate. For example, B Doubles and B Triples can operate in some built up regional centres enroute. They improve the productivity of livestock movements with only a marginal reduction in fuel consumption.<sup>15</sup>

To demonstrate the scope of the productivity gains, the number of trucks required to transport 1000 steers, each weighing 475 kilograms, 1000 kilometres was evaluated. During the estimation<sup>16</sup>, it was assumed that:

- Each steer had available to it the floor area specified in the Australian standards for the land transport of animals (Animal Health Australia 2008); and
- The gross weight on each axle or group of axles did not breach maximum weights specified for vehicles operating at ‘higher mass limits’ in New South Wales. The maximums were six tonnes for the steer axle, 17 tonnes for the drive axle and 22.5 tonnes for a tri axle.

It is estimated that it would take approximately eleven B triple truck movements to move the 1000 steers, as opposed to 21 movements for a six axle articulated truck. The total factor productivity of the B triple operation to move the steers was 40 per cent higher than the total factor productivity of the six axle articulated trucking operation.

However, a case study undertaken by the Australian Livestock Transporters Association as part of its submission to the Productivity Commission inquiry into road and rail pricing indicated that road infrastructure was not sufficient to support B triple operations to an abattoir in Dubbo in New South Wales. The main impediments were found to be:

- inadequate length of turning lanes so that multi combination vehicles could not exit a road without holding up traffic following the truck;
- short merging lanes;
- low bridge heights; and
- insufficient line-of-sight for multi combination vehicles to undertake turns without disrupting traffic.

<sup>15</sup> The Australian Trucking Association estimates that the fuel required per 100 kilometres for a 6 axle articulated truck, B Double, B Triple and BAB Quad (all operating at so-called ‘higher mass limits’) are 50 litres, 65 litres, 72 litres and 85 litres respectively. See Australian Trucking Association (2009).

<sup>16</sup> The calculations were undertaken using Livestock load planning software. See Woolnough and Zeitsch (2008)

If the identified impediments could have been removed it was estimated that inbound livestock transport costs could have been reduced by 5 per cent per year. Also, because many of the truck movements identified in the study took place with trucks operating at less than 'higher mass limits' it was estimated that inbound livestock transport costs were raised by a further 10 to 14 per cent. Overall, inbound livestock transport costs were estimated to have been 15 to 19 per cent higher than they would otherwise have been. This was equivalent to an increase in the ex-works cost of meat products of around one per cent (Australian Livestock Transporters Association 2006).



**Box 9 Sustained improvement in Australia's livestock transport fleet**

6 axle articulated trucks introduced in the 1980s can carry up to 48 steers weighing 475 kilograms



B-doubles introduced in the 1990s can carry up to 72 steers weighing 475 kilograms



B-triples introduced in the early 2000s can carry 96 steers weighing 475 kilograms



BAB Quad introduced in the early 2000s can carry 144 steers weighing 475 kilograms



**iv. Coordination of transport system across regional and international borders**

Coordination of transport systems across regional and international borders is important for reducing the cost of food transport. The APEC forum can play a facilitating role in this regard. The need for coordination extends across all modes of transport. However, the coordination of cool transport is perhaps most challenging.

In June 2009 the East West Economic Corridor – an upgraded highway between Viet Nam and Thailand that passes through Laos – opened under the Cross Border Transport Agreement (Asian Development Bank 2009). This agreement between Viet Nam, Laos and Thailand now allows trucks to transit the three economies without having to unload cargo at border crossings for reloading. This will reduce delivery times and reduce the cost of food transportation (including the duration of refrigeration from shorter transit times) and decrease wastage. Under the Cross Border Transport Agreement some loads can be certified as ‘low risk allowing these loads to be fast tracked at border crossing checkpoints (container seals will be accepted for the duration of the transit route).

Also in June 2009, a railroad agreement aimed at linking 28 economies in Asia and Europe came into effect (UN 2009). The Intergovernmental Agreement on the Trans-Asian Railway Network, facilitated through the United National Economic and Social Commission for Asia and the Pacific, will create a railway network comprising 114,000 kilometres of rail routes linking 28 economies in the region. Aside from reducing cross border transportation costs, it is expected to significantly reduce the cost of shipping exports for landlocked economies by providing improved access to major ports.

China introduced a ‘Green Corridor’ program in the 1990s. The program was designed to reduce cost but also to reduce travel times for perishable food products by eliminating local charges for road vehicles. A brief case study on the ‘Green Corridor’ program is contained in Box 10.

**Box 10 The Green Corridor Program in China**

China's government launched the Green Corridor for Fresh Agricultural Produce initiative in 1995. The initiative was designed to facilitate further economic growth in the agricultural sector, to increase farmers' income, and to provide stable supply of fresh vegetables and fruits to major cities from major production areas, such as Shouguang County of Shandong Province and the southern island of Hainan Province. Under the program, governments involved in the network do not charge toll fees, or if they do, charge discounted rates to vehicles carrying agricultural products.

By the end of 2007, China's Green Corridor program encompassed a 45,000 kilometer road transport network to facilitate the transportation of fresh agricultural produce, including fresh vegetables, fruits, aquatic products, livestock, meat, eggs, and milk. Based on the domestic highway network, the network has expanded its connections to China's 29 provincial capital cities and 71 major prefecture cities. Some provinces have also opened regional Green Corridors based on the domestic highway network and regional transportation networks.

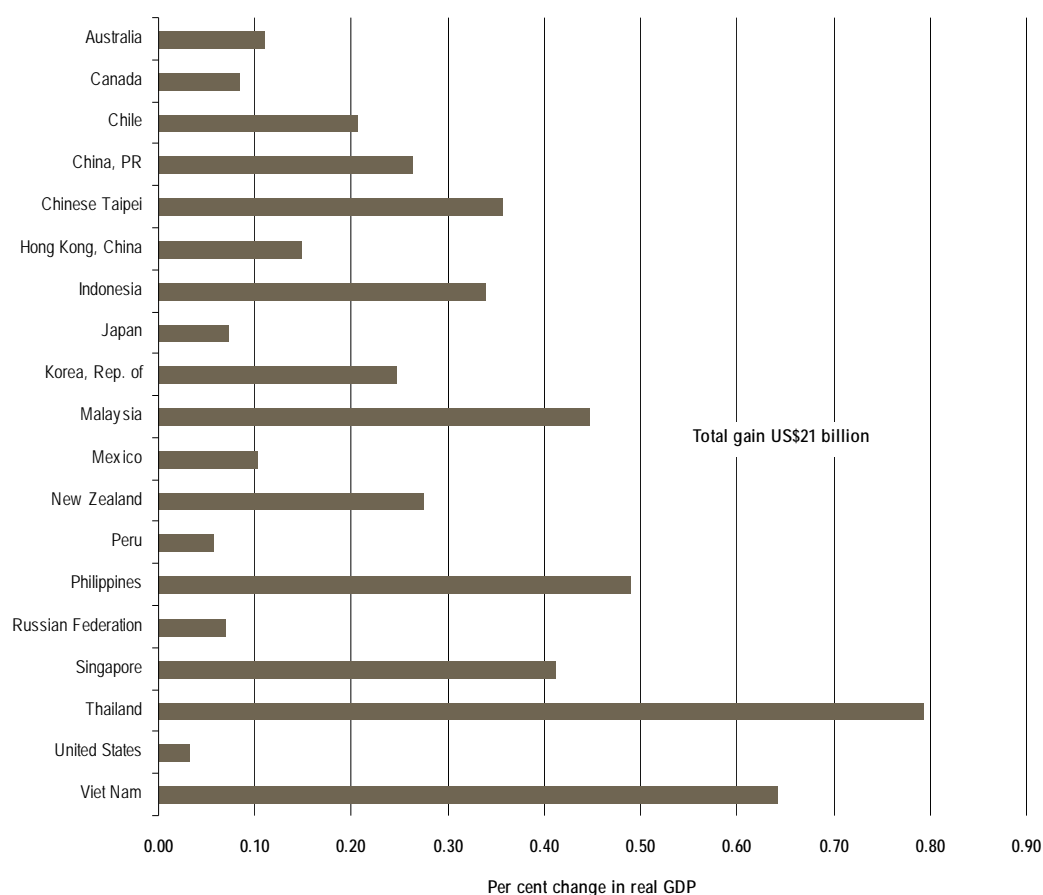
According to the State Council of China, more than 9.5 billion RMB of toll fees were waived in 2008 alone (Xinhua News Agency 2008).

**1. Supply-chain connectivity**

Supply chain connectivity is focused on the transitional movements of food and food products from producers to consumers. This can be the movement of grain from farm to storage facilities, from storage to rail or inland barges or from ships through port facilities. It includes not only the movement of physical product but also inspection and certification systems and the creation and exchange of documentation.

CIE (2009) estimated that a 10 per cent increase in across-the-border supply chain efficiency or connectivity would have substantial benefits for a number of APEC economies. The estimated benefits for selected APEC economies, expressed as a percentage increase in GDP, are shown in Figure 19. The largest benefits are in developing APEC economies, regardless of whether they are net food importers or exporters. CIE noted that some of these benefits would be the result of behind-the-border improvements to, for example, port handling. More importantly, the benefits would be substantially higher if behind-the-border increases in supply chain connectivity were considered.

**Figure 19 The impact of a 10 per cent increase in across the border supply chain connectivity**



**Note:** Figures are based on 2004 GDP estimates.

**Data source:** CIE 2009.

## D. STORAGE

Storage plays a number of roles in the food marketing system. They include:

- Working inventories – that assist in maintaining high levels of capacity utilisation, prevent disruptions to supply and, from a consumer point of view, provide convenience and choice;
- Seasonal stocks – that reflect the seasonal variation in availability and the need to distribute product for consumption throughout the year. Seasonal stocks are not confined to primary food products, a number of processed products, such as canned fruits and frozen vegetables, are produced on a highly seasonal basis;
- Carry-over stocks – stocks held over from one growing season to the next (generally limited to grains and oilseeds that can be stored in bulk at relatively low cost);
- Arbitrage or speculative stocks – stocks held privately in anticipation that that price rises will more than compensate for the physical and opportunity cost (the time value of foregone revenue) of holding stocks;

- Buffer stocks – stocks that are held and liquidated to either stabilise prices or to smooth shortfalls in production; and
- Strategic stocks – stocks that are held to avoid the cost of major disruptions to food supplies.

Changes in stocks may be involuntary, arising from unanticipated differences in demand and supply or voluntary as with speculative and strategic stocks.

Khols and Uni (2002) note that it is very difficult to know how much food is stored on farm, along the food marketing chain and by consumers in the US. They cite estimates of civil defence studies that found there was a five to seven week food supply in the food marketing chain. During extended droughts, Australian industries and governments have found it difficult to determine the level of feed grains stocks that should be held domestically. This makes the risk of speculative stock holding high and the assessment of strategic stock requirements difficult. Estimating stocks in developing economies is likely to be even more problematic.

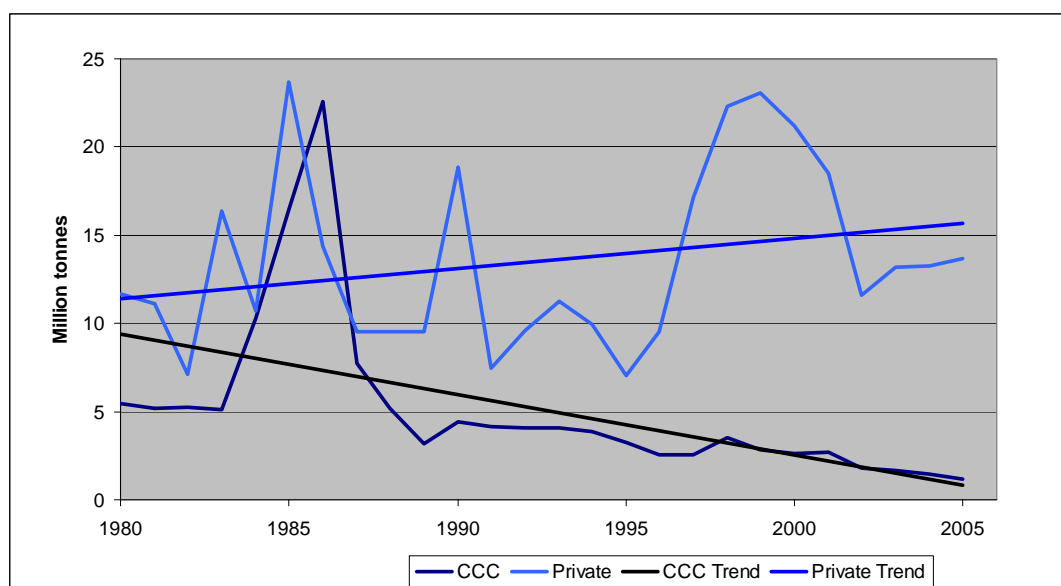
Despite this problem, it is important to assess the extent to which private stockholdings or stockholding by governments in large grain producing economies are adequate to ensure food security. Government stockholding is considered first.

#### **i. Government stockholding**

Stockholding by governments in food exporting APEC economies, outside the US, has been limited and stockholding by the US government has declined over the past two decades. The majority of public stocks in the US have been held by Commodity Credit Corporation (CCC), which, for the most part, operates as a buffer stock scheme. CCC wheat stocks are shown in Figure 20. The massive accumulation of stocks that occurred in 1985 led to a shift in policy away from price stabilisation and toward direct payment to farmers. CCC stocks have continued to decline gradually since that time. The general trend in CCC stocks is downward.

To some extent a decline in public stockholding will be replaced by private stockholding. This is especially the case when public stocks are accumulated and liquidated in response to price – as with a buffer stock scheme. Private or free wheat stocks are also shown in Figure 20. The general trend is upward and offsets the reduction in CCC stocks. The accumulation and liquidation of strategic stocks will be correlated to demand and supply and will displace some level of stockholding. However, given that desired stock levels are set in the context of managing severe, as opposed to moderate, imbalances in demand and supply, the displacement of private stockholdings may be less – so long as market participants understand the governments' strategic goals and stock management strategies (Williams and Wright, 1991).

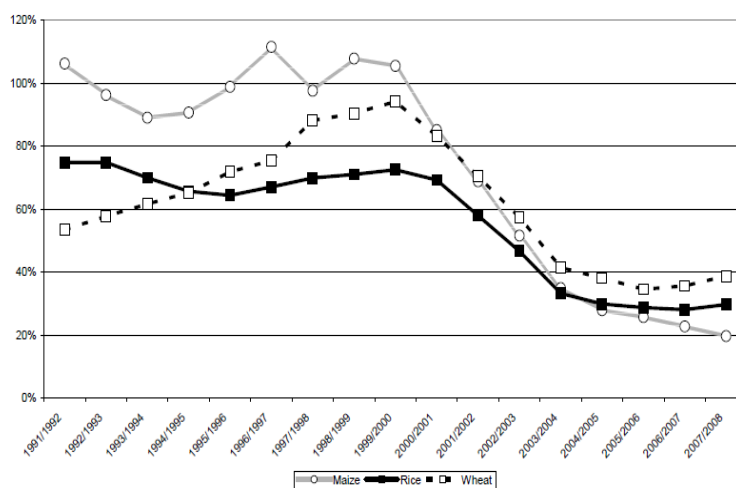
**Figure 20 US Commodity Credit Corporation and private wheat stocks 1980 to 2006**



**Data source:** US Department of Agriculture

China is the other APEC economy that holds major reserves of grain stocks. China is more an opportunistic exporter of grain, as opposed to a major exporter. The stock ratios for maize, rice and wheat are shown in Figure 21.

**Figure 21 Maize, rice and wheat stocks-to-use ratio, China**



**Note:** From Dawe 2009

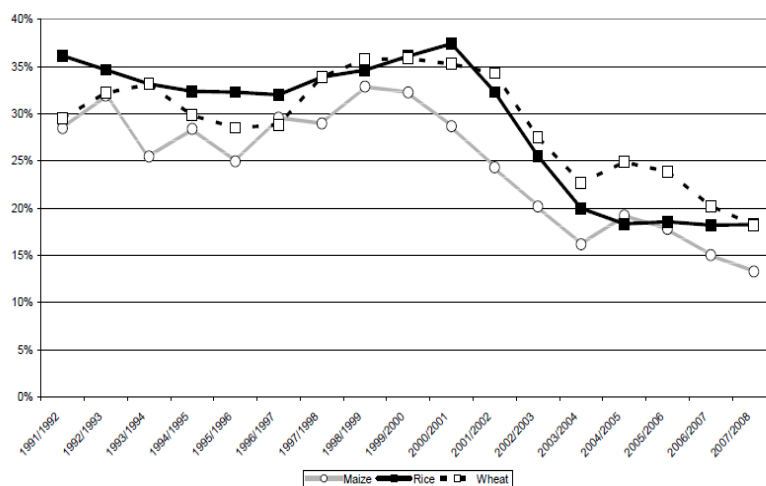
**Data source:** FAO

Stocks-to-use ratios in China declined substantially between 1999-00 and 2004-05 and have since levelled out. Dawe (2009) argues that the drawdown was from particularly high levels and that more recent stocks levels are not unduly low. He cites Headey and Fan (2008), who note that China is largely self-sufficient in each of the three major cereals and is not a major player in these markets and that China's drawdown of stocks beginning in 1999-2000 did not lead to increases in China's share of the world export market for any of these cereals suggesting that the stocks were used domestically.

## ii. World stocks

The decline in stockholding by China and to a lesser extent by the US has led to a decline in world stockholding as can be seen in Figure 22.

**Figure 22 World stocks-to-use ratios for maize, rice and wheat**

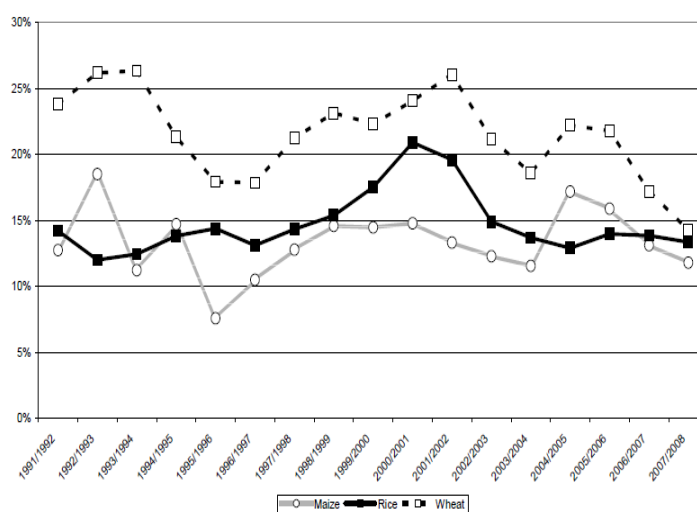


**Note:** From Dawe 2009

**Data source:** FAO

Stockholding outside of China is shown in Figure 23. There has been little change in stocks-to-use ratios outside China over the past 15 years. More importantly, the reduction in Chinese stocks was not offset to any significant degree by private stockholdings elsewhere.

However, as noted by Williams and Wright (1991), the benefits of strategic reserves are ‘exported’ in a traded environment. The reduction in China’s reserves has resulted in a substantial decline in the global reliability of food supplies. Other APEC economies may need to consider their own strategic reserves if this tightening of the balance between global demand and supply is likely to persist.

**Figure 23 World stocks to use ratios for maize, rice and wheat, excluding China**

**Note:** From Dawe 2009

**Data source:** FAO

### iii. Who and where

It is also difficult to make generalisations about which economies should hold stocks and where food stocks should be held. To the extent that working inventories are simply a cost of doing business, then firms will try to minimise their stockholding functions relative to the benefits. Seasonal and carryover stocks may be for the most part an exercise in minimising costs. However, this is a complex problem that requires consideration in an economy-specific context.

Improved on farm storage capacity has the potential advantages of increasing the reliability of food supplies on smallholder farms that consume a large proportion of their production, and may expand their marketing opportunities. The costs of upgrading farm storage may be prohibitive but, collectively, shared storage infrastructure using techniques such as ferro-concrete bunkers (which are being more widely used in Thailand) may be a viable alternative.

While storage facilities may not have returns to scale in their own right, the transfer of product in and out of storage is likely to have returns to scope. Locating storage near transport hubs is clearly advantageous and points to the link between transport infrastructure and food reliability. The need to locate smaller storage facilities near final destinations is reduced the more efficient is the overall efficiency of transport logistics.

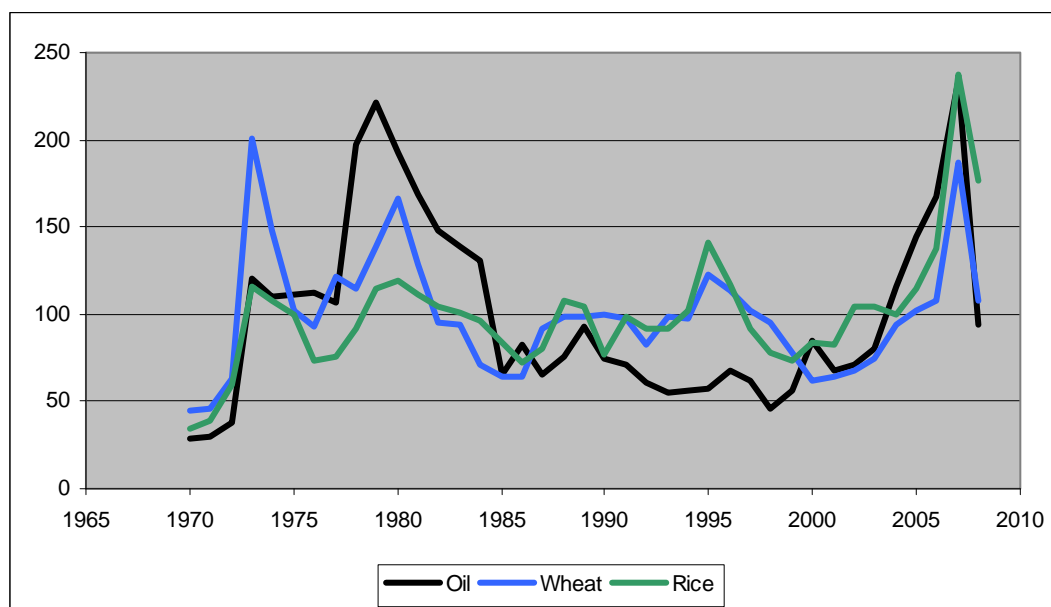
Higher fuel costs may also influence the optimal level and location of stocks. This would be especially important if world commodity prices, including food and oil, move together. That is, if we will tend to see high food and oil prices as happened in 2007-08. Net importers may need to consider the value of increased local reserves under such circumstances.

The historical level of correlation between international oil and wheat prices and oil and rice prices is around 65 per cent. Over the longer term we would expect this correlation to be driven by common drivers of demand such as income growth. There is no obvious reason to expect that supply side shocks would be highly correlated except for the fact that fuel is an input into food production and distribution. The main source of large shifts in world production of wheat and rice is weather conditions in major producing economies.



However, there is a tendency for oil, wheat and rice prices to move together through major price swings as can be seen in Figure 24. One possible reason for this is that they are all storable commodities and subject to speculative demand that often tends to affect a broad range of primary commodities.

**Figure 24 Real oil, wheat and rice prices 1970 to 2008 (index 100 = average)**



Data source: Forbes 2009, Australian Bureau of Agricultural and Resource Economics 2009

The expectation that oil and staple food prices will continue to move together through sharp rises and falls in commodity prices more generally has an implication for both private and strategic movements in stockholding. It shifts the balance in favour of holding localised stocks by net importers, as opposed to relying on storage by, and facilities for, storage in exporting economies.

## E. KEY MESSAGES

- Better transport infrastructure is improving overall food distribution logistics, with increased operational scale better capacity utilisation. In developing economies, ongoing investments in public infrastructure will lower the costs of food distribution.
- Higher fuel prices tend to favour local products, as opposed to imported foreign products. This may have significant implications for transport policies in APEC economies.
- Food storage occurs at every stage of the agrifood system. In developing economies, investments in cold storage facilities can substantially reduce wastage and improve food safety.

- Food stocks are an important aspect of food security. Government-run buffer stock schemes displace private storage as opposed to purely augmenting storage levels. It is important to consider why the incentives for private storage may or may not need to be augmented. One argument is that private stocks will not be sufficient to deal with large disruptions in supply.
- Strategic reserves should have transparent rules for acquisition and disposal of stocks while acknowledging that no contingency plan will be ideal in all situations.

## **PART 3: THE AGRIFOOD SYSTEM WITHIN THE BROADER ECONOMY**

### **8. SYSTEMIC ISSUES AND ECONOMY-WIDE POLICIES**

This chapter examines some key systemic issues and economy-wide policies that reach across all parts of the food supply chain with an impact on the efficiency, resilience and sustainability of agrifood systems in the APEC region. In each case, certain high level trends and themes provide the focal point for exploring the role and impact of behind-the-border impediments and approaches toward structural reform, including the sorts of complementary policies and measures needed to facilitate reform.

The areas covered in this chapter are:

- Food safety; and
- Broad based structural reform.

#### **A. FOOD SAFETY ISSUES**

Food safety and quality considerations are an essential part of meeting food security objectives. They are critical “whole-of-chain” issues affecting the demand and supply of food products, market prices and volumes, and domestic and international market access, as they affect the health and welfare of food consumers.

While difficult to assess with precision, the human and economic costs of unsafe food are known to be substantial. It is estimated that one in three people worldwide suffers annually from food-borne disease and that food and water-borne diseases cause hundreds of thousands of deaths each year in the Asia Pacific region (FAO-WHO 2004).

Studies from the United States have put the total annual cost of illness associated with food-borne disease in that economy in the range of \$US5-10 billion annually, with some studies obtaining values in the range of US\$20-30 billion (Antle 1998). According to one estimate, there are approximately 76 million food-borne illnesses each year in the United States, including 325,000 hospitalisations and 5,000 deaths (Mahoney 2007).

As higher incomes increase consumer preferences for safer food, concerns can often appear strongest in developed economies. The reality, however, is that the effects of unsafe food, together with poor animal and plant health, are more acute in developing and transitional APEC economies. In China, for example, there are an estimated 300 million cases of food-borne illness per annum (Mahoney 2007).

In Viet Nam, the total annual cost to the economy from food-borne disease has been put at US\$450 million. Survey data points to 1.5 cases of diarrhoea per person per year (roughly five times the rate in developed economies) with one fifth requiring medical attention. Among the many problems associated with unsafe and low quality food are the compounding of child malnutrition (thereby depressing physical and cognitive development), loss of economic productivity, and acute strain on health care systems.

Human as well as plant and animal health concerns can lead to lost export opportunities. For example, the prevalence of fruit fly in Viet Nam prevents the export of virtually all untreated fruits to developed APEC economies, while the export of most meat products is also precluded due to a range of diseases (World Bank 2006).

Food production, processing and distribution systems are one, but not the only, source of food safety concerns. Food preparation within and outside of households is another pathway for food borne diseases.

In general, food safety risks can occur at any stage in the food supply chain, from using contaminated raw materials or from handling during the processing, transportation, storage, sale and consumption of food. As well as impacting directly on human health, they pose a major challenge to market and regulatory institutions with the potential to disrupt food production, distribution and sale, both domestically and internationally. Appropriate food regulation can therefore facilitate production and exchange by reducing the risk that consumers might purchase unsafe food, thereby increasing consumer confidence in food markets. On the other hand, overly onerous food safety regulations, as well as poor regulatory governance, can impose unnecessary cost burdens on food chain participants which flow through to consumers.

In examining the enablers of, and impediments to, supply chain efficiency and food security, two issues are considered in this section: (a) the challenges developing APEC economies face in responding to the global trend toward higher and more complex food standards; and (b) the scope for improving regulatory systems for food safety across the APEC region.

The decline in border barriers to trade has prompted concerns in developing economies about higher and more complex food standards (including private sector standards) acting as impediments to new entrants in high value food markets. A considerable body of trade-related literature has viewed higher standards as behind-the-border trade barriers, blocking or otherwise limiting access of developing economy exports to developed economy markets. However, a broader focus on the costs and longer term benefits of compliance by APEC developing economies with higher global food safety standards may yield different conclusions. It is important in this context to look broadly at the full range of tradeoffs and synergies that policy makers in developing economies confront to assess whether higher standards are indeed behind-the-border impediments in food supply chains (domestic and international) or, alternatively, core drivers to increased competitiveness in modern food supply chains.

The second issue highlights the degree to which food producers and suppliers in the APEC region face considerable variation in regulatory arrangements and requirements in an area like food safety. This is apparent even among industrialised economies with broadly similar regulatory systems. Partly the result of different tastes, diets, climatic conditions, regulatory traditions and perceived risks, such variation also reflects widely differing resource and technical capacities and governance practices across APEC economies. While it can be a source of transaction and other costs for market participants operating across APEC economies, institutional and policy diversity is not in itself indicative of impediments to supply chain efficiency. It does, however, draw attention to potential variations in food safety regulations that do not serve a substantive purpose and the scope for efficiency enhancing regulatory reform.

These issues are explored more closely focusing on food safety regulation in Indonesia and, in particular, on safety and quality management systems for fresh fruit and vegetables. As well as highlighting the different drivers of higher standards in developing economies, this case study indicates the scope for improving food safety regulation so as to both better facilitate food production and exchange and reduce regulatory burdens.

#### **i. Food safety regulation: An overview**

In an absolute sense food safety implies absence of contaminants, adulterants, naturally occurring toxins or any other substance that may make food injurious to health on an acute and/or chronic basis<sup>17</sup>. It is an important starting point for food security policy. However, ultimately for consumers and governments an operational definition of food safety must be framed in the context of acceptable and unacceptable risk.

A shared responsibility of the public and private sectors, food safety is affected by the decisions of producers, processors, distributors, food service operators and consumers, as well as by government regulators (Caswell 2003). The role for government is based on the presence of market failures such as high information costs or asymmetric information between producers and consumers (for example, consumers unable to judge the safety or quality of a particular food product) and externalities (for example, consumption of unsafe food imposes broader costs on a society's health system and economy than simply the cost to individuals).

The public good dimension to food safety regulation can arise also from the inability of individual food producers to control their operating environment, necessitating the certification of production conditions, enforcement of standards or investment in supporting infrastructure (Unnevehr et al., 2003). As such, food safety regulation, together with animal and plant health measures, can help to facilitate production and exchange by reducing transactions costs, thus improving the functioning of markets.

There is also growing evidence of market incentives leading to food safety and quality standards often higher than those imposed by government regulation. With consumers demanding safer, higher-quality food, firms that misjudge market demand risk losing market share and their business reputation or brand capital. To the extent that such incentives allay concerns about market failure, policy makers need to weigh carefully the benefits of regulatory action against the costs that it entails. The case for public intervention to ensure low cost consumer protection may be stronger in developing economies where consumers are seen as more preoccupied with the access dimension of food security. It is important to recognise that there are commonly many food production and marketing channels that are accessed by different segments of an economy's population. What is appropriate regulation in one channel, such as for supermarkets, may not be appropriate in another, such as a public wholesale market.

The costs of food safety regulation include the costs of compliance, borne by both industry and consumers, as well as the administrative costs borne by taxpayers and any deadweight loss associated with taxation. While optimal policies can be described conceptually, empirical analysis of the costs and benefits of specific food safety regulations is very difficult due to often limited and imperfect data (Antle 1998). With regulatory decision-making also subject to political pressures, where concentrated interests may benefit from over-regulation, there is a strong public interest in establishing rules and norms that provide guidance and disciplines

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<sup>17</sup> Food quality can be considered a more complex characteristic of food that determines its value or acceptability to consumers. Besides safety, quality attributes include nutritional value, appearance, texture and taste (FAO undated).

while allowing economies reasonable scope to set their own health, safety and quality standards (Josling et.al, 2004, ch 2).

**Box 11 Food safety standards: Global governance, limited harmonisation**

Food safety standards deal mainly with maximum residue levels for chemical substances (for example, pesticides, heavy metals, hormones etc.), natural toxins, zoonotic diseases (bacterial and parasitic), food additives, decomposition of food products, and other microbial and chemical contaminants. The Codex Alimentarius Commission (Codex) provides the international framework within which economies are encouraged to develop domestic food safety systems. Codex standards provide the key reference point for bodies such as the World Trade Organization and APEC.

Over time, the structure of Codex has shifted progressively from a prescriptive, rule-based approach to a risk analysis approach. Under risk analysis principles, and in line with the WTO's Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), regulations should be based on scientific risk assessment and the targeted measure linked to clear regulatory goals. Under the SPS Agreement, the risk management options chosen should restrict international trade as little as possible (Caswell 2003).

An economy's individual circumstances will shape its capacity for, and interests in, aligning with international standards such as Codex, WTO Agreements or private sector standards. Despite efforts to promote greater international harmonisation, even within industrialised economies there remains substantial diversity in the 'rules of the game' with regulatory systems marked by both old and new regulatory approaches with differing perceptions of risk and varying geographical considerations. As a result, harmonisation is the exception rather than the rule. Within APEC, the main focus of food safety dialogue has been on encouraging economies to align their domestic food safety regimes with Codex standards.

Lastly, regulation is not the only avenue for governments to intervene with respect to food safety. Public investment into improving water quality and research into alternatives to herbicides and pesticides are just a couple of examples of non regulatory measures that can improve food safety.

**ii. Higher food standards: Challenges for APEC developing economies**

Agrifood systems across the APEC region are characterised by the wider global trend toward higher and more complex food safety and quality standards. Among the drivers have been greater scientific understanding of the sources of food-borne illnesses, growing international trade in food products and increased consumer awareness, including in the wake of various highly-publicised food safety 'scares' over the past two decades (Roberts and Unnevehr 2002).

Set largely within developed economies, a new paradigm for food safety regulation has emerged that addresses more types of safety-related attributes (such as microbial pathogens, environmental contaminants and animal and drug pesticide residues) and imposes stricter standards for those attributes. The emphasis is on comprehensive "farm-to-fork" coverage of all stages of the food supply chain focusing on the prevention of current and potential food safety

and agricultural health threats with greater attention to the traceability of animals, products and raw materials and to ensuring the private sector meets quality control responsibilities.

Representative of this trend has been the widespread adoption of international safety and quality control mechanisms such as the Hazard Analysis and Critical Control Point (HACCP) system based on identifying those stages in the food chain where contamination can take place and focusing remedial controls on those points.<sup>18</sup> Other regulatory developments include increased customer information, institutional changes in food safety oversight and a strengthening of border inspection systems (Henson and Caswell 1999, Josling et al 2004).

Side by side with higher official standards, private food safety standards have assumed a more prominent role in food supply chains, supplementing and even overtaking the role of public sector regulation. The heightened role of information, quality and reputation in high value food markets has seen safety become a major focus of market differentiation strategies, leading to greater scrutiny of production and processing techniques employed along food supply chains (Fulpino 2006).

In developed economies, major food retailers, manufacturing companies and food service chains have been leaders in transforming food safety and quality management systems while requiring suppliers to meet more stringent safety and quality requirements. In this context, there has been a greater propensity for food supply chain leaders to enter into longer term relationships with a more limited number of preferred suppliers, whether in domestic or international markets. The result has been a proliferation of schemes at the level of individual companies, specific supply chains, domestic industries, regional groupings of firms, and globally. The tendency within the private sector to package together safety, quality, environmental, and social standards has reinforced the movement towards more complex standards for high value foods (World Bank 2005).

Compared with higher income economies, food safety regimes in developing economies tend to be less organised and less comprehensive. In many developing APEC economies, for example, self-supply of food remains significant and a large informal sector is often a major producer and distributor of fresh and processed food products for direct consumption (through wet markets and 'street' foods). These factors tend to make effective food safety regulation and control relatively difficult, especially when combined with the rapid evolution of the food sector and the limited technical support for small and medium-sized food producers. There are clear exceptions such as when multinational firms bring with them integrated procurement and logistic systems. There are also examples of domestic start up firms that make use of ISO standards and accreditation.

High levels of food-borne diseases are particular risks in those parts of the APEC region where animals and people live in close proximity and where urbanisation is placing increased pressures on food systems. With urban populations reliant on much longer food chains, with food and feed being distributed over far greater distances than in the past and passing through multiple handlers, risks to food safety are seen as increasing. Without appropriate precautions and monitoring, changes in animal husbandry practices and the adoption of modern intensive agriculture may also have serious consequences for food safety (Noraini 2007).

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<sup>18</sup> The HACCP system for prevention of hazards has been mandated during the 1990s for parts of the food sectors in the United States, Canada, Australia and New Zealand (OECD 2003).

Establishing and maintaining a regulatory framework that both satisfies domestic needs and meets international obligations and trading partners' demands thus presents major challenges for developing and transitional APEC economies. Being aware of evolving rules is itself a resource intensive activity and the diversity of standards can mean significant transaction costs for developing economy food suppliers. Moreover, many developing economies lack the administrative, technical and other capacities to comply with more stringent requirements. The costs required to reach compliance can pose a challenge to the competitive position of domestic food producers, especially small farmers and operators.

Nevertheless, cooperatives and firms in developing economies accessing export markets was highlighted earlier in this report. The scale of these opportunities may be small but they do offer a template for private sector process standards.

Compliance with higher food safety standards can be seen as raising barriers to entry in high value food markets within developing economies, with possible negative affects on small scale food producers and domestic consumers. This may arise from official steps to align regulatory systems with higher international food standards or from the increasing role of private food safety standards within developing economy supply chains. The rapid growth of international supermarket chains in many APEC economies, especially in Asia and Latin America, has been a critical driver of this trend (Berdegue et al. 2003).

In assessing such concerns, generalisations are difficult. This study found very little in the way of comprehensive research examining the broad array of costs and benefits surrounding developing economy compliance with international food standards.

Developing economy policy makers face a mix of tradeoffs and synergies when making compliance decisions over agrifood standards. Tradeoffs can arise between different objectives. Investments required to maintain or to improve international market access may reduce resources available for domestic food safety priorities. In some cases, there may be direct tradeoffs between the need to meet international requirements and the resulting increased costs to consumers. Actions geared towards compliance may result in clear improvements in market access for certain industries and firms, yet result in the continued exclusion of other food producers from higher value food markets. Inevitably, priorities must be set regarding which domestic standards should be brought to international benchmarks recognising the variability in export potential, the importance of individual standards to public health, the enforceability of standards and the effect on the affordability of food products to domestic consumers.

On the other hand, investments to meet international market standards can also have synergistic benefits for domestic food safety. These synergies are more likely to occur when the export product is also consumed domestically, the investments affect a large portion of production, and the safety requirements do not price the food out of the range of the majority of domestic consumers (Unnevehr et al 2003). Other synergies may be unrelated to international market access issues. For example, steps to improve food safety may reduce food losses, thereby increasing food availability for both domestic and international markets (Noraini 2007, p. 83).

Taking account of this more complex picture of costs and benefits has called into question those studies which emphasise the loss of export competitiveness and the costs of developing economy compliance with higher international food safety standards. This rebalancing of the debate has seen greater focus on the longer term synergies that flow from compliance based on the benefits that accrue to economies and food suppliers that improve food safety systems.



In this context, the World Bank (2005) has sought to elevate strong food safety and agricultural health risk management alongside factors such as stable macroeconomic conditions and effective logistics as ‘core competence’ factors necessary for developing economy suppliers of high value food products. Based on a study of international SPS standards it concluded that developing economies were not suffering from a tightening of standards and that cases of unjustified standards were not the norm.

This research stated further that the way the issue has been framed in much of the trade literature may have reinforced certain policy reactions among developing economies. The central problem is that while the costs of compliance with new agrifood standards are typically more tangible (and thus more visible) than any benefits, and because recurring benefits are typically more significant than shorter term nonrecurring benefits, compliance is widely perceived to be costly. The result, according to the study, is a:

... perceptual barrier that overstates the overall net cost and drives strategic decisions toward exit, reaction, and defence in an attempt to minimize change. Such approaches are typified by efforts to cut corners and put out fires, and to delay efforts to comply until the very last minute (World Bank (2005, p. 72).

In short, a broader appreciation of the array of tangible and intangible benefits, has tended to highlight the synergies to developing economies from moving to meet higher standards. The experience of a cross-section of APEC developing and transitional economies tends to reinforce the view that enhanced capacity to comply with stricter standards can provide benefits beyond higher exports and extending to the modernisation of developing economy food supply chains (Box 12). However, export opportunities appear to be the initial key driver.

There are, however, qualifications that should be noted. Compliance costs will vary between different economies, as well as between industries and firms in the same economy. The transition to adopting international standards for the domestic market will necessarily be gradual in some cases, either due to the compliance costs involved or difficulties in enforcement. For example, in Viet Nam, where around half of domestic health standards comply with Codex standards, it has been estimated that the adoption of ‘gold standard’ food safety, animal and plant health measures would increase the cost of food by between 5 and 30 per cent (World Bank 2006, p. 25). As noted, there are many food production and distribution channels in developing economies. These channels will substantially different risk profiles and compliance costs.

The ultimate cost benefit calculus will reflect a range of factors including the starting point for compliance, the prevailing organisational and geographical structure of the supply chain, the availability of administrative and technical capacities, the level of intra-industry and public-private cooperation and the strength of existing technical service industries. Larger incumbent suppliers can often be best positioned to gain advantage based on economies of scale, better access to information and because of well established reputations. In the case of small producers and farmers, a key challenge is to reduce, through collective action, the transaction costs associated with monitoring and certifying compliance.

While standards compliance (or non-compliance) can bring about significant distributional effects, public policy can make a difference in the pattern of winners and losers. More broadly, compliance with higher international standards is only one of many factors affecting the

competitiveness of an economy, industry or firm and only one of many variables affecting the overall welfare of stakeholders, including smallholder farmers and vulnerable food consumers.(World Bank 2007a). Increasing food security along traditional food marketing channels may prove to be one of the most challenging food safety issues facing developing economies.

**Box 12 Higher food standards: Successes in APEC developing economies**

The vegetables sector in Thailand has successfully adapted to demands for higher standards led by exporters acting to intensify their contractual relationships with smallhold farmers and relying much less on open-market purchases. Thailand's Department of Agriculture facilitated industry wide quality improvements by establishing a farmer registration system that has enabled both exporters and the Thai Government to trace back produce found to be noncompliant with regulations on residues and pesticides.

Peru has achieved considerable export growth of fresh asparagus due to upgrading to internationally certified levels of good agricultural practices, good manufacturing practices and HACCP. Again, the key feature has been a strong partnership between the public and private sectors, especially in the wake of trade disruptions in European markets in the late 1990s. As a first step, the Peruvian Commission for Export Promotion (PROMPEX) worked with industry leaders and production managers to implement the Codex code of practice on food hygiene. Domestic norms were subsequently published to provide overall quality and performance benchmarks for the industry, with many large exporters then taking the lead in meeting certification levels of the stricter EUREPGAP protocol.

Viet Nam has made substantial progress in the fisheries sector and is among the world's top ten exporters of seafood. Improved food safety and aquaculture practices, driven by consumer pressure and industry requirements for quality and traceability, have facilitated strong export growth. As of May 2007, eight seafood companies have received certification under the Global Aquaculture Alliance's Best Aquaculture Practices system. This is accorded to companies that meet specific hygiene and source requirements for greater sustainability. As in other economies, strong public-private cooperation and advances in technology are leveraging improvement in standards. An example is the collaboration between the Viet Nam Association of Seafood Exporters and Producers and the Vietnamese State Agency for Technological Innovation, together with IBM Corp. and FXA Group, to accelerate the adoption of traceability solutions to improve food safety.

In Chile, medium-large fruit producers and exporters have worked with the government to establish a clear strategy for market promotion and grades and standards implementation. Private sector actors, principally the Coordinating Committee for Fruit and Vegetable Producers and Exporters, took the initiative in establishing a 'code of good practice' for production, processing and distribution of fruit for export. In turn, the committee worked with the Ministry of Agriculture and the domestic CODEX entity to reform Chilean health and safety laws, improve infrastructure provision and influence international Codex discussions.

Sources: World Bank (2005), Reardon et al. (2001), AP-Food technology.com and EE Times Asia (accessed July 2009).

### iii. Food safety systems in APEC economies: Unfinished business

A common criticism of food safety systems in a number of APEC economies is that while standards may equate with international standards on paper, the lack of technical and institutional capacity to control and ensure compliance can undermine the effectiveness of regulatory systems. Inadequate infrastructure – food laboratories, surveillance and enforcement capacity etc. – as well as general weaknesses in management and coordination are seen as widespread problems in many developing APEC economies in particular (APEC 2006).

In Southeast Asian APEC economies, for example, areas of weakness nominated by Codex representatives include a lack of appreciation of the nature and extent of food safety problems, little awareness of the consequences of contaminated food on domestic health and development and a lack of coordination among relevant agencies. A scarcity of resources for food safety objectives given other priorities is seen as compounding these problems (Noraini 2007).

In the face of these challenges, APEC (along with international development agencies and donors), is developing a range of capacity building strategies to strengthen food safety standards and practices in the region. The APEC Food Safety Cooperation Forum established in April 2007 recognises that food safety and internationally harmonised food standards are key factors for improving public health and safety and facilitating trade in food for APEC economies (APEC 2008). The Forum is currently responding to the request by the APEC Economic Leaders Meeting in Australia in September 2007 to:

- Strengthen food safety cooperation among member economies; and
- Develop a more robust approach to strengthening food safety standards and practices in the region.

Three inter-related challenges highlight the degree to which improving food regulatory systems in the APEC region remains unfinished business.

First, reflecting broad stages of development, there is wide variation in the degree to which APEC economies adopt transparent risk-based approaches to food safety issues. A number of APEC economies have well developed risk analysis systems and it is in their interests to share this expertise. An example of an area where this is apparent is in improving the consistency and transparency of risk assessment of genetically modified (GM) foods. In this context, Australia and New Zealand have taken a leadership role in APEC based on region-wide training in safety assessment of GM foods.

Second, substantial scope exists for more general improvements in food safety governance – coordination across government agencies, efficient regulation, basic enforcement and the like. One indicator of poor governance practices in the past has been that the majority of detections and rejections of food from developing economies are not related to highly technical or sophisticated requirements. Data from the US Food and Drug Administration has shown, for example, that more than 50 per cent of rejections were attributable to lack of basic food hygiene and failure to meet labelling requirements. The FAO (undated) has concluded on this basis that dealing with these problems is ‘well within the means’ of most developing economies.

Third, notwithstanding the outward orientation of most APEC economies, very few developing economies have taken a strategic decision to engage actively in international standards forums

such as Codex. While there are exceptions (for example, Malaysia and China), they serve largely to prove the rule that the majority of developing APEC economies remain ‘standards takers’ rather than ‘standards makers’.

#### **iv. Case study: Food safety regulation in Indonesia**

Indonesia provides a case study of a transitional economy seeking to improve food safety standards consistent with broad economic and social development objectives. Basic challenges include limited information about food safety problems and risks in food supply chains, significant cultural and language diversity, inadequate infrastructure (including electrification for refrigeration and transport infrastructure) and a regulatory framework characterised by overlapping responsibilities and weak enforcement.

Institutional weaknesses have seen developed economy export markets and major retailing organisations (supermarkets, restaurant chains and international hotels) emerge as key drivers of higher food safety standards. This case study looks at some of the behind-the-border deficiencies of Indonesia’s food safety system and its limited effectiveness in terms of supply chain competitiveness.

##### **1. The context**

In the past three decades, Indonesia has been transformed from a predominantly agriculture based economy to one reliant increasingly on non agricultural growth. Even so, agriculture remains the largest source of employment and most of Indonesia’s poor depend on agriculture, either directly or indirectly, for their livelihood.

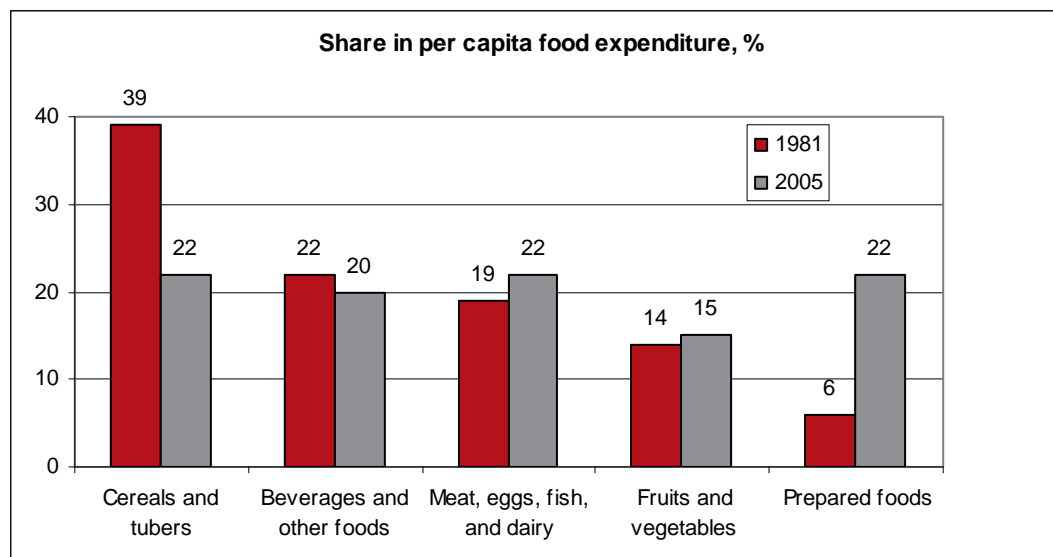
Increasing domestic food production has long been a major priority for Indonesia given unstable export prices and a limited ability to pay for food imports. In this context, rice self sufficiency has been a domestic goal since the late 1960s. With rapid industrialisation, high value products such as estate crops (for example, palm oil and coconut), livestock, fisheries and fruit and vegetables have increased their contribution more rapidly than staple crops. Despite this structural change, diversification is still limited to only a few regions and a few products. Indonesian agricultural policy, focusing on self sufficiency and import minimisation, continues to have a strong bias toward rice and other commodities such as sugar maize and soybeans (Molyneux and Rosner 2004).

On the demand side, income growth, urbanisation and demands for greater convenience have led to changing food consumption patterns. Where Indonesians used to eat mostly rice, cassava and maize, they now consume much more meat, fish, fruits, dairy products and processed foods (Figure 25). High levels of protection for rice, soybeans, sugar and maize will become increasingly costly if, in the face of increasing domestic demand for high value products, Indonesia’s agricultural policies maintain their current bias.

Changing consumer demand and rapid urbanisation, means more Indonesians now rely on much longer food supply chains, though traditional marketing systems – including wet markets – remain important for a large percentage of the population. In certain contexts, such traditional systems have offered a degree of protection from major food-borne diseases, notwithstanding inadequate basic hygiene facilities. Working to mitigate risks have been the very short supply chain and traditional protective measures – such as cooking foods shortly after harvesting with few intermediate handlers and the use of spices. Critical exceptions include human cases of

avian influenza acquired from birds in wet markets and pesticide contamination of leap crops, while studies point to a more or less persistent level of intestinal disease from wet market purchases (Morris 2008).

**Figure 25 Changing food consumption in Indonesia**



**Data source:** World Bank (2007a)

Changing consumption behaviour and longer food supply chains have focused attention on the safety and quality risks arising from deficient production, processing, marketing and retailing technologies. Agricultural practices can directly contribute chemical and microbiological agents into the food chain. Examples include pesticide and microbial contamination of vegetable and horticultural products which can account for significant illnesses and deaths (FAO/AFMA 2005).

In addition, poor transport infrastructure can add to transaction costs and cause significant deterioration in food safety and quality. Indonesia's needs in this area appear acute given declining investment in transport infrastructure over time and low investment relative to neighbouring APEC economies such as Thailand, Malaysia and the Philippines (ADB 2006). According to one study, inadequate infrastructure (road and port) combined with poor governance and administrative burdens (for example, export procedures) account for more than 60 per cent of inefficiencies in output logistics costs (free-on-board) in Indonesia (Patunru et al. 2007).

A general challenge in relation to food safety is the paucity of critical information about the extent of food-borne disease in Indonesia, as well as the critical risk points in the food supply chain for various products. While estimates put the number of cases of foodborne disease at between 30 million to 60 million each year, a relatively small number are likely to be reported and investigated (Jakarta Post 2002).

## **2. Market-based drivers for higher standards**

Large food processors and retailing institutions – in particular supermarkets – and export markets for high value food products constitute major drivers for higher food safety in

Indonesia. Perspectives vary nonetheless as to overall importance of these drivers and the individual effectiveness of particular channels in specific product areas.

Rapid growth in supermarkets can be seen as both a consequence of changing food consumption patterns and a driver of new consumption patterns. Growth of a more affluent middle class, urbanisation and greater tourism has also seen the rapid spread of international hotels, major restaurants and fast-food chains in Indonesia to the point where spending on food services now accounts for 22 per cent of food budgets.

Foreign supermarket chains expanded investments in Indonesia after restrictions on wholesale and retail trade were lifted following the 1997-98 Asian financial crisis.

As in other developing APEC economies, supermarket growth in Indonesia has resulted in greater vertical integration along the food chain, with benefits including improved food safety and quality, reduced price and production risk and lower transactions costs and information asymmetries (ADB 2006). The benefits of increased supply chain integration can be seen, for example, in the case of PT Bimandiri which specialises in procurement and marketing of fresh produce. A dedicated supplier to Carrefour, Bimandiri worked actively with a group of farmers on the production of a small, low-pesticide watermelon for Carrefour. Ultimately, those farmers able to meet the relevant standards earned twice the price per kilo of a standard watermelon (Coyle 2006).

As in other developing APEC economies, concerns have surrounded the potential costs of smallholders being left out of modernised value chains. In the case of fresh vegetables, for example, it is estimated that only five per cent of small scale farmers or growers in Indonesia produce under contract to large companies and thus contribute to large integrated supply chains. Hence, produce supplied to large retailers, multinational supermarkets and restaurant chains is sourced overwhelmingly from large producers (Morris 2008, p. 25).

In some commodities, domestic market drivers for food safety remain relatively weak compared with the export market. Examples include products such as shrimp and certain niche vegetables which must meet high, well enforced standards in developed economy markets. Again, the capacity to meet these standards in Indonesia has been confined mostly to large scale producers. In the case of shrimp, for example, the lack of traceability within the small scale sector reduces the incentive to maintain high food safety standards (Morris 2008, p. 35).

### **3. *The regulatory system and state capacity***

The overall importance of government regulation relative to the market-driven forces for food safety is ambiguous at best. The current domestic framework of food safety and quality regulation has its origins in the late 1990s. The Integrated Food Safety System was developed by the Indonesian agency of Drug and Food Control (BPOM) and based on WHO 'Guidelines for Strengthening National Food Safety Programmes'.

Conceptually at least, it is based on risk analysis and the use of a HACCP based system designed to improve food safety assurance and ensure the effective use of available resources (Box 13). In terms of constraints, official statements in the past have tended to focus attention on the lack of farmer awareness of food safety as the principle reason for Indonesia's agricultural produce falling behind the standard required by consumers and the international market (Iwantoro 2002).

**Box 13 Indonesia: The formal regulatory setting**

The Integrated Food Safety System (IFSS) is designed around three networks based on functional stakeholder groups:

Food Intelligence Network – Risk Assessment: this brings together agencies involved with food-borne disease monitoring, food surveillance and food assessment, including government departments, industry, academia and consumers.

Food Control Network – Risk Management: this brings together agencies involved with administration of food law, inspection and analysis of food.

Food Promotion Network – Risk Communication: this brings together government, industry and consumers to communicate on food safety issues.

The sub-programs have been developed within the IFSS as the basis for policy and practical action at economy-wide, provincial and local levels (see diagram). These are

- Food Watch – a domestic food monitoring program that:
  - uses analytical results to identify food safety problems,
  - works with key stakeholders to find practical solutions, and
  - produces user-friendly reports and information for industry to improve practices
- Food Stars – a voluntary award program centred on three levels of food safety training across all industry sectors ‘from paddock to plate’.
  - one star – basic hygiene training,
  - two star – good manufacturing practice or good agricultural practice (depending on the industry sector,
  - three star – implementation of a food safety program based on Hazard Analysis Critical Point Principles (HACCP)
- Rapid Response – a program designed to enable effective communication between agencies during times of crisis (for example, strategies for food recalls).

In practice, however, Indonesia’s regulatory system itself suffers from a number of deficiencies. While inadequate resources and technical capacity clearly present obstacles to an efficient and effective regulatory system, various other problems relate more directly to institutional weakness, poor regulatory practice and a lack of strategic direction in setting food safety priorities.

Enforcement of regulations and food safety programs appears patchy at best. The main targets are large food producers and manufacturers. Meanwhile mobile street food vendors, small-scale restaurants ('warung') and family based food producers remain largely outside the formal regulatory system. This constitutes a major gap in the regulatory framework with these suppliers contributing more than 20 per cent of domestic food consumption (mostly in urban areas) and considered the highest safety risk suppliers in the food supply chain (Puspa and Kuhl 2007).

Regulations themselves can be voluminous and complex, notwithstanding poor monitoring and enforcement. For example, the file of existing regulations which govern the activities of street vendors runs to 90 pages and the requirements imposed on vendors are difficult to understand and interpret accurately (Morris 2008, p. 33). In addition, the registration of imported food products is complex and often non-transparent.

Overlapping responsibilities and lack of coordination across government agencies also works against efficient regulation. Upwards of eight domestic departments and agencies are involved in food safety activities. The devolution of certain food safety responsibilities to local government can also present problems, as the experience with attempts to introduce GAP in Indonesian vegetable production would indicate (Box 14).



**Box 14 Regulatory failure: Obstacles to affordable, safer vegetables**

Attempts to develop and test a GAP system for vegetable production in Indonesia have highlighted areas of regulatory failure which, along with low farmer awareness of food safety risks, act as barriers to an effective supply response to Indonesia's growing demand for high value food products. Government related structural bottlenecks in the control of food safety during the production of vegetables include:

**Lack of accessible and transparent information:** Farmers have limited knowledge of rules and regulations concerning food safety requirements. For example, access by farmers to official information about pesticides heavily constrained. The Indonesian Government does have an admission system for pesticides, but this information is not included on the label of the crop protection packaging. This results in purchases of illegal pesticides or the wrong use of permitted pesticides.

**Unclear or overlapping responsibilities:** The above problem is increased by the fact that two government agencies make policies on pesticides.

**Inadequate testing facilities:** A number of HACCP-based processes – for example, testing for MRLs, water and soil quality – are not possible or very costly due to no or limited access to laboratory facilities.

**Lack of official certification systems:** Farmers who comply with certified standards are unable to obtain official certification because of institutional weaknesses at local government level, the jurisdiction responsible for auditing the pesticide control (SI SAKTI) system.

While in some cases compliance costs may outweigh the benefits of strengthening official monitoring of integrated disease and pest management strategies, in many cases cost containment (together with benefits such as pesticide residue reduction) is viewed as one of the benefits of regulatory improvement.

Source: Asandi et al. (2006).

Most of these regulatory deficiencies, it should be noted, can be traced back to more systemic weaknesses in Indonesia's regulatory environment that fail to provide a good microeconomic foundation for regulatory reform. Among the shortcomings identified in this context are wide variations in the capacity and technical expertise of various ministries and agencies, regulatory coordination and implementation problems based on unclear boundaries between entities, and the absence of a high level regulatory reform commission with the ability to maintain an independent view separate from status quo interests (Srinivas 2008).

As such, weak state capacity as it relates to food safety systems should be viewed as part of a much larger behind-the-border reform imperative if Indonesia is to improve the food supply chain. Encouragingly this is recognised by senior figures in the Indonesian Government:

If we are to maintain our competitive position and attract sufficient investment to reach our growth, poverty and employment goals, we need to improve the implementation of regulatory reform efforts at all levels of government (Trade Minister, Dr Mari Pangestu, 2007).

**v. Key messages: Food safety**

- While generalisations about the costs and benefits of compliance are difficult, many APEC developing economies have demonstrated the benefits from meeting international standards. This suggests that most economies can align progressively domestic food safety regulation with core global standards (that is, Codex) without undermining the cost of food to consumers.
- The proliferation of private food standards (often higher and more complex than official standards) may call for additional policy attention to facilitate domestic production and exchange and to address potentially adverse distributional effects, especially in relation to small farmers. At the same time there is evidence that with effective Government support, small farmers can succeed in this challenging environment.
- Considerable scope exists for improving domestic food safety regimes within the APEC region, recognising the difficulties many economies face in this context. Priorities include improving risk analysis, better coordination across agencies and rebalancing regulatory approaches away from reactive strategies, aimed at correcting problems after they occur, and toward proactive strategies that prevent breakdowns in food safety in the first place.
- In developing economies in particular, there are many food production and distribution channels ranging from traditional to modern. These channels will have very different risk profiles and compliance costs. Food safety policy will need to acknowledge and potentially take on different roles within those channels to cost effectively improve food safety for all consumers.

**B. BROAD BASED STRUCTURAL REFORM**

This section examines some of the larger dynamics of structural reform in the APEC region recognising that a broad range of policies and institutions impact on the competitive performance of the agrifood sector and hence on behind-the-border impediments within domestic food supply chains. Importantly incomes growth, especially at lower income levels will arguably have the greatest positive impact on food security. To the extent that broad based reform lifts not only average but the lower end of the income distribution in developing economies its contribution to food security will be substantial.

As well as exploring the major trends in structural reform in APEC economies, some key lessons are identified that may aid future reform progress, including in the agrifood sector. An economy-wide perspective on structural reform allows for closer examination of the links between various behind-the-border policies that impact on food systems. Mexico provides a case study of the obstacles to and potential gains from further structural reform that would improve the functioning of food markets and the overall competitiveness of that economy's agrifood sector.

**i. Structural reform in APEC economies: An overview**

Structural reform covers a wide range of policy areas, but with a core focus on improving the functioning and performance of markets, including product markets, labour markets and markets for services. From an APEC perspective, it consists of improvements made to

institutional frameworks, regulations and government policy so that ‘behind-the-border barriers’ to regional economic integration and improved economic performance are minimised.

Structural reform encompasses policies such as financial and capital market reform, international trade and investment reform, exchange rate reform, privatisation and reform of public sector management, competition policy reform, labour market reform, infrastructure reform and resource management reform. Broad based regulatory reform is a further distinct strand of a structural reform, one where APEC has taken a regional leadership role (box).

By facilitating competition and allowing resources to flow to their most valued use, structural reform has encouraged innovation, higher productivity and improved living standards across APEC economies at different stages of development. Gains have proven especially strong for economies that have pursued sustained integration into the global and regional economy. When combined with domestic efficiency reforms, the benefits have included lower prices, better quality products and services and more choice.

Virtually all APEC economies have pursued some form of structural reform in the two decades since the body’s formation reflecting the worldwide trend toward more market-friendly policy frameworks that gained momentum in the 1980s. The scope, pace and priorities of reform have differed across APEC economies, with differing starting points providing one lens for viewing this variation.

For former centrally planned APEC economies (for example, China and Viet Nam), structural reform has involved the dismantling of state dominated economies and their replacement by more market oriented economies. In the case of China, for example, the scale of transformation has been enormous, embracing the end of collective agriculture, state owned enterprise reform, financial market development, trade reform secured ultimately through membership of the World Trade Organisation and many other reforms (Garnaut and Song 1999).

**Box 15 Regulatory reform: Part of APEC's wider structural reform agenda**

Regulations include laws, formal and informal orders and subordinate rules issued by all levels of government, and rules issued by non-governmental or self-regulatory bodies to whom governments have delegated regulatory powers (OECD 1997). The goal of regulatory reform is to achieve policy objectives with less economic distortion. The issue is less one of deregulation and relates more to the quality of regulation and how best to ensure that regulations are effective and efficient with a minimum of adverse secondary effects on economic welfare.

A considerable amount of work has examined the impact of regulation, the gains from regulatory reform (both economy-wide and in specific sectors) and ways to improve regulatory quality and management. The OECD has been at the forefront of this work focusing on industrialised economies. Since 2000, the APEC-OECD Cooperative Initiative on Regulatory Reform has provided a focal point for sharing experiences and raising the profile of regulatory reform in the APEC region, especially among developing and transitional economies.

The first phase of this initiative focused on the development of the APEC-OECD Integrated Checklist on Regulatory Reform. Based on the shared knowledge of APEC and the OECD, the checklist highlights key issues to be considered during the process of development and implementation of regulatory policy. It is a voluntary tool for self assessment of regulatory reform efforts, recognising that the circumstances of individual economies differ and that there is no single model of regulatory reform.

Complementing the checklist, the APEC Economic Committee has Good Practice Guide on Regulatory Reform. The purpose of the guide is to assist member economies to design and improve their regulatory systems, in the process dealing with both the stock and the flow of regulations. The APEC-OECD agenda for 2009 includes further self assessments by member economies using the Integrated Checklist on Regulatory Reform and efforts to convert the Good Practice Guide into practical steps that economies can take to implement its principles.

While less sweeping in scale, other APEC economies have also engaged in far-reaching market oriented economic reform geared towards deeper integration into the global and regional economy, macroeconomic stability and improved capital and labour markets. In a number of APEC economies (for example, Thailand, the Philippines, Mexico and Chile) trade and foreign investment reform provided the foundation for replacing an import substitution strategy to development, with strong anti-export bias and misallocation of resources, with a more outward-oriented development strategy. Among developed APEC economies, Australia and New Zealand have also undergone major structural transformation in moving from high protection and extensive behind-the-border regulation of their economies to a point where they are among the most open, market oriented economies in the world. In each case, trade reform was part of a wider structural reform process, including reforms in foreign investment policy, exchange rate policy, capital and labour markets, product markets and privatisation.

In other cases reforms have been more modest based on the starting point, yet equally important in improving economic performance. For example, the United States in key sectors

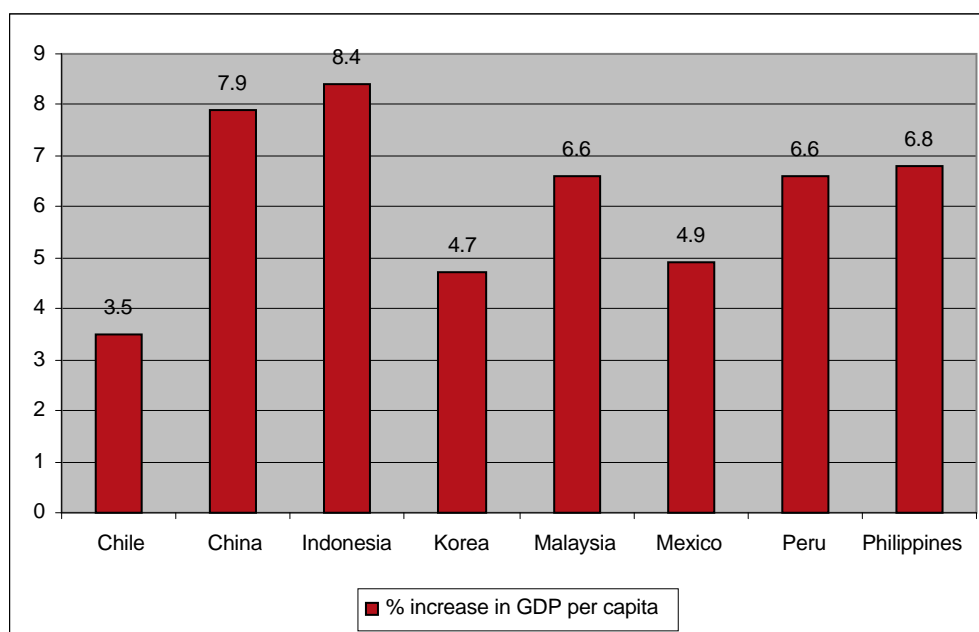
(for example, road transport) can be seen as pioneering behind-the-border regulatory reform based on reductions in product market regulation beginning in the 1970s.

Not surprisingly, APEC economies have pursued different approaches to structural reform. Examples of ‘big bang’ reform (for example, the Philippines in the 1980s, Thai trade reforms after the Asian crisis) sit alongside more gradualist approaches (for example, Australia and China in the 1980s and 1990s). In line with the diverse approaches taken, progress has been uneven, with examples where reforms have stalled or been reversed. In some cases, the impetus for reform, or for renewed reform momentum, has awaited major economic crises to remove reform obstacles (for example, Mexico in 1994-95; Thailand, Indonesia and Korea in 1997-98).

Gains from reform have varied markedly given significant differences in the content and pace of structural reform and in complementary policies. In turn, substantial scope exists for further income gains from structural reform in APEC economies. For example, a study by Buckle and Cruickshank (2008) suggests that behind-the-border policy settings, including the quality of regulations and the costs of doing business, can have a profound impact on the rate of economic growth convergence in the APEC region. They conclude that structural policies can reduce the “half-life” of complete income convergence from about a century to a matter of a single generation.

Miroudot et al. (2007) has similarly found scope for significant income gains based on mutually reinforcing reforms of trade, investment and competition policies. As a measure of structural reform potential, an index was developed synthesising 13 indicators of trade, investment and competition policy across 82 economies, both developed and developing. The results point to the potential for substantial income gains in APEC economies from market and regulatory reforms (Figure 26). Gains are highest among economies with the most restrictive structural policies. These results are consistent with other international studies which have shown that industrialised economies that have extensively reformed their product markets experienced an acceleration of productivity in the 1990s (OECD 2003).

**Figure 26 Potential gains in GDP per capita, select APEC economies**



Source: Miroudt et al 2007

## ii. **Four key lessons**

Within the APEC region and beyond, various lessons have emerged from the structural reform experience of both developing and developed economies. Four are outlined below:

### ***1. Various structural reform policies appear closely interlinked; for example, there is a positive interrelation between greater international market openness and good regulatory practice behind-the-border***

The connection between openness to trade and FDI and pro-competitive behind-the-border policies has been well established in an APEC context. Maximising the gains from reducing border barriers requires well developed behind-the-border policies supportive of competition and efficiency, but also aligned closely with the particular circumstances of individual economies. Meanwhile, gains from behind-the-border reforms increase significantly in an economy open to the opportunities of globalisation (APEC Policy Support Unit 2008).

A large number of APEC economies at different stages of development and with diverse economic structures – including China, Singapore, Korea, Thailand, Chile, Australia and New Zealand – have demonstrated the positive linkages between greater international openness and sound domestic structural policies. In the case of New Zealand, for example, the mid 1980s witnessed the beginning of a period of wide ranging reforms beginning with the floating of the exchange rate and the liberalisation of international capital flows. Successive steps included trade liberalisation, removal of distortions in domestic markets, labour market reform and the introduction of more transparent frameworks for macroeconomic policy management. The New Zealand economy's performance improved significantly following these reforms with an acceleration of growth driven to a large extent by growth in total factor productivity (Diewart and Lawrence 1999).

Conversely, economies that fail to pursue pro-competitive reforms domestically in conjunction with trade and foreign investment reform miss out on potential gains (Miroudot et al. 2007). For example, inadequate reform of critical services inputs to the production of goods and services, such as transport and communication, can constrain significantly the opportunities from lowering border barriers. In Thailand, telecommunications costs have been found to be 80-90 per cent higher than otherwise thus imposing costs on the export sector (Dee 2004).

### ***2. On-going evaluation and benchmarking of structural reform can play a key role in ensuring it is a continuous, dynamic process rather than a one-off event***

Among the lessons of the OECD's extensive work on regulatory reform is that behind-the-border policy frameworks need regular reviews so that they can continue to meet original policy goals, as well as a complete reworking to meet new policy goals. Without regular evaluation of regulatory performance existing frameworks can fail to allow for sufficient flexibility and innovation in economic processes.

One of the issues highlighted in this context is the importance of a consistent, whole-of-government approach to pursuing 'regulatory quality'. Regulatory quality goes beyond the specific content of regulations to include the processes by which regulations are drafted, updated, implemented and enforced. In this context, there appears to be a strong relationship between an effective, comprehensive regulatory policy and the existence of a central oversight body that can ensure regulatory quality principles are applied successfully.

In the context of the APEC-OECD Cooperative Initiative on Regulatory Reform, there is considerable scope for further regulatory reform. Korea is one example of reforms undertaken following the Asian financial crisis in 1997. A joint government/non-government Regulatory Reform Committee establishes basic quality guidelines, ensures quality control of Regulatory Impact Analysis and reviews new and existing regulations. With strong political leadership, the Committee has significantly reduced the number of regulations as well as improve regulatory transparency and accountability (OECD 2008).

### ***3. Promoting complementary policies and assisting those who lose as a result of reform decisions can help to overcome obstacles to reform and insure against reversals***

Complementary policies, by helping ensure that those disadvantaged by one reform benefit from another, can ensure that the combined effects from structural reforms are greater than the sum of the parts. Economy-wide benefits include creating an environment conducive to innovation and technical diffusion that will enable economies to move up the international value chain (OECD 2005).

In this context, flexible labour markets and social security policies can play a critical role in addressing the adjustment challenge from structural reform. Care needs to be taken in laying down prescriptions for economies at different stages of development as the adjustment challenge faced by different APEC economies will vary markedly.

In some APEC economies, major reforms have been complemented by labour market reform and/or targeted adjustment assistance to facilitate worker mobility across occupations, firms, industries and regions. This has allowed new growth opportunities to emerge based on higher value activities, including in the export sector. For example, in order to secure the gains from deeper integration under the North American Free Trade Agreement (NAFTA), the NAFTA Transitional Adjustment Assistance program was developed in the US to assist workers who were found to have lost their jobs, or whose hours of work and wages were reduced as a result of trade with, or a shift in production to, Canada or Mexico.

### ***4. Politics matters based on the importance of institutional design, political leadership and high level technical capacity to credible, sustainable reforms***

Structural policies alone are not enough. Reform is by definition a government driven process, and so at various stages it may be susceptible to government failure and the problems created by such failure. Reasons for poor reform processes and outcomes and government failure include asymmetric information, rent seeking behaviour, and bureaucratic management and incentive problems (IMF 2004). A major World Bank study of economic reform in the 1990s found that while reforms were directed at increasing the role of markets and decreasing the role of the state, they tended to neglect the role of institutions (World Bank 2005).

In some economies, state enterprises were privatised without adequate attention to the operation of the markets in which they would operate. Similarly, public sector reforms that look impressive on paper failed to affect behaviour in the face of weak financial controls, opaque budget processes or non-meritocratic civil services. Part of China's success in sustaining reform has been its ability to develop extensive domestic capacity to design reforms suited to its particular circumstances. By contrast, in Indonesia (at least throughout the Soeharto era), this capacity remained limited to a small group of policy makers and advisers (Hofman et al. 2007).

The outcome of privatisation in the Russian Federation illustrates both the benefits and problems that reform can create and highlights the importance of coherent property rights structures. Property rights entail both a right to use property, as well as a right to exclude others from using it. When several individuals possess multiple, overlapping rights to exclude, each effectively possesses veto power over usage decisions taken by the other owners. This increases transactions costs and reduces the extent to which the resource is used, reducing the value of the resource (Heller, 1998, 2008; Buchanan and Yoon, 2000). In the case of the Russian Federation, these considerations turned out to be a crucial determinant of privatisation outcomes. On the one hand, housing privatisation in the Russian Federation was a relative success because multiple exclusion rights were rarely issued. On the other hand, commercial real-estate privatisation in the Russian Federation was plagued by overlapping exclusion rights and the transaction costs problem, and as a result was far less successful.

### **iii. The agrifood sector in an economy-wide context: A mixed picture**

These lessons provide a useful lens for exploring linkages between broad based structural reforms and the performance of the agrifood value chain in APEC economies. Overall, the picture is a mixed one. Where some APEC economies have pursued extensive and coherent reform agendas that have improved the competitiveness of both the agrifood sector and the wider economy, other economies have been unable to fully exploit opportunities to reduce distortions and to provide an enabling environment for competition, innovation and structural change.

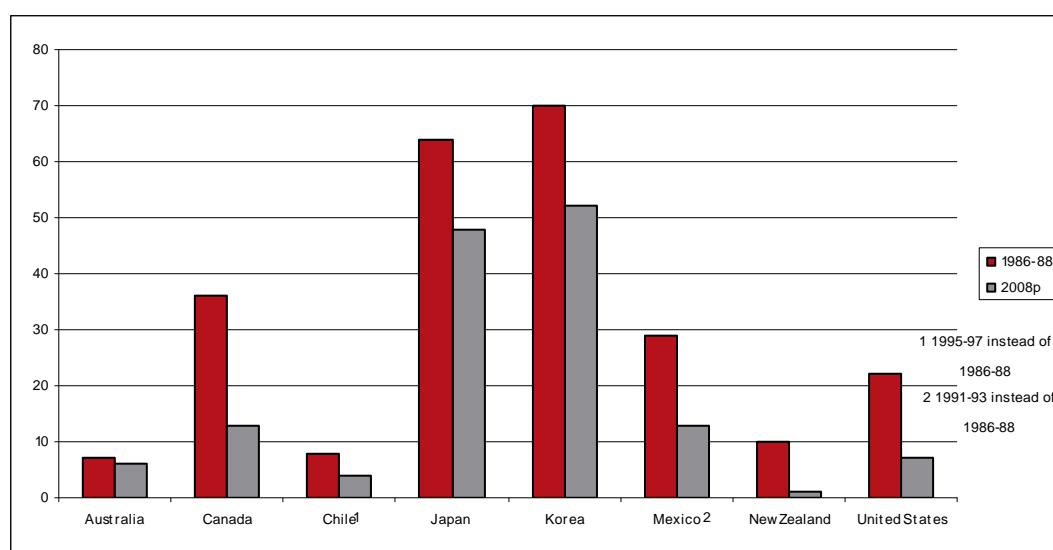
In this context, particular emphasis is placed on the role of trade and investment policies, labour market policies and regulatory frameworks (including for key input services), recognising that the circumstances of, and appropriate policy mix in, individual APEC economies will differ widely. The role of complementary transitional programs to assist losers from the reform process and to facilitate adjustment is also examined

Trade and investment policies both at home and abroad have the potential to impact on economic welfare through various channels. An economy-wide perspective on trade policy and reform would take account not only of direct price distortions by border measures but also of policies affecting the prices of products that are substitutes or complements in production or consumption. Macroeconomic instruments (for example, the exchange rate) can also distort incentives.

A number of APEC economies maintain significant trade policy distortions in agriculture with consequences for both international and domestic food markets. Despite some movement toward lower producer support estimates in a range of middle to high income APEC economies (see Figure 27) (that is, the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers measured at the farm gate level as a share of the gross value of farm receipts), there remains significant scope for further liberalising reform.



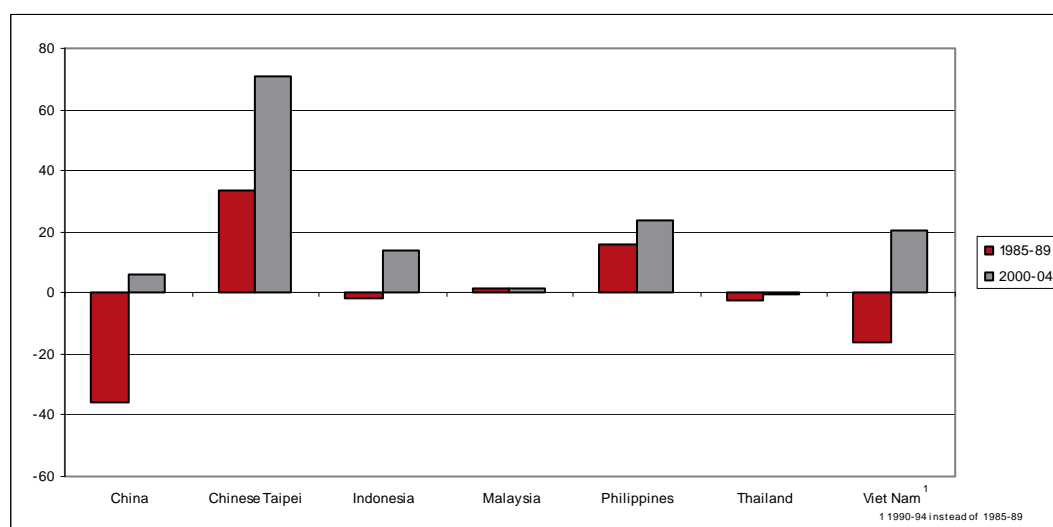
**Figure 27 Producer support estimates, select middle and high income APEC economies, per cent**



Data source: OECD 2009

By contrast, the pattern in developing APEC economies has reflected the historical policy bias against agriculture characteristic of low income economies (see Figure 28).

**Figure 28 Producer support estimates, select developing APEC economies, per cent**



Data source: OECD 2009

In a structural reform context, the experiences of Australia, New Zealand and Chile provide strong evidence of the benefits and synergies of exposing an economy’s agrifood sector to greater international competition when combined with behind-the-border reform to improve the operation of domestic markets. In each instance, adjustment measures helped to facilitate the reform process.

In the case of Chile, economy-wide reforms over three decades have reduced international and domestic distortions and underpinned the rise of an export-oriented agrifood sector. The elimination of export biases due to an initially overvalued exchange rate, export promotion

measures and adjustment assistance to small farmers have helped to support export led growth in a number of high values sectors including fresh fruit and vegetables, processed products and wine. With extensive forward and backward linkages, growth in the agrifood sector in Chile has helped to deliver improved living standards and poverty reduction (OECD 2005).

New Zealand's reforms began in 1984 and saw the swift removal of export and production support policies in the agriculture sector, followed by the more gradual removal of support policies across traditional import competing sectors. Later economy-wide reforms (including macroeconomic stabilisation measures, labour market reform and social security reform) enabled New Zealand's agrifood sector to benefit from the better use of resources and to become more responsive to market signals. The result has been an improvement in total factor productivity growth from an average of 1.5 per cent a year in the pre-1984 period to an average of 2.5 per cent a year in the post-1984 period. Higher productivity growth has been based on productivity improvement in individual sectors (for example, dairy, beef and sheep) and a shift of resources into high productivity sectors (ABARE and MAF 2006). The New Zealand Government introduced a range of transition programs, including in some cases to facilitate adjustment out of farming. While criticisms surrounded the perceived unfair burden of adjustment borne by farmers relative to other sectors in the early reform years, the result has been the growth of a more competitive, innovative and quality focused agrifood sector (Forrest 2008 p. 40-41).

Australia also began major economy-wide reforms in the 1980s that included a reduction in high protective tariffs and quotas, including in the agrifood sector, together with a range of behind-the-border reforms designed to reduce distortions and increase competition in the Australian economy. Industry case studies have identified a number of structural reforms as relevant to the performance of the agrifood sector including: reforms to statutory marketing arrangements for agricultural products; reductions in assistance to agriculture and manufacturing; labour market reforms; infrastructure reforms; mutual recognition of regulations including product standards; and reforms to government services such as export inspection. Heightened competition has delivered a more competitive and diverse agrifood sector with a strong export focus.

A sharply different policy context has tended to characterise many developing APEC economies. Historically, many relatively low income economies have taxed agriculture in one form or another.

With relatively more people employed in agriculture, it suggests that the employment adjustment resulting from border liberalisation may be of greater concern than in developed economies where adjustment will be more incremental.

**iv. Case study: Economy-wide reform, productivity and the agrifood sector in Mexico**

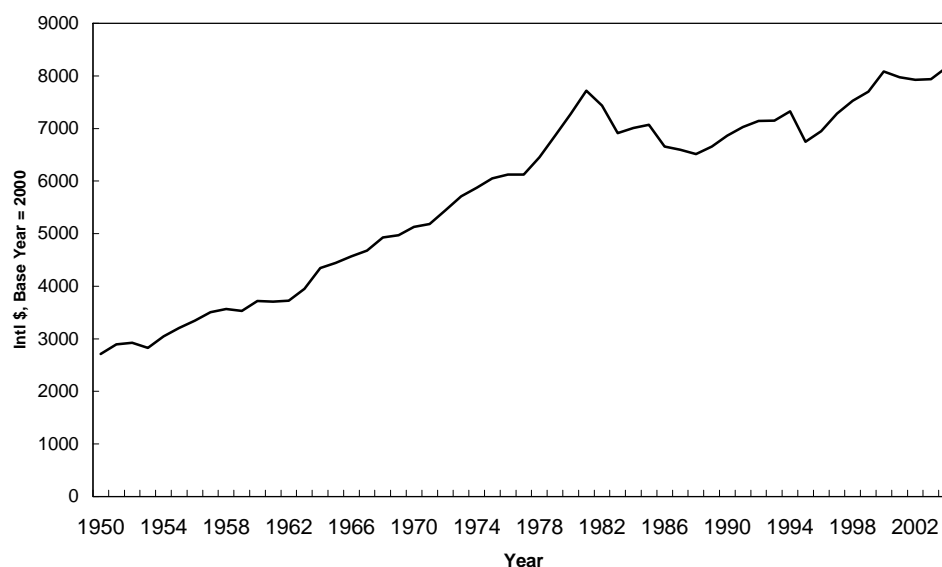
An economy-wide perspective on structural reform allows for more informed examination of the links between various behind-the-border policies that can affect food systems. Mexico provides a case study of the gains from past reform, and the obstacles to (and potential gains from) further structural reform.

As in most other APEC economies, the relative importance of the agrifood sector to the Mexican economy has declined in the last two decades. The agricultural sector in Mexico is characterised by great disparities in farm sizes and types from highly commercialised to subsistence. Mirroring overall productivity patterns, productivity growth in the agricultural sector has been poor since the mid 1990s. As a result, there has been little reduction in rural poverty, even as overall poverty levels have declined. Identifying the main impediments to overall productivity growth in Mexico thus highlights which economy-wide or cross sectoral policies are likely to have the most impact on improving the efficiency of food markets and the performance of the agrifood system.

**1. Economy-wide reform developments**

For more than two decades, Mexico has maintained a path of structural reform, albeit unevenly and in the face of periodic setbacks and economic crises. The debt crisis of the early 1980s served as the initial catalyst for a shift away from an import substitution strategy and toward a process of market liberalisation. This led to a reduction in trade and investment barriers, the lifting of price controls, including in agriculture, and the dismantling of a range of financial controls (including ceilings on interest rates and ownership restrictions in the banking sector). Mexico's entry into GATT in 1986 helped entrench a more outward looking economic growth strategy.

However, despite these reform achievements, Mexico's economic performance has lagged behind comparable economies, with weak growth in real GDP per capita since 1980 (Figure 29). Low productivity growth and international competitiveness has been mirrored in the agrifood sector where particular challenges also surround issues such as land fragmentation, a large informal sector and acute rural poverty.

**Figure 29 Mexico real GDP per capita, 1950-2004**

**Data source:** Heston et al (2006)

At the heart of economic reform was the reinterpretation of government's role in the Mexican economy, with the pervasive planning and control of 'strategic sectors' replaced by a process of privatisation of publicly-owned enterprises (SOEs). Among the largest and most extensive SOEs to be sold after 1985 was CONASUFO, the economy-wide commodity marketing and food distributor for basic crops and food-stuffs with a network of 18,000 retail stores and 32 manufacturing and food processing operators, together with 70 per cent ownership of Mexico's food storage facilities (Garcia 1996).

The negotiation of the North American Free Trade Agreement, which came into force in 1994, extended Mexico's shift toward global integration. In 2006, the weighted average tariff rate in Mexico was 2.4 per cent (Heritage Foundation, 2009), although the existence of non-tariff barriers means that the actual costs of international trade can still be quite high.

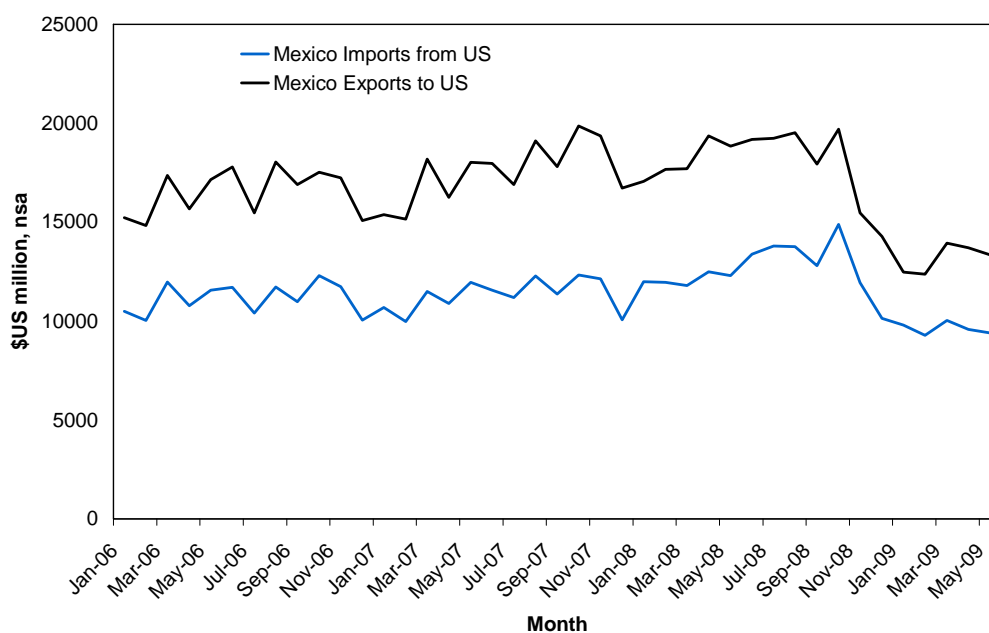
The macro-financial crisis of 1994-95 led to renewed structural reforms with a strong behind-the-border focus. Privatisation was extended to the majority of state owned enterprises, new emphasis was given to competition policy, and regulatory reform was given greater prominence.

**Box 16 The performance of the Mexican economy during the global financial crisis**

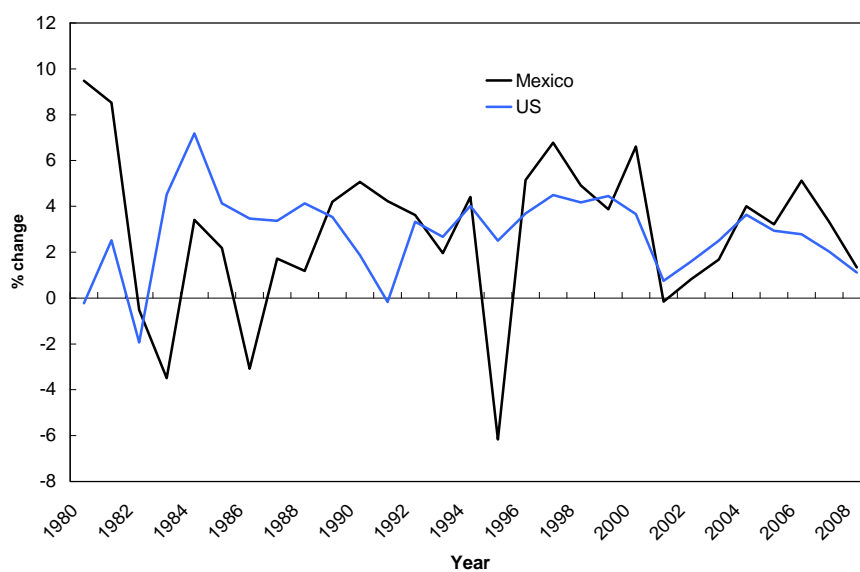
The global financial crisis has reduced credit growth, consumer and business confidence, consumption, investment, share prices, employment, trade volumes, and the near term growth outlook in most economies, including Mexico.

Whilst economic growth in Mexico has experienced a great deal of volatility at various points throughout the past few decades, a key catalyst for the recent downturn is the economy's growing trade and financial linkages with the United States. Figure 30 below shows that since the onset of the US recession, trade in goods and services between the US and Mexico declined substantially in late 2008, although the sharp decline now appears to have abated, with trade volumes stabilising and increasing slightly in recent months. During the last decade, as trade and financial linkages between the two economies have become tighter, the business cycle of the Mexican economy has become much more synchronised with the US business cycle (Figure 31). Thus, whilst the recent global macroeconomic shock comes during a period in which the Mexican economy has become more resilient and open to trade, it has also become much more sensitive to external economic shocks from the United States.

Assuming that the macroeconomic linkages between the two economies continue to grow, they will have both benefits and costs. Short term external macroeconomic shocks can lead to sectoral disruptions and associated adjustment costs, as factors of production move from lower to higher valued uses in response to changing macroeconomic conditions. However, if economic integration and closer trade and financial links mean that the growth rate of the Mexican economy also matches or exceeds that of the US economy in the long run, then the short term adjustment costs will likely be outweighed by the longer term gains brought about by higher overall living standards.

**Figure 30 Mexico US trade, 2006-2009**

**Data source:** US Census Bureau, Foreign Trade Statistics

**Figure 31 Mexico and US GDP growth, 1980-2008**

**Data source:** IMF World Economic Outlook Database, July 2009

Intertwined with Mexico's economic transformation has been radical changes in its political system towards competitive elections, greater transparency and a stronger voice for civil society. The 1990s also saw the beginning of a process of decentralisation that has delivered greater spending responsibilities to the states and, to a lesser extent, municipal levels of government (World Bank 2007, 13).

Mexico's structural reform experience has yielded a better integration between market openness and competition and regulatory reform (OECD 2004). Particular achievements in

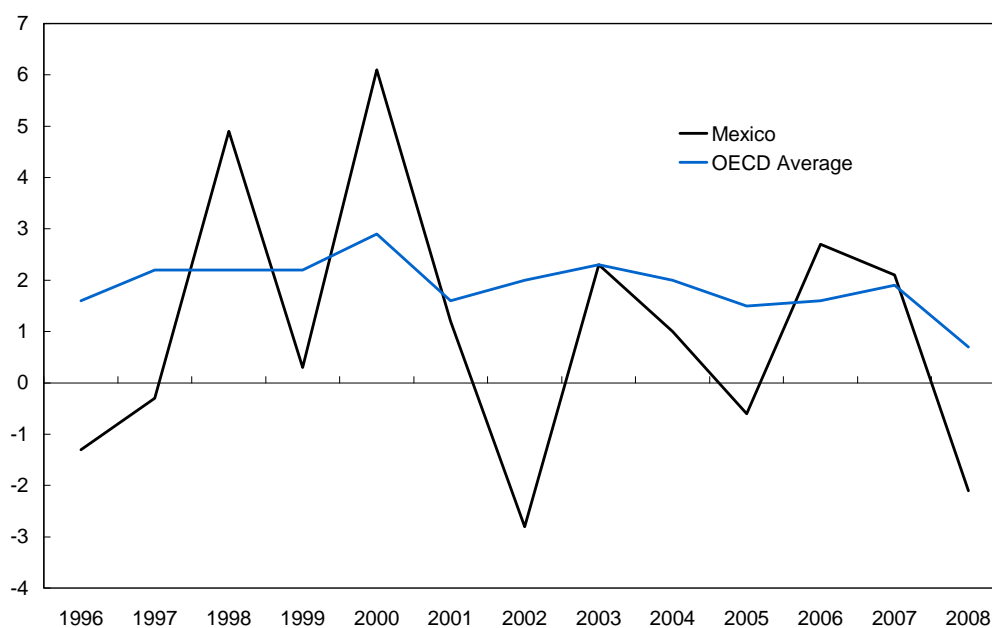
regulatory reform have included the reform of public institutions and the modification of legal and policy instruments to improve regulatory quality. All regulatory proposals (including laws, major implementing regulations and decrees) that are likely to impose costs on individuals or businesses must be submitted to the Federal Commission of Regulatory Improvement (COFEMER) with a Regulatory Impact Analysis Statement (APEC 2008).

In the wake of the 1994-95 macro-financial crisis and coinciding with the early years of NAFTA, Mexico experienced a period of higher, more stable growth. Macroeconomic stability, low inflation, better targeted government transfers and income diversification in non-agricultural activities also contributed to a reduction of overall poverty (World Bank 2007).

## **2. *Productivity in Mexico: Challenges and opportunities***

Despite past reforms, tangible progress in reducing the income gap between Mexico and industrialised economies has remained limited, due essentially to an underlying problem of low productivity growth in a wide range of sectors. Figure 32 below plots the growth rate of labour productivity (aggregate output per worker) in Mexico since 1996, and shows that the growth rate of this indicator has been sluggish compared to the OECD average, particularly since 2000.

Mexico's poor productivity performance is even clearer if we examine total factor productivity growth in other Latin American economies over a longer period of time. For example, Bergoing et al. (2007) study the relative performance of the Mexican and Chilean economies since 1980, noting that over this period, detrended output per person in Chile far exceeded that of Mexico. They show that that differences in total factor productivity growth (and the structural reform policies that influence productivity) account for more than two thirds of this difference in growth rates of output per person, with the remainder being explained by differences in supplies of factor inputs. Bergoing et al. also show that the timing of reform explains much of the difference in productivity performance, with Chile implementing reforms much earlier than Mexico.

**Figure 32 Labour productivity in Mexico and the OECD, 1996-2008**

**Data source:** OECD

In a major study of competitiveness issues in Mexico, World Bank (2007, p. 20) researchers argued that:

Part of the challenge facing Mexican policy-makers is that there are not a lot of big-bang reforms that one can enact to make the next leap in development: from upper-middle-income status to high income status. Instead, there are a variety of long battles to be waged in improving institutional performance.

High cost utility and infrastructure services rank as a notable drag on both economy-wide competitiveness and the performance of agrifood sector (OECD 2006a, 10). In various areas, the decentralisation of governance has reinforced the complexity of the business environment and the costs that can be incurred in starting and operating a business. For example, the cost of starting a business varies markedly between different Mexican states as does the overall quality of regulatory governance.

A range of studies have therefore highlighted both areas of economy-wide structural weakness in Mexico and the potential gains from further structural reform. Among the areas likely to deliver reform gains are those directed at the cost wedges and supply side impediments that have been identified in Chapter 3 of this study: reforms to infrastructure investment and network industries (such as electricity and telecommunications); institutional reform, education reform, improved competition policy, and the reduction of corruption. These economy-wide reforms and cross sectoral policies are likely to have a positive impact and improve the efficiency of food markets and the productivity performance of the agrifood system.



**v. Key messages: Structural reform**

- Certain reform ‘lessons’ may aid future progress. Four key lessons highlight: 1) the close inter-linkages between reform of trade and foreign investment regimes and coherent and efficient behind-the-border policies; 2) the importance of ongoing evaluation of reform benchmarks; 3) the contribution complementary policies and measures to assist those who lose as a result of reform can play in overcoming obstacles to reform and guarding against reversals; and 4) the critical role of politics given the degree to which reform success relies on institutional design, political leadership and strong technical capacity.
- Given these lessons, the picture that emerges of the agrifood sector in APEC economies remains decidedly mixed. Where some APEC economies have pursued coherent and integrated reform agendas improving the overall competitiveness of their agrifood sectors, others have failed to overcome reform obstacles. Given the importance of income growth, especially at the lower income level, addressing these obstacles will be a high priority in terms of increasing food security.
- While virtually all APEC economies have undertaken major structural reforms over the last two decades, the gains from reform have varied markedly given significant differences in the content and pace of structural reform and in complementary policies.
- In a structural reform context, the experiences of Australia, New Zealand and Chile provide strong evidence of the benefits of exposing an economy’s agrifood sector to greater international competition when combined with behind-the-border reform to improve the operation of domestic markets. In each instance, adjustment measures helped to facilitate the reform process.
- Notwithstanding the APEC region’s impressive growth performance, substantial scope exists for further income gains from structural reform. Differences in the policy environment and resource constraints mean that economies will (and should) place priorities on different areas.

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## 9. CONCLUDING REMARKS – A TAXONOMY

The creation of a taxonomy or typology can serve a number of purposes. The purpose here is principally in the sense of a performance diagnostic. Performance diagnostics are somewhat unique in that the benchmark, the impediment or problem, and the way forward may all need to be identified and understood at the same time.

Benchmarks are particularly important in an APEC context because of the diversity of individual economies, as reflected in difference in their stages of development, endowments of natural resources and cultural values. One benchmark does not suit all, especially at a given point in time. The sectors and stages of the agrifood system are roughly classified in Table 13. In making inter-economy comparisons it is important to use benchmarks that align these sectors and stages. The majority of developing APEC economies would be placed in the modernising category, however, there remain strong traditional elements, especially in more remote regions

For a taxonomy to be effective in this context there must be degrees of commonality and also recognisable and meaningful points of divergence. Further, it is important that exceptions can be recognised without undue loss in the value of the taxonomy.

Even where the impediments are similar across economies, the gains, and therefore the priorities of addressing them, will differ. Impediments can be classified into four basic types:

- Structural adjustment costs – the costs of shifting human, land and water resources within and between sectors of an economy. These costs can include transactions costs, and the stranding of human, physical cultural assets.
- Market access – the ability of participants in the food production and marketing chain to access the inputs and products as needed. This needs to be seen across the range of participants at each stage of the production and marketing chain and includes access to market information.
- Competition – the existence of barriers to entry allow firms to achieve returns that are in excess of their long run marketing costs, leading to lower prices to food producers and higher prices to consumers.
- Other market failures - that result in market prices that do not reflect the full costs and benefits of food production, distribution and consumption. These can arise from poorly defined property rights, public benefits and non market costs such as environmental degradation.

Market failures are often related to non-market values or the provision of public goods and services that compete with other needs within an economy. The priority that they are given will reflect the preference of a particular economy.

However, given the broad classification of the impediments above, and the structure of the agrifood system shown in Table 13, it may be useful to construct a initial set of rankings for APEC economies, as shown in Table 14.

**Table 13 The structure of the agrifood system across different APEC economies**

<b>Sector</b>	<b>Traditional</b>	<b>Modernising</b>	<b>Industrialised</b>
Production	Small producers Diversified products Labour intensive Low input	Small producers but starting to increase in scale Specialised cropping High input use Mix of capital and labour adjusting	Specialised production Advanced management systems Increasing environmental focus
Processing	Limited small scale processing	Diversified small to medium enterprise processing Introduction of large scale processing	Large scale processing High level of regional concentration
Wholesale	Highly diversified Publicly owned and informal markets	Upgraded public facilities Increasingly specialised often private facilities	Reduced importance, replaced by retail distribution centres
Retail	Local wet markets Street markets	Introduction and expansion of supermarket formats	Widespread supermarkets Larger store formats
Consumption	Increasing caloric intake	Increasing diet diversification	More elaborately transformed food products
Procurement	Traditional markets with Export bypass	Traditional markets with export and retail bypass Limited contracting	Centralised procurement by large chains and processors
Handling	Labour intensive Non centralised Limited packaging, mainly for export	Labour intensive Increasingly centralised Improved packaging	Increasing mechanisation Centralised Advanced packaging
Transport	Limited public infrastructure Small scale and labour intensive	Improving public infrastructure Introduction and expansion of modern logistics	Advanced logistics
Vertical Coordination	Relationships	Relationships Preferred suppliers Limited contracting	Contracts Competitive concerns
Food Safety	No trace back	Emerging private food and processing standards Limited trace back	Private food and processing standards Government standards and enforced liabilities Moving toward full trace back

**Source:** Adapted from McCullough, Pingali and Stamoulis (20080)

The relative importance of structural adjustment and market access in developing economies is largely a reflection of the large number of small producers, agents, merchants and consumers that need to be able to access the channels of the agrifood system as well as the needs to modernise the system to achieve efficiency gains in procurement and distribution. The large number of players is likely to reduce, at least initially, concerns about competition. The relatively higher ranking of competition in developed economies is due to the greater degree of penetration by large scale vertically integrated firms that has already occurred. The relative benefits of further integration may be more closely weighed against the concerns regarding excess profits due to market power.

The mixed weight given to other market failures is a reflection of several factors. In developing economies, tenure over and water resources and the rapid shift of these resources from agriculture to industrial and urban use are important issues. The need to maintain access to traditional wholesale and retail markets for a substantial proportion of the population may also be an issue. In developed economies environmental concerns have become a focal issue.

**Table 14 Ranking of potential impediments in the food production and marketing chain – a developing and developed APEC economy perspective**

Sector	Structural Adjustment		Market Access	
	Developing	Developed	Developing	Developed
Production	High	Low	High	Low
Processing	Moderate	Low	Moderate	Low
Wholesaling	Moderate	Low	High	Low
Retailing	High	Low	Moderate	Low

Sector	Competition		Other Market Failures	
	Developing	Developed	Developing	Developed
Production	Low	Low	Moderate	High
Processing	Low	Moderate	Low	Low
Wholesaling	Low	Low	Moderate	Low
Retailing	Moderate	Moderate	Moderate	Moderate



## APPENDIX A TECHNICAL APPENDIX

This technical appendix discusses in more detail some of the economic concepts discussed in Chapter 3.

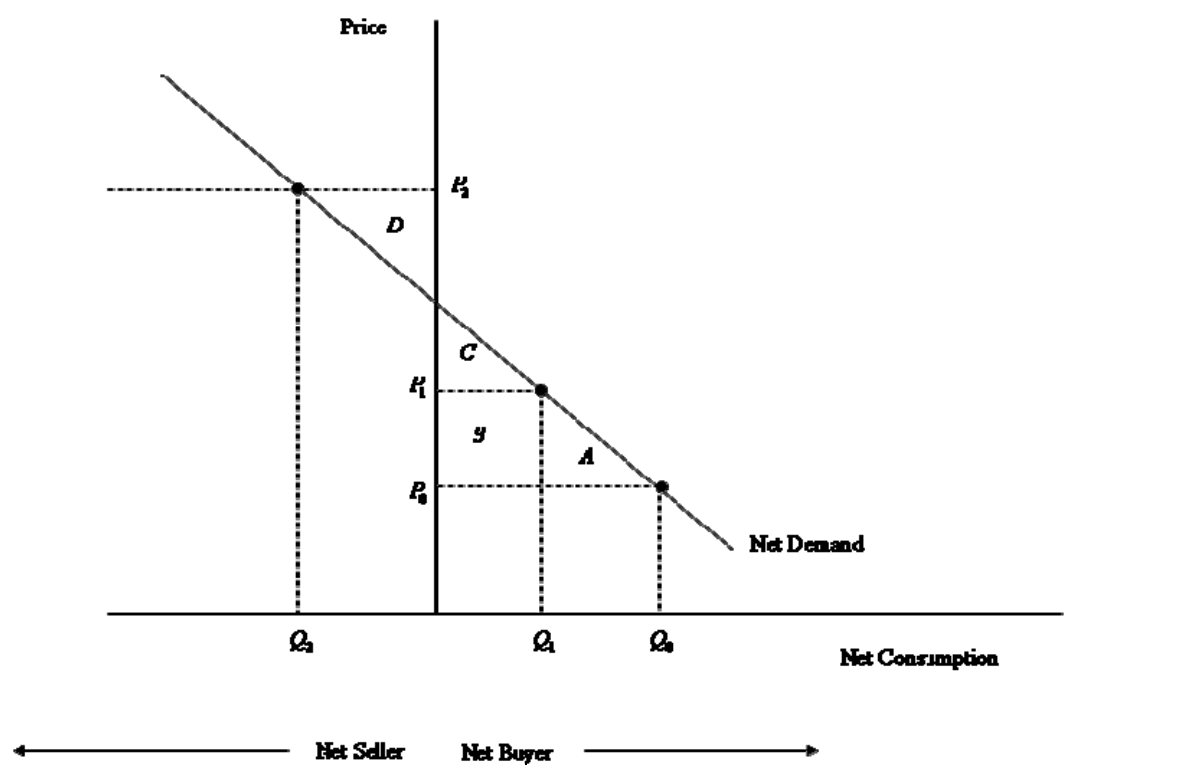
### A. Net food demand, price changes and welfare

To the extent that higher food prices are also associated with higher agricultural prices and wages, higher food prices will tend to increase incomes and are welfare-enhancing (Aksoy and Isik-Dikmelik, 2008).

Consider, for example, Figure A1, which plots the net demand curve for food for a single household/producer, abstracting from any changes in wages. This curve reflects the marginal value that the household places on each unit of net food consumption.

In a competitive setting the household's net demand occurs at the point where the marginal value of consuming the last unit of food is equal to the market price. When prices change, the change in household welfare is measured by the change in the area to the left of the net demand curve (area A+B when the price rises from  $P_0$  to  $P_1$  in the diagram below). It follows that for a household that is a net buyer of food, a price increase reduces net consumption and welfare.

Now suppose that there is a price rise to  $P_2$ , which is sufficiently high to cause the household to become a net supplier of food. The net effect of this price change is shown as  $-C+D$  in the diagram. The first effect is the usual welfare loss from higher consumer prices, but the second effect is a welfare gain from higher prices as the consumer switches to becoming a net supplier, and price received exceeds their marginal valuation of the good. Since the household is a net supplier at this price, any price increase above  $P_2$  will improve welfare.

**Figure A1 Net demand for food**

In such cases, then, a relevant indicator of the welfare effect of higher prices is the extent to which consumers are net buyers of the product in question. If food prices rise but the individual sells more than he buys, then that individual may benefit from higher prices.

### **B. The welfare effects of higher food prices**

Increases in food prices can cause significant changes in consumer behaviour and reductions in consumer wellbeing. A price rise effectively reduces a consumer's income but this can be partially offset as a consumer can replace the higher priced good with an alternative. For example, an increase in the price of meat may be partially offset by an increase in the consumption of legumes and rice. These welfare effects of price changes can be captured by analysing substitution effects and the money equivalent of price changes using a willingness to pay approach.

One of the common approaches to measuring the welfare effects of a price change is to use the compensating variation (CV) of a price change. When prices rise, the CV is defined to be the amount of money that must be given to a consumer at the new set of prices to leave him just as well off as he was before the price change occurred. Intuitively, the CV compensates the consumer for a price change that has already occurred. Alternatively, the equivalent variation (EV) of a price change can be used. The EV is defined to be the amount of money that can be taken from a consumer at the old set of prices to make him just as well off as he would be if the price change had in fact occurred.

Cross economy comparisons of the welfare effects of price changes is complicated by the fact that consumption and spending patterns tend to vary considerably across economies. The evidence suggests that among the basic groups of goods that individuals consume (such as

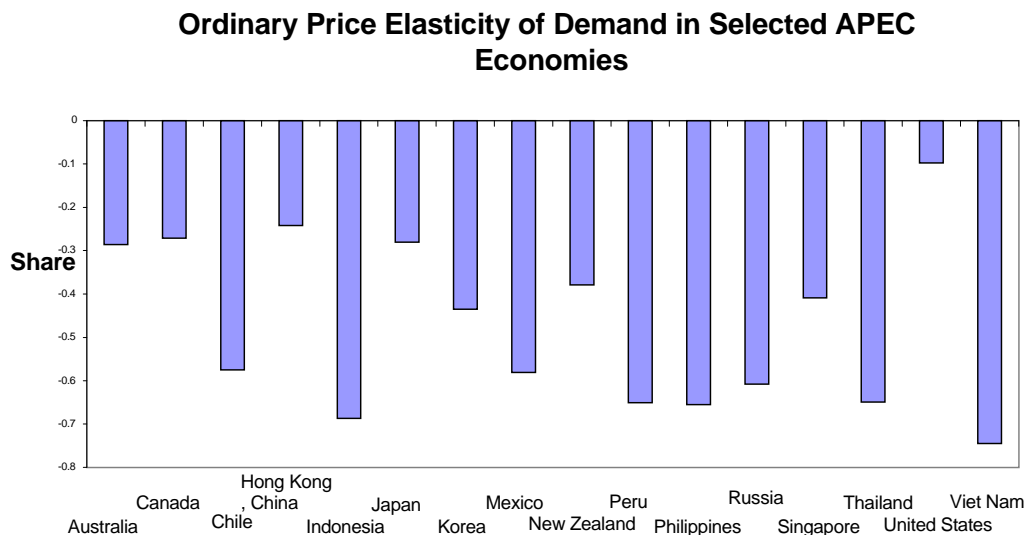


housing and rent, fuel and electricity, clothing and footwear, healthcare, education, and so on) demand for food tends to be the least responsive good to changes in price. This is true for developed and developing economies.

However, consumers in low income economies tend to spend a greater proportion of their income on food. Therefore, for these consumers, an increase in food prices is more comparable to a fall in real income and purchasing power over other goods and services than is the case for consumers in wealthier economies facing the same percentage increase in food prices. That is, for consumers in low income economies, even modest food price increases can be equivalent to significant declines in real income.

The responsiveness of consumers to changes in food prices can be measured by estimating the ordinary price elasticity of demand for food. This is a commonly used economic indicator which shows how food demand changes in response to a one per cent change in food prices. Figure A2 plots estimates of this ordinary price elasticity for 16 APEC economies<sup>19</sup>, using estimates calculated by Seale et al (2003).

**Figure A2 Ordinary price elasticity of demand in selected APEC economies**



Source: Seale et al (2003), Table 10, page 36.

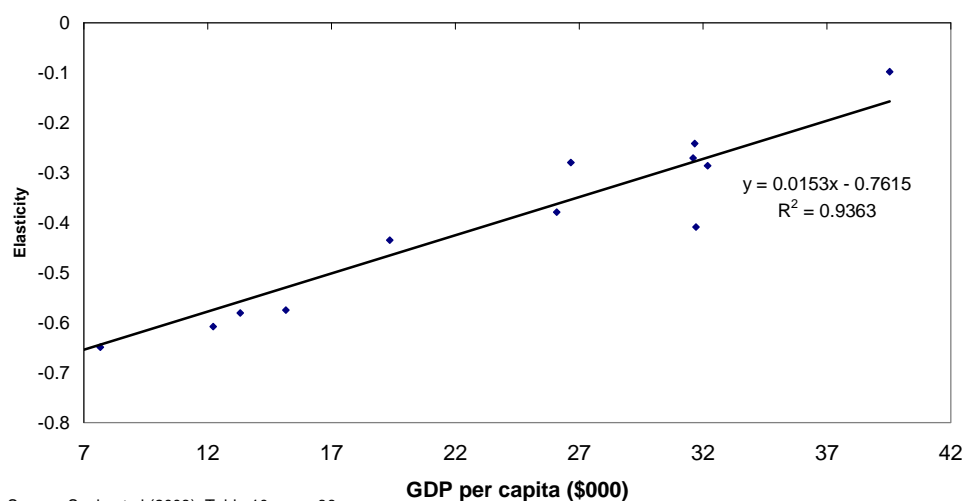
**Data source:** Seale et al. 2003 table 10, page 36

The empirical evidence suggests that the responsiveness of consumer demand to price increases as income declines. Moreover, the relationship appears to be linear. In other words, when food prices rise, consumers in poorer economies tend to reduce food consumption by more (in proportionate terms) than do consumers in wealthier economies. To show that this also applies to APEC economies, estimates of GDP per capita (for the year 2003) for selected APEC economies were obtained from the Penn World Tables (Heston et al, 2006). Figure A3 plots this responsiveness as a function of GDP per capita for selected APEC economies, and suggests

<sup>19</sup> The APEC economies for which elasticity data was available are: Australia; Canada; Chile; Hong Kong, China; Indonesia; Japan; Korea; Mexico; New Zealand; Peru; the Philippines; the Russian Federation, Singapore, Thailand, the United States and Viet Nam.

that an increase in per capita GDP of \$1000 is associated with a decrease in consumer responsiveness to food prices of 0.015 units.

**Figure A3 Ordinary price elasticity and GDP per capita in selected APEC economies**



Source: Seale et al (2003) Table 10 page 36

There are two key points here:

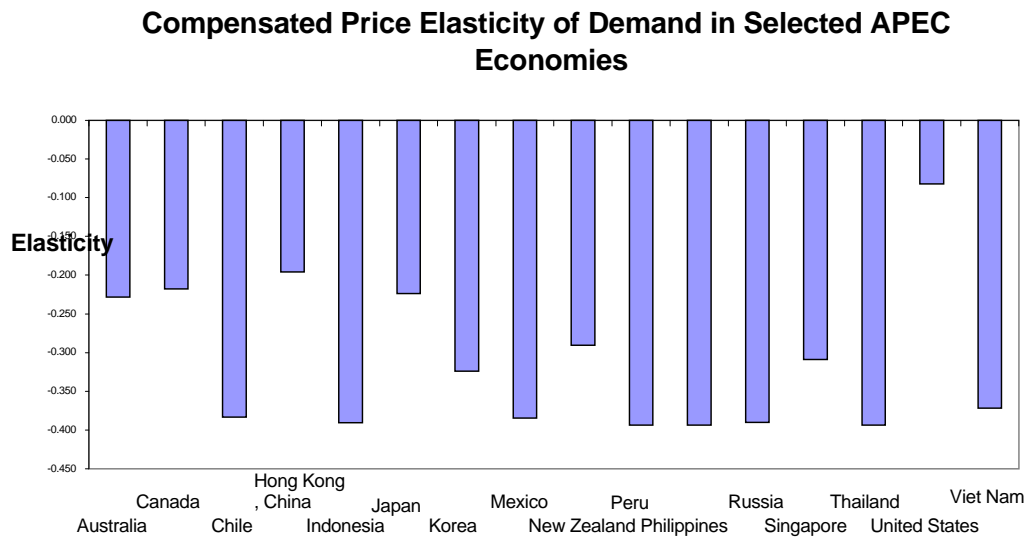
- The welfare effects on consumers of a food price increase will be greater the lower is income; and
- In markets where food prices are determined by domestic demand and supply a reduction in supply will result in a proportionately greater increase in food prices in developing economies.

The responsiveness of food demand to an increase in food prices is comprised of two conceptually separate but equally important effects:

- A substitution effect, which measures the degree to which a consumer substitutes out of food and into other goods, assuming that the consumer is compensated for the price change with an equivalent increase in real income; and
- An income effect, which captures the reduction in real income or purchasing power brought about by the price increase.

### 1. Substitution effects across APEC economies

The willingness of a consumer to substitute out of food and into other goods when food prices change can be isolated by estimating the consumer's compensated elasticity of demand. This elasticity tells us how the consumer adjusts demand in response to a one percent increase in price, assuming that the consumer is fully compensated for that change with higher money income and so is indifferent between the initial and final set of prices. Figure A4 plots estimates of this compensated price elasticity for food for 16 APEC economies, again using estimates obtained by Seale et al (2003).

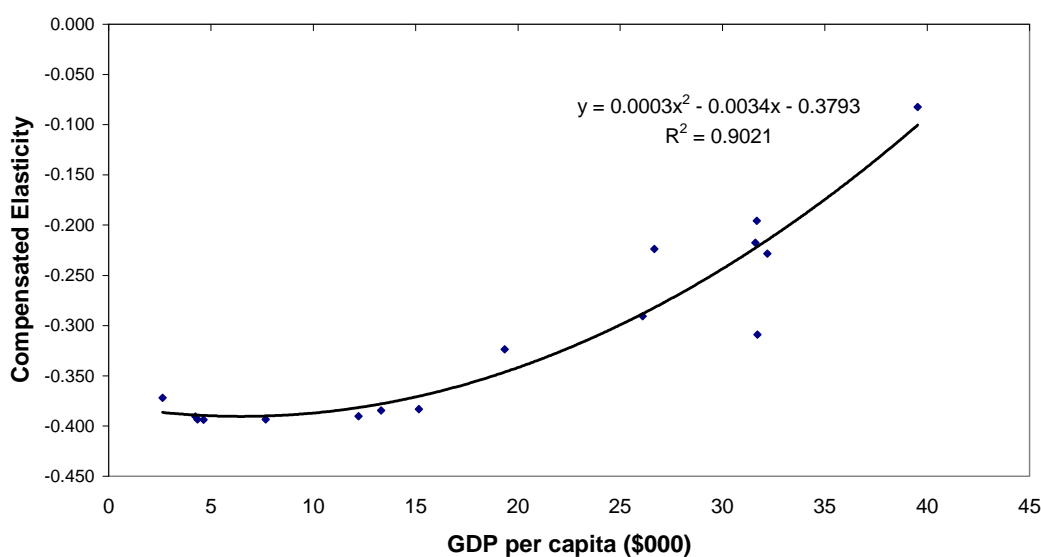
**Figure A4 Compensated price elasticity of demand in selected APEC economies**

Source: Seale et al (2003), Table 10, page 33.

**Data source:** Seale et al (2003), Table 10, Page 33

The empirical evidence suggests that the absolute size of this substitution effect increases – so consumers become more price responsive – as income declines, but only up to a certain point. Figure A5 plots the compensated elasticity as a function of GDP per capita in selected APEC economies. It suggests that the willingness of consumers to substitute out of food in response to price changes reaches a maximum when GDP per capita is approximately \$5700 (the income level corresponding to lowest or minimum point on the curve plotted in Figure A5). For incomes lower than this, price responsiveness for food begins to decline. In other words, the evidence tends to suggest that consumers in very poor economies tend to be less able to substitute out of food than consumers in moderately poor economies as there are limited substitution possibilities in a diet made up primarily of staple food commodities.

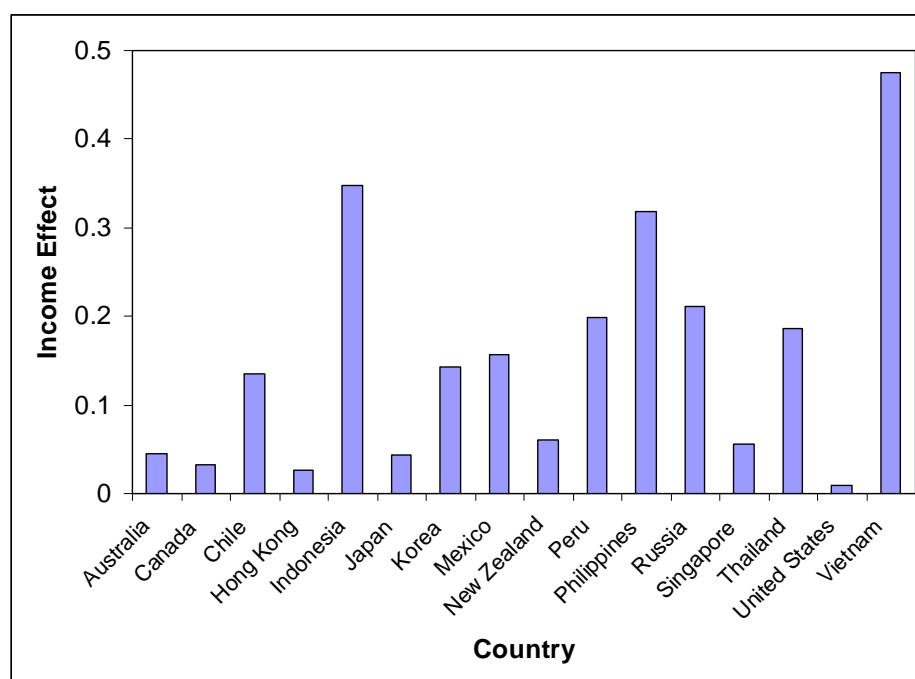
**Figure A5 Compensated own price elasticity of food in APEC economies**



Data source: Seale et al (2003),

The income effect of a food price change can be calculated as the difference between the ordinary and compensated elasticity of food demand. The income effect is in fact the measure of interest as it indicates the percentage change in a consumer's real income that is lost due to a price increase or gained through a price decline. The income effects calculated from the elasticity estimates provided by Seale et al (2003) are shown in Figure A6.

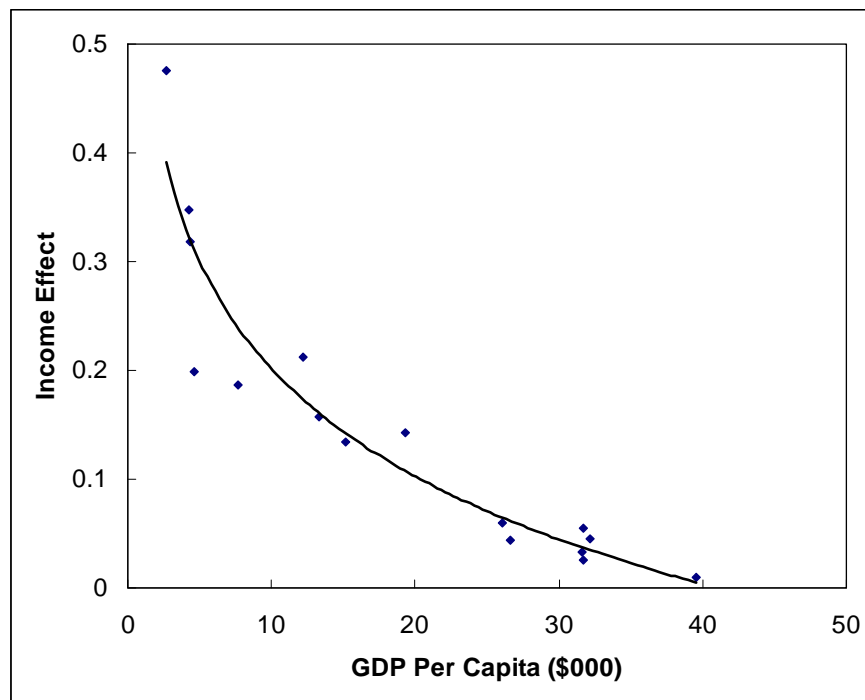
**Figure A6 The income effect for selected APEC economies**



Data source: Seale et al (2003)

In developing economies the income effect ranges from about 0.15 per cent to nearly 0.5 per cent. In the developed APEC economies a one per cent increase in the price of food produces less than a 0.05 per cent reduction in disposable income. The income effect is plotted against GDP per capita in Figure A7. The income effect rises sharply as incomes fall in the first third of the graph (compared to the last third of the graph), corresponding to relatively lower incomes. This provides a clear indication of how the welfare effects of an increase in food prices vary at different levels of income.

**Figure A7 The income effect and GDP per capita**



Data source: Seale et al (2003)

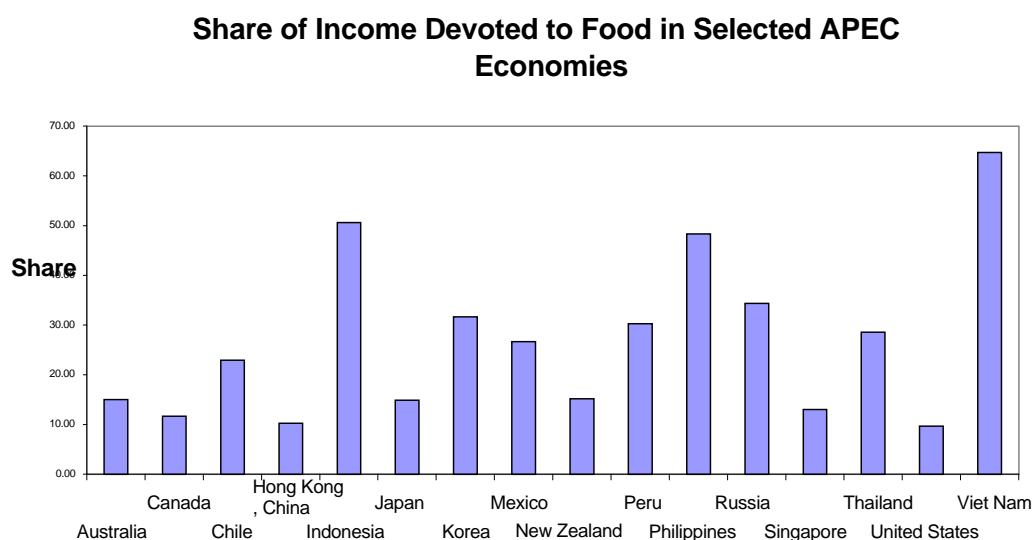
## 2. The income effect of changing incomes across APEC economies

The relationship between incomes, food consumption, and the share of income devoted to food has been studied at length in the literature. The empirical evidence suggests that as incomes increase, food consumption increases but at a slower rate.

One of the most important theoretical and empirical propositions in the economics literature is Engel's law, which states that the share of income devoted to food expenditure declines as income increases (Engel 1895). Under certain assumptions about consumer preferences, the share of income devoted to food expenditure can be used as an indirect indicator of living standards within and across economies. Indeed, a common approach to comparing living standards across economies is to compute real discretionary expenditure, which is the inflation-adjusted amount of income that is available after spending on necessities (such as food) has been accounted for.

Figure A8 plots estimates of the share of income devoted to food for selected APEC economies, again using estimates from Seale et al (2003).

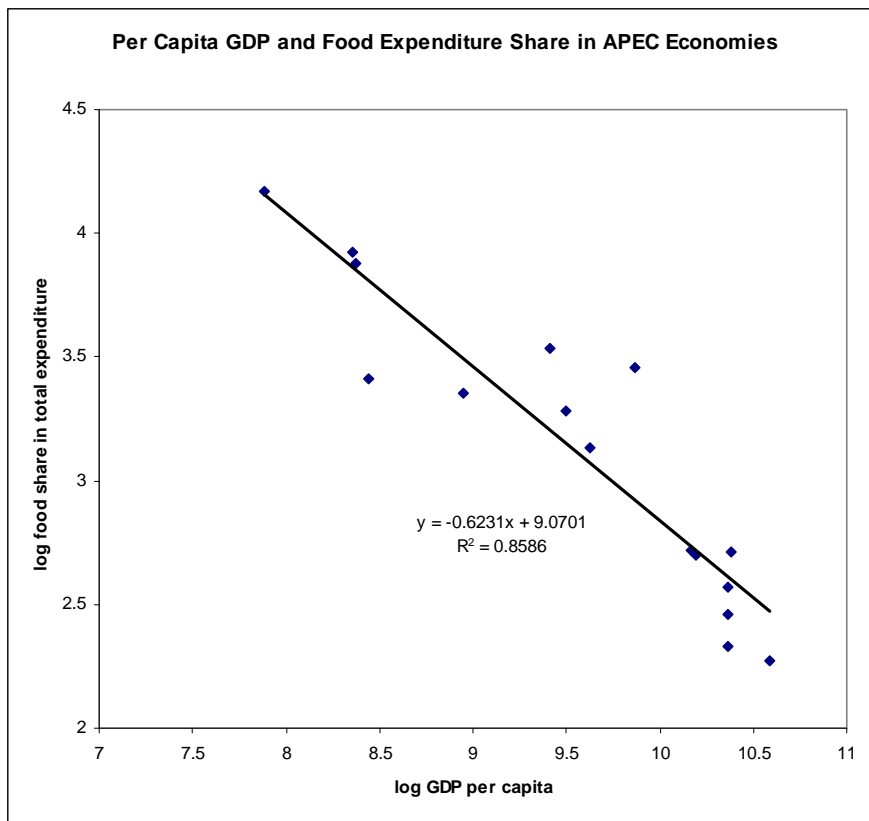
**Figure A8 Share of income devoted to food in selected APEC economies**



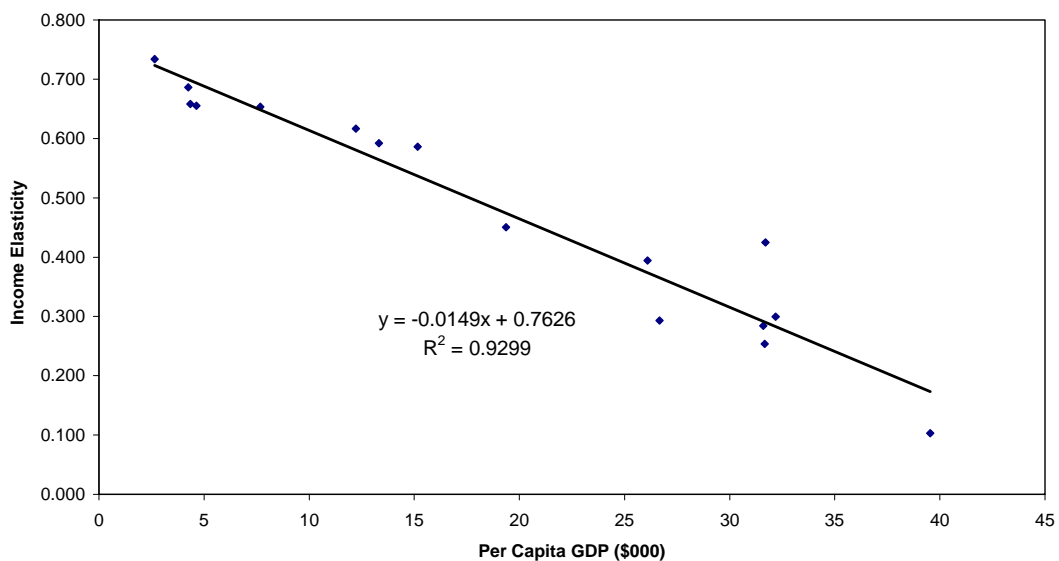
Source: Seale et al (2003), Table 3, page 15.

**Data source:** Source et al (2003), Table 3, Page 15

The results, which are illustrated in Figure A9, illustrate how strong Engel's proposition regarding the proportion of income spent on food is. The regression line estimated in the chart suggests that among APEC economies, a one per cent increase in GDP per capita is associated with a 0.62 per cent reduction in the share of expenditure devoted to food.

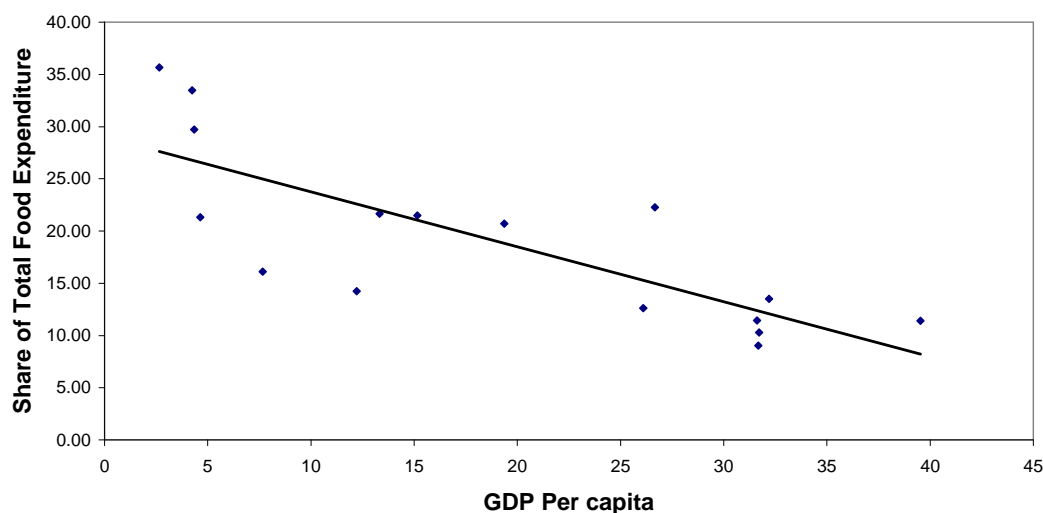
**Figure A9 Per capita GDP and food expenditure share in APEC economies**

In poorer economies food tends to be more responsive to changes in income than in wealthier economies. That is, the income elasticity of demand rises as income falls. This relationship is shown in Figure A10. The regression line estimated in the chart suggests that among APEC economies, an increase of \$1000 in GDP per capita is associated with a -0.01 unit change in the income elasticity of demand for food.

**Figure A10 Per capita GDP and income elasticity of food in selected APEC economies**

Finally, poorer economies tend to spend a greater fraction of their food expenditure (as opposed to expenditure on all goods) on staples such as breads and cereals. This is illustrated for selected APEC economies in Figure A11.

**Figure A11 Share of bread and cereals expenditure as a proportion of total food expenditure in selected APEC economies**



Moreover, in APEC economies, breads and cereals is the only food subgroup for which spending as a share of total food expenditure is negatively related to GDP per capita. This is shown in Table 15 below, which shows the results of simple bivariate regressions of shares of food spending on GDP per capita in selected APEC economies. The entry in the first row of the first column of the table shows, for example, that an increase in GDP per capita of \$1000 is associated with an increase in the share of food spending devoted to beverages and tobacco of 0.47 percentage points, and a decrease in the share of food spending devoted to breads and cereals of -0.53 percentage points.

**Table 15 Estimates of the relationship between share of food expenditure spent on subgroups and GDP per capita in selected APEC economies**

	Beverages, tobacco	Breads, cereals	Meat	Fish	Dairy	Fats, oils	Fruits, vegetables
Slope estimate	0.47	-0.53	-0.02	0.01	0.02	-0.04	-0.01
Standard error	0.12	0.11	0.11	0.13	0.07	0.03	0.09
t-stat	4.04**	-4.82**	-0.18	0.08	0.26	-1.55	-0.09

Note: \*\* Indicates statistical significance at 1 per cent level.

Source: Seale et al (2003), Heston et al (2006), own calculations

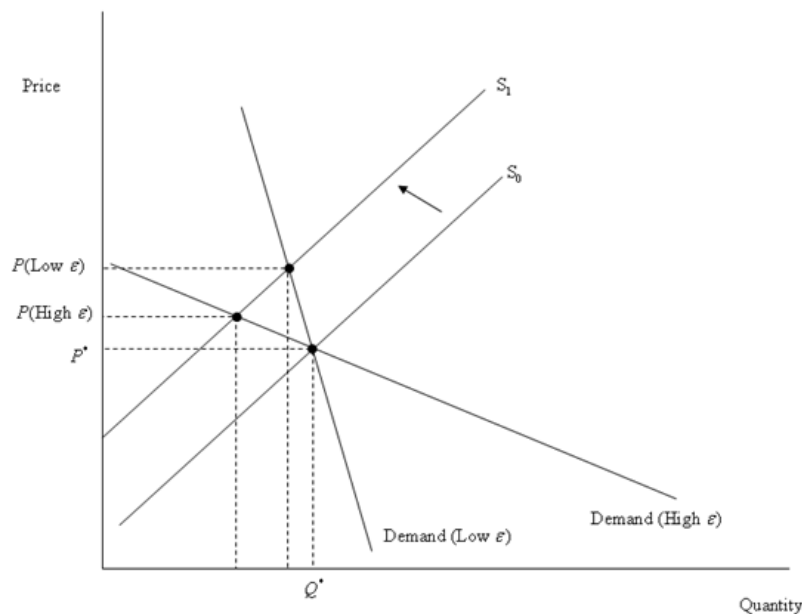
Therefore, in low income economies, when the 'average' price of food changes, consumers may substitute out of food if this is considered as a single category. However, the demand for certain staples that are needed for subsistence may not change by much. Indeed, in every one of the 116 economies examined by Seale et al, the demand for breads and cereals is the least price-sensitive food subgroup. In other words, to isolate the effect of higher food prices in very poor economies where spending on bread and cereals is relatively large, it is necessary to look deeper into the consumption and price data and examine consumption patterns and prices for these individual food items.



### C. Potential Sources of Food Price Volatility: An Example

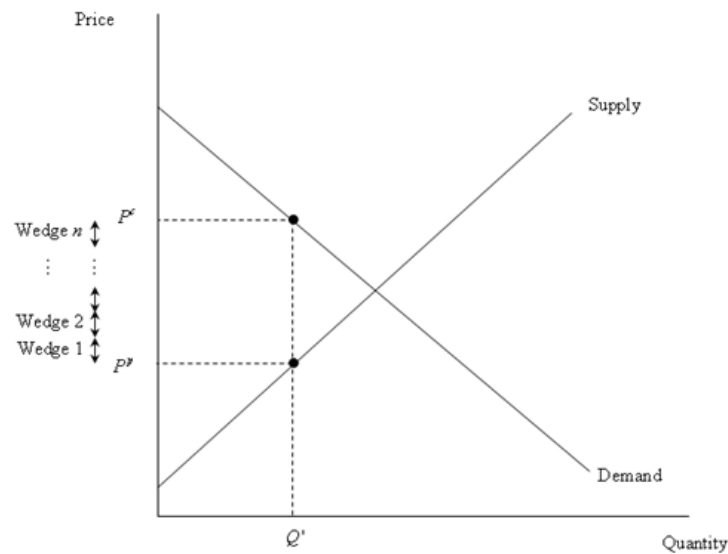
If food demand is not responsive to price changes (that is, demand is price inelastic), then relatively small supply-side shocks will produce large changes in equilibrium prices in order to ration supply and clear the food market. This proposition is illustrated in Figure A12. The initial market price is  $P^*$ . An exogenous supply side shock (for example, due to an increase in energy prices) reduces supply, with price adjusting upwards to clear the market. The effect of the supply-side shock on the market clearing price depends on the responsiveness to demand. If demand is responsive (highly elastic) then only a small increase in price is needed to ration the lower supply and clear the market. On the other hand, if demand is not responsive (low elasticity) then for the same supply shock a large increase in price is needed to ration the lower supply and clear the market. The other propositions outlined in section 3.2.2 can be shown using the same diagram.

Figure A12 Food prices and volatility



### D. Intermediaries and Cost Wedges

Consider a competitive market in which consumers and producers seek each other out but the costs of doing so (the cost wedge) are equal to TC per unit of the good exchanged, where TC denotes the cost of transacting. In all, we can imagine  $n \geq 1$  cost wedges, all of which together create a gap between the price that consumers are willing to pay for the final good, and the price that producers are willing to receive for their primary production. These wedges are illustrated in Figure A13.

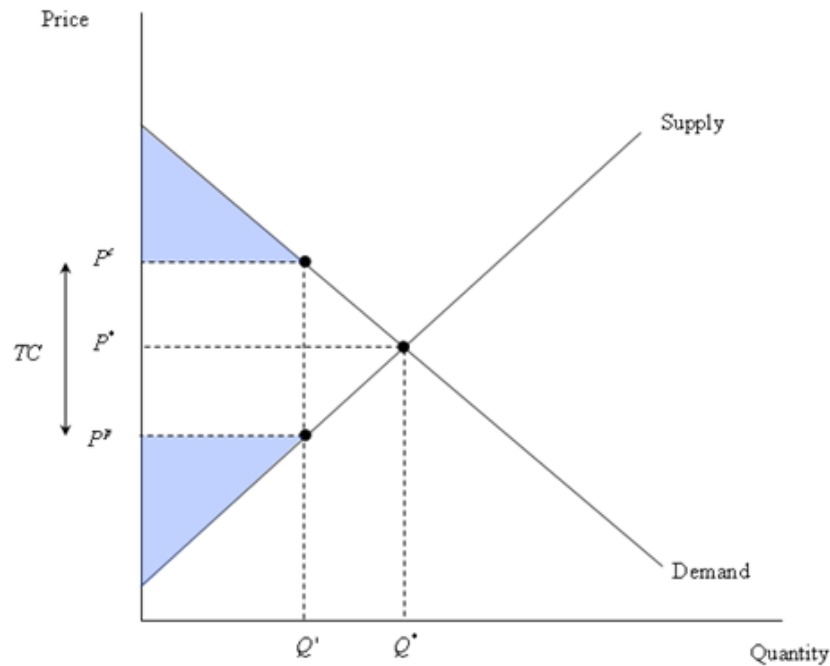
**Figure A13** Cost wedges

Now consider the effect that cost wedges have on observed market outcomes and economic welfare. This is illustrated in Figure A14. The direct money price paid by consumers (and received by producers) is  $P^*$ , but the transactions costs for consumers are  $P^c - P^*$  and  $P^* - P^p$  for producers. Therefore, the 'full' price paid by consumers is  $P^c$ , and the full price paid by producers is  $P^p$ . At these prices the quantity of food that is exchanged is  $Q'$ , and the gains from exchange for consumers and producers are given by the shaded areas. In total, transactions costs are  $TC \times Q'$ .

Note that the full price paid by consumers is  $P^p + TC$ , which in a competitive producer market is the cost of production, plus the total cost wedge.

Anything that lowers either of these two final consumer price components will by definition lead to lower prices. For example, in a competitive primary production market, the  $P^p$  term will be determined by supplier productivity, as well other influences on the costs of physically producing the good, such as conditions in markets for inputs used by producers.

**Figure A14 Cost wedges, market outcomes and consumer welfare**

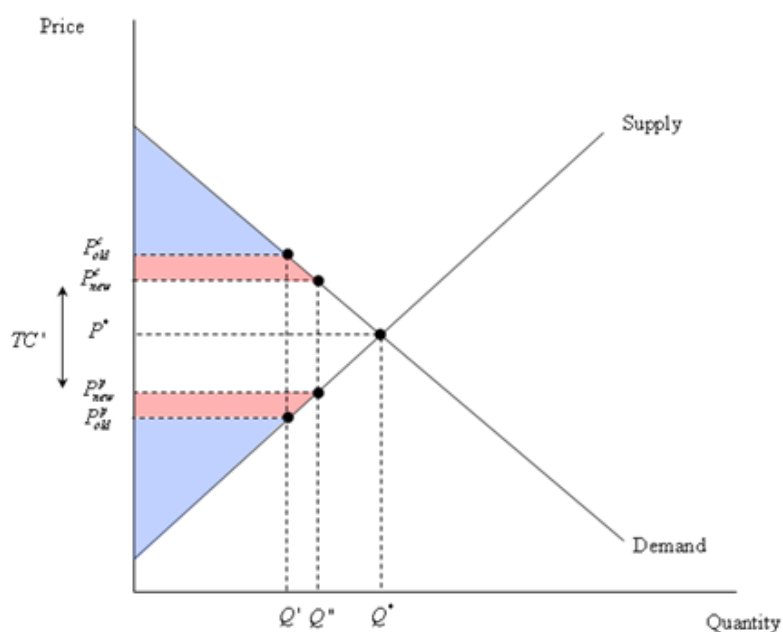


This simple example shows how final consumer prices will be determined by three factors identified above: supplier productivity, conditions in input markets, and conditions in output markets.

Consider the welfare consequences of the establishment of a supply chain or a set of markets of intermediary suppliers, some of which provide services to primary producers and final consumers, and some of which supply services to other intermediaries in the supply chain. For example, these specialist ‘middlemen’ might supply transportation services, food processing services, storage, quality verification services, retailing services and so on.

Suppose in Figure A15 that the total market price of these services is  $P^c_{new} - P^*$  per unit for consumers, and  $P^* - P^p_{new}$  per unit for producers. Thus the total per unit cost of intermediation is assumed to be  $P^c_{new} - P^p_{new} = TC' < TC$ . The lowering of the cost wedge between consumers and producers means that there are greater gains from trade between consumers and producers that can now be exploited. At these prices the quantity that is exchanged is  $Q'$ , and the gains from exchange for consumers and producers are given by the red and blue shaded areas. The amount  $TC' \times Q'$  is received by firms along the supply chain who supply intermediary services.

Consumers now pay a higher money price  $P^c_{new} > P^*$  than they did in the absence of intermediary services, but this is lower than the full price in the absence of the supply chain. Similarly, producers now receive a lower money price  $P^p_{new} < P^*$  than they did in the absence of a supply chain, but this is higher than the full price they received in the absence of intermediaries.

**Figure A15**      **The effect of the entrance of intermediaries**

Thus, in a dynamic environment in which competitive forces are driving innovation and cost reductions along the supply chain, care must be taken in interpreting observed changes in money prices. It is possible that an increase in observed money prices could come about as the result of greater efficiency and lower costs along the supply chain. Money prices would rise, but non-money transactions costs for producers and consumers would fall. In this case, an increase in money prices paid by consumers would indicate an increase in consumer welfare, not a reduction, since the total price paid – money price plus non-money price – would fall.

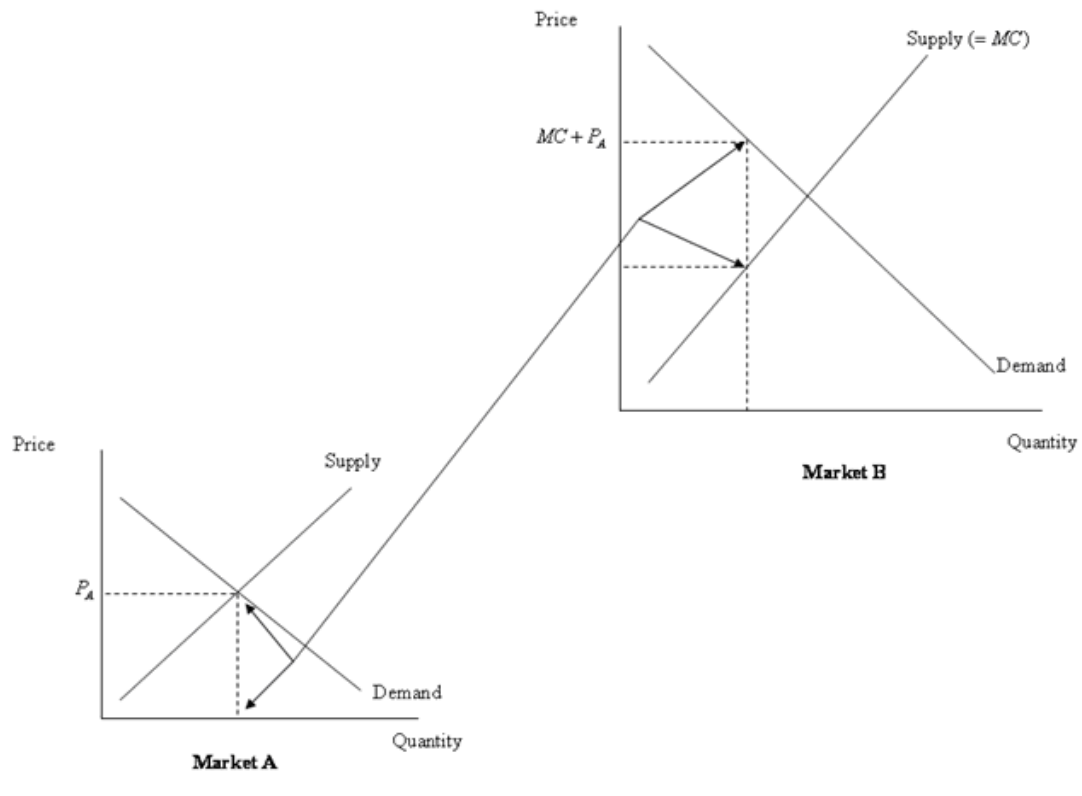
This analytical approach provides a framework for analysing costs along the supply chain and how they determine final consumer prices. For example, consider Figure A16 which examines two competitive markets which sit at two different points on a supply chain.

Suppose that market A supplies packaging and storage services for market B, which is the market for packaged food. Primary food products are supplied at marginal cost by producers, who then demand packaging services in market A. These are supplied by packaging producers in market A at the competitive (per unit) price of  $P_A$ . The final per unit consumer price of packaged food is  $P^c = MC + P_A$ , which is the sum of the marginal cost of primary production plus the competitive per unit price of packaging.

Note that if the packaging market was not competitive, then  $P_A$  would likely be higher, leading to a higher cost wedge and higher final consumer prices. Similarly, even if market A was competitive, market B may not be, which may again result in higher consumer prices. Again, this simple example shows how final consumer prices will be determined by three factors identified above: supplier productivity, conditions in input markets, and conditions in output markets.

To summarise: efficient, smoothly functioning intermediary markets along the supply chain will lower costs along the supply chain, and lead to lower final prices to consumers, higher prices paid to primary producers, or both.

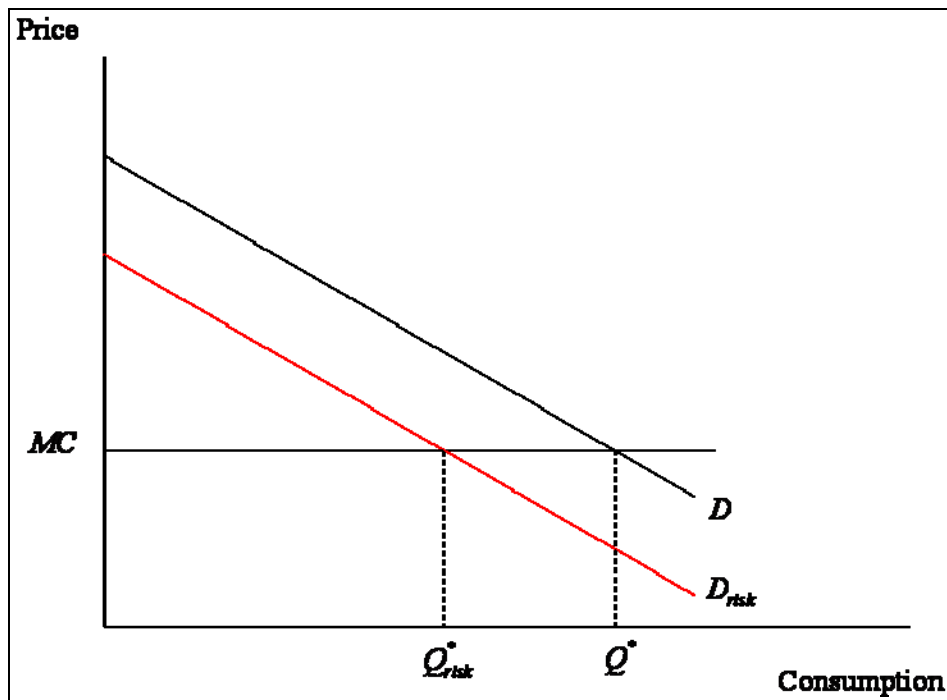
**Figure A16 Comparing two competitive markets**



**E. Food Safety Regulation: An Analytical Framework**

The potential benefits of food safety regulation can be illustrated using a simple analytical framework. Consider Figure A17 below. In this figure,  $D$  is the demand (marginal willingness to pay) curve for food in the absence of any perceived health risks.  $MC$  is the marginal production cost.  $Q^*$  is the competitive equilibrium quantity consumed in the absence of risk.  $D_{risk}$  is the demand curve in the presence of those risks, assuming they are correctly perceived by consumers, and  $Q^*_{risk}$  is the quantity consumed in the presence of those risks. This quantity is optimal and any form of corrective taxation or regulation that attempts to reduce consumption further results in a welfare loss.

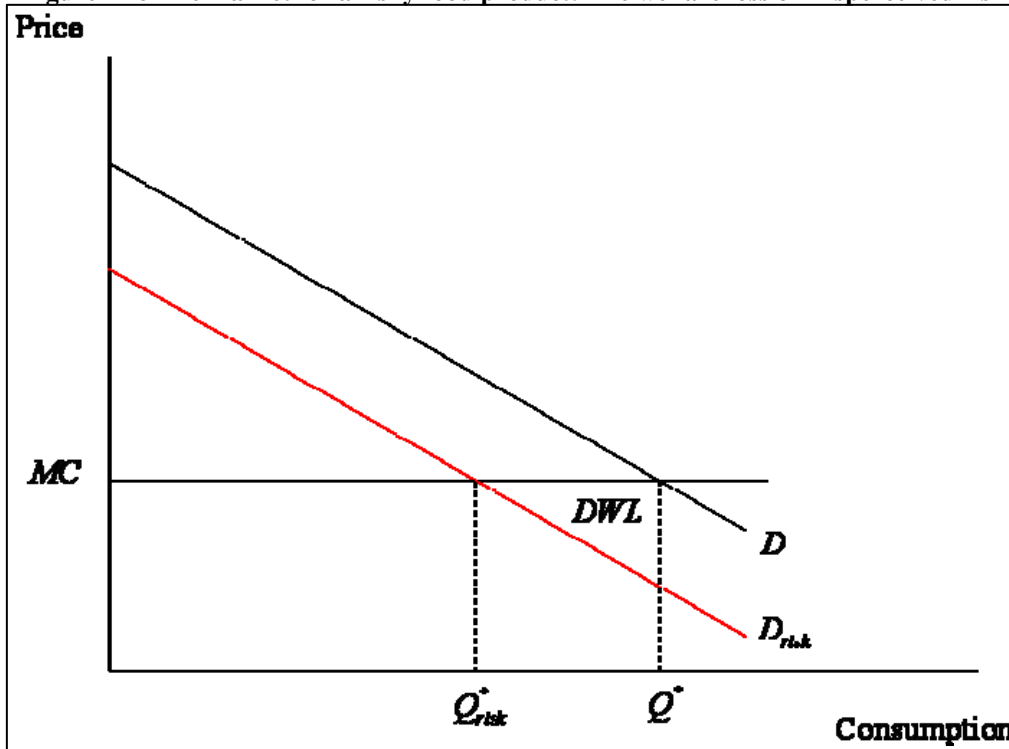
Importantly, note that our framework takes into account the benefits of food consumption as well as the costs. People gain utility from eating food even though it may not be of the highest quality. The benefits of consuming low quality food must be taken into account in any cost-benefit analysis of various policy alternatives.

**Figure A17**      **The market for a risky food product**

On the other hand, a case for corrective taxation or food safety regulation is strengthened if consumers misperceive the health risks to themselves, because of a lack of information or simply because they underestimate the probability or extent of damages. Alternatively, they may have addiction or self-control problems and ignore some of the future costs to their own health.

Suppose, for example, that consumers completely misperceive the health risks of a certain food product and take none of the health costs into account. Then their demand curve is  $D$ , but the actual marginal benefit curve is  $D_{risk}$ . Consumers consume  $Q^*$  at the market price, mistakenly believing that the marginal benefits of the units between  $Q_{risk}^*$  and  $Q^*$  exceed that market price. But in reality that is in fact not the case, and so for every unit consumed in excess of  $Q_{risk}^*$  there is a welfare loss. The accumulation of all of these marginal welfare losses is labelled DWL (Figure A18).

Figure A18 The market for a risky food product: The welfare loss of misperceived risk



**i Correcting misperceptions and providing information**

One possible form of regulation here would simply be to design policies which help consumers understand the health risks and potential damages that they might otherwise misperceive. The extent and nature of regulation would depend on the degree of misperception that would otherwise occur, which influences the size of marginal damages at the welfare optimum – the vertical distance between  $D$  and  $D_{risk}$ .

For example, one approach would be to force producers to publicise the health risks and then let consumers make their own decisions. The goal would simply be to force producers to inform consumers that the true marginal benefits of consumption of a particular food item are  $D_{risk}$  rather than  $D$ . Were the regulation effective in achieving this goal, it would pass a cost-benefit test as long as the marginal cost of regulation was less than the marginal benefit (damages avoided). Total possible benefits would be limited to the  $DWL$  triangle, and marginal benefits of regulation would be measured by the change in the  $DWL$  triangle as more information is provided. Note that the marginal benefit of spending declines – as  $D$  moves towards  $D_{risk}$  the welfare loss of consumer misperceptions and poor information shrinks accordingly.

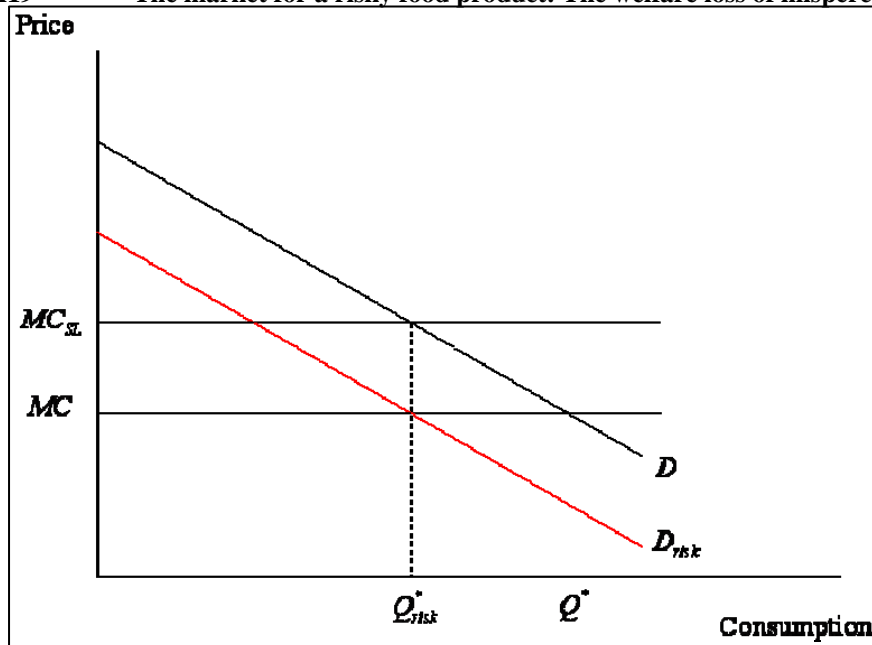
**ii Direct regulation**

Yet another alternative here would be to impose direct regulations on food producers and force them to adhere to certain health standards, imposing penalties for non-compliance. Suppose, for example, that food producers were made liable for all damages caused by a lack of food safety. Then consumers would effectively be fully compensated for all health risks and so their demand curve would be  $D$ . But the marginal cost of production would also increase because the regulations would impose new costs; it would increase by the same amount per unit of production as the increase in consumer marginal willingness to pay. The final result would be

identical to what would happen in the absence of regulation if consumers had perfect information.

This is illustrated in Figure A19 below. Regulation in the form of strict liability increases consumer demand, but also increases production costs to MCSL. Prices adjust to cover costs and consumers still consume  $Q^*_{risk}$  in the new equilibrium.

Figure A19 The market for a risky food product: The welfare loss of misperceived risk





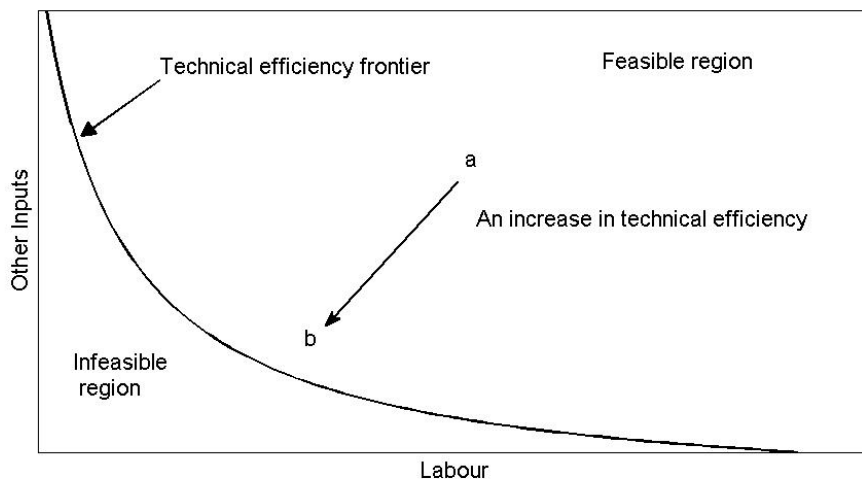
## A.2. PRODUCTIVITY GROWTH

Productivity improvements contribute to improved food security in three ways:

- They increase technical efficiency, that is, they increase the number of actors operating at best practice;
- It increases allocative efficiency, that is, all direct and indirect costs are considered and inputs and outputs go to where they are valued most; and
- It moves the technical efficiency frontier, that is, it improves best practice through innovation.

Technical efficiency is illustrated in Figure A20. The hypothetical curved line (an isoquant) shows the various minimum input combinations of labour and other inputs that can be used to achieve a given level of output. That is, it shows the rate at which labour can be substituted for other inputs while still maintaining production at a given quantity of output. The curve itself is the technical efficiency frontier. A combination of inputs that are below and to the left of the curve is infeasible given the technology that is available. A combination of inputs to the right and above the curve is technically inefficient in that it uses more inputs than necessary. Any point on the curve is technically efficient. For example, moving from point a to point b increases technical efficiency.

**Figure A20** Technical efficiency

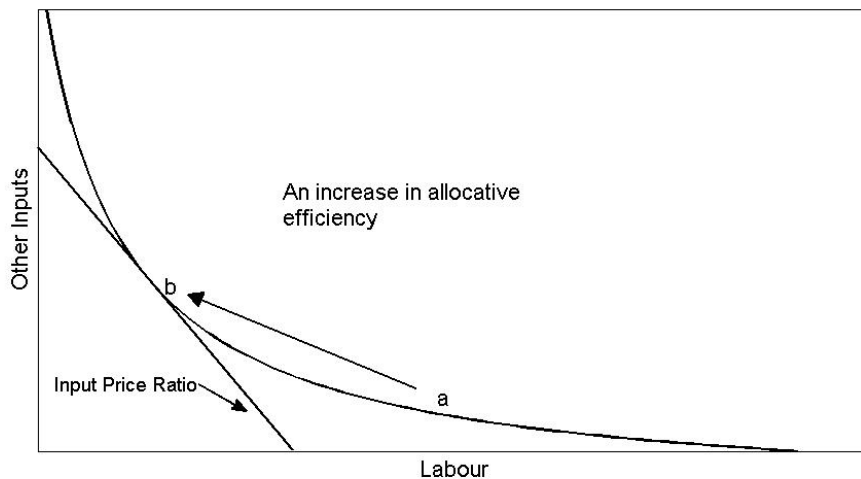


The potential level of productivity growth that can be achieved through increased technical efficiency depends on the distribution of individual enterprises with respect to the efficiency frontier. It is linked to factors that influence the adoption of new technologies.

Allocative efficiency takes into consideration the minimisation of input costs for a given level of output, as illustrated in Figure A21. To achieve allocative efficiency the rate at which inputs can be substituted while maintaining output should equal the rate at which a change in the input

mix affects production costs. For a given cost, this is the ratio of the price of labour versus the price of other inputs (shown as the line tangent to the efficiency frontier and labelled ‘input price ratio’). A movement along the curve to the point where the two slopes are equal represents an increase in allocative efficiency, for example from point a to point b. The same quantity of output is being produced at a lower cost (in the case of point b, the minimum possible cost).

**Figure A21**      **Allocative efficiency**

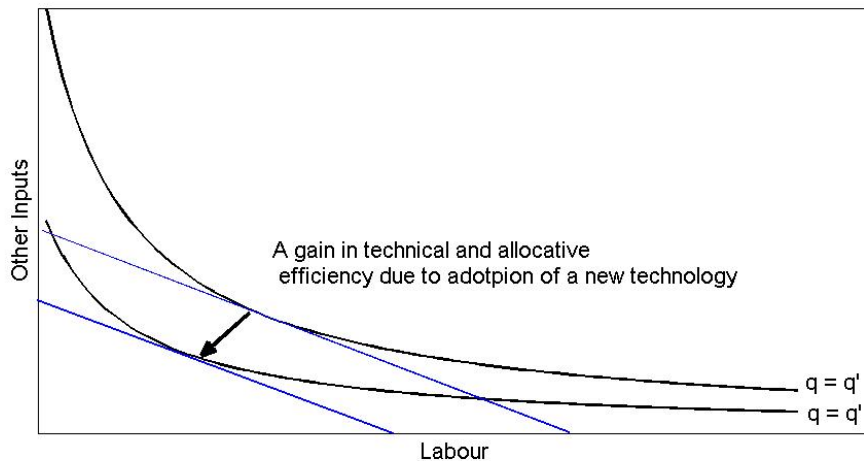


The potential level of productivity growth that can be achieved through increased technical and allocative efficiency depends on the distribution of individual enterprises with respect to the most efficient combination of inputs. Allocative inefficiency can occur when input prices do not reflect true economic costs. For example, policies that affect the transfer of land or the persistence of large wage differentials between the primary production sector and other sectors of the economy due to rapid rates of economic growth will influence allocative efficiency within an economy. This, in turn, will influence the combination of inputs used in primary production.

Governments may intervene in inputs markets, for example, to increase output and increase farm incomes through direct subsidises that target specific inputs such as fertiliser. This can also lead to allocative inefficiency unless the subsidy corrects some underlying failure in the input market. Otherwise, the intervention can generate distortions that cause input use to not reflect true relative input costs. Governments have other options to influence relative input costs, such as investments in infrastructure that reduces the transport cost of purchased inputs.

The effect of innovation is illustrated in Figure A22. An innovation alters the technical relationship between inputs and outputs. It increases technical efficiency so that the required combination of inputs declines for production of a given quantity of output. This is shown as an inward shift of the efficiency frontier curve. Note that the level of output has remained the same, ( $q'$ ), while the input ratio and cost of production have changed. As producers adopt the new technology they can increase technical efficiency while maintaining allocative efficiency.

Figure A22 Innovation



### A. Allocative efficiency in the output mix and food security

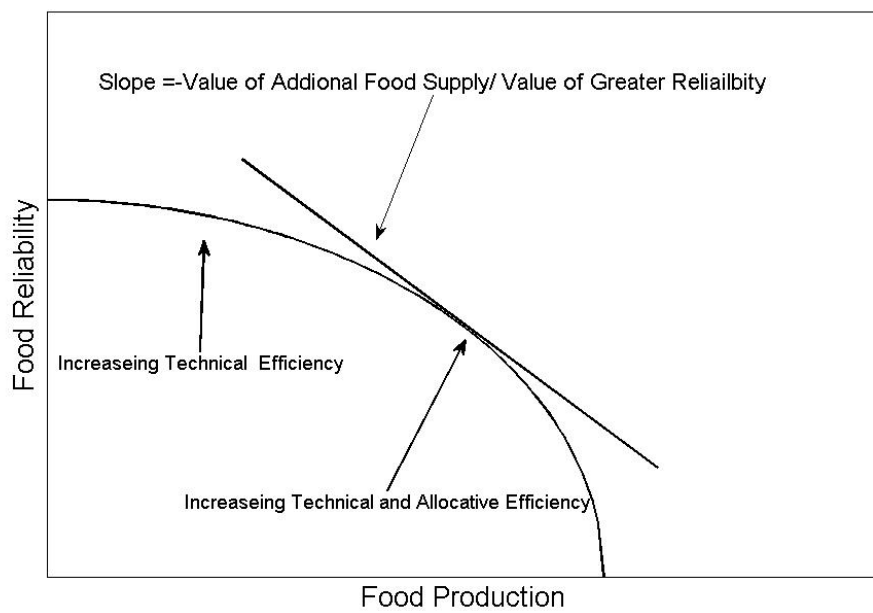
It is also possible to increase productivity by varying the mix of outputs as well as inputs. There are a wide range of food products that compete for a common set of scarce resources. For example, the production of grains competes with the production of oilseeds for land resources. Getting this balance right is another means of increasing economic productivity in food production and the overall economy more generally.

This is illustrated in Figure A23 which sets out a hypothetical tradeoff between food production and the level of reliability. The curve is the production possibilities frontier and shows the maximum combination of food reliability that can be achieved for every level of food production. Internal points are technically inefficient.

For example, favouring high yielding plant varieties can come at the expense of genetic diversity – leading to a greater degree of exposure to adverse growing conditions. Balancing this tradeoff involves consideration of the relative value of additional food versus the value of increased reliability. Allocative efficiency is achieved when the rate at which additional production can be exchanged for increased reliability matches the relative value of increased food supply versus the value of greater reliability. The example is hypothetical, but points to possible issues relating to genetic diversity. Individual producers may not take into account the full costs of a loss in genetic diversity, such as the spread of a disease from their own farm to a neighbouring location. Their production decision will tend to focus on selecting the variety with the greatest expected yield.

The key point is that governments can influence allocative efficiency, and hence food security, in output markets through market intervention (such as taxes and subsidies), through public investment, and through output controls and other forms of regulation.

**Figure A23**      **Food production and reliability**



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