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The Secretary
Standing Committee on Economics
House of Representatives
PO Box 6021
Parliament House
CANBERRA ACT 2600

Dear Sir/Madam

Please find attached ABARE's submission to the House of Representatives Standing Committee on Economics inquiry into raising the level of productivity growth in the Australian economy.

The submission addresses a selection of the issues on which the commitvtee is examining and focusses on the areas where ABARE is able to contribute particular expertise. In particular, the submission provides an analysis of productivity growth and its measurement in Australia and the role of agricultural productivity growth in the national economy. A discussion of current drivers and opportunities for accelerating productivity growth in the economy is also presented.

Yours sincerely

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Inquiry into raising the level of productivity growth in the Australian economy

ABARE submission to the House of Representatives Standing Committee on Economics

September 2009

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ABARE is a professionally independent government economic research agency.

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1 Background

The House of Representatives Standing Committee on Economics has requested a submission from the Australian Bureau of Agricultural and Resource Economics (ABARE) to its inquiry into raising the level of productivity growth in the Australian economy. The inquiry has been directed to identify key factors contributing to Australia's productivity growth rate.

2 Introduction

ABARE is a professionally independent government economic research agency. ABARE welcomes the opportunity to provide a submission to the House of Representatives Standing Committee on Economics Inquiry into raising the level of productivity growth in the Australian economy, as announced on 25 June 2009. Productivity growth in Australian agriculture has always been an integral component of ABARE's research program and there has been a revived focus in this area in recent years. During this time, ABARE has examined a number of drivers and constraints to productivity growth relevant to the inquiry.

ABARE considers this inquiry to be timely and valuable given the recent decline in Australia's productivity growth. In line with the terms of reference, ABARE's contribution will:

- discuss productivity growth in the Australian economy, including the contribution of agricultural productivity growth
- identify trends in agricultural productivity growth in Australia
- discuss productivity growth measures including their strengths and weaknesses
- highlight the current understanding of the drivers and threats to productivity growth
- provide research findings on how productivity growth may be accelerated.

ABARE's submission is based on its research findings and those of others on productivity growth, with a particular focus on Australian agriculture. While individual industry sectors are not the focus of the committee's assessment, productivity growth determinants in agriculture and the economy are in many ways analogous. More so, agriculture has been a major contributor the Australian economy and the recent overall declining trend in productivity growth has in large part reflected movements in agricultural productivity growth (Productivity Commission 2008).

Factors driving (and constraining) agricultural productivity growth are similar to those driving productivity growth in other sectors. These factors will be a key part of any efforts to raise the level of productivity growth in the Australian economy.

The key points from the submission are:

- Productivity growth is fundamental to maintaining and improving living standards. It measures change in the efficiency of converting inputs into outputs and largely reflects technological progress.
- Estimates of productivity growth are not perfect in reflecting technological progress because of imperfect data, methodological limitations and other constraints. However, the methods used by ABARE and the Australian Bureau of Statistics (ABS) are broadly consistent with those used internationally and provide a consistent framework for analysing industry and Australian productivity performance.
- For a large part, the slowing of national productivity growth appears to reflect the declining productivity growth rates in agriculture, mining and manufacturing. Although drought has had a strong affect on agricultural productivity in recent years, a number of other factors have also been identified as contributing.
- ABARE has identified five major areas where significant productivity gains could be made. There is a role for government to assist in these areas through investments and policy settings that enable and encourage productivity growth. These areas are:
  - **R&D investment** – There is a well-established link between R&D expenditure and productivity growth. To improve long-term productivity growth there is an important role for government and industry to support R&D and accelerate the development of new knowledge and technology.
  - **Innovation adoption** – Facilitating innovation through improving the incentives and capability of industry to develop and adopt new knowledge and technology can accelerate productivity growth. This could be through improvements in access to research results, training and education, communication services and public infrastructure.
  - **Removing policy impediments** – Some current regulations provide a disincentive for producers to innovate and change practices in response to market developments. Policy settings which enable flexibility in decision-making among firms provide a broader set of opportunities for innovation. Reforms that encourage competition and reduce regulatory constraints will provide a stronger basis to enable productivity gains.

- **Improved market access** – International competition can stimulate innovation and its diffusion across the economy as industries endeavour to remain viable and improve competitiveness. Therefore, greater market access provides a strong incentive to lift productivity.
- **Addressing environmental pressures** – Climate change, resource depletion and other environmental pressures pose a major threat to productivity growth. Accelerating the development of low environmental impact and mitigation technologies and implementing policy settings to allow environmental objectives to be met at least cost will create opportunities for simultaneously lifting productivity growth and reducing environmental pressures.

3 Why is productivity growth important?

Productivity growth is a key determinant of economic performance, international competitiveness, economic welfare and living standards. Productivity reflects the efficiency with which resources are utilised to produce goods and services. Explained simply, productivity measurements reflect the ability of producers to convert inputs into outputs. An increase in productivity growth indicates that inputs are being used more efficiently over time. Fewer inputs are required to produce the same output level, or alternatively, additional output is possible from a given input use.

Productivity improvement is the dominant means by which living standards improve over the long term. Increased output, or decreased input use, leads to lower production costs and higher incomes. Consequently, productivity growth can mean higher returns on capital, higher wages, higher profits and increased tax revenue. It can also lead to lower prices for consumers and may benefit the environment as less land, water and chemicals are required to produce the same amount of output (Productivity Commission 2005). As Krugman (1992) explained, 'productivity isn't everything, but in the long run it is almost everything'.

Productivity growth is valuable for maintaining and improving international competitiveness. Productivity gains have been a means of offsetting declining real prices received for farm commodities on global markets. As well as declining prices received for outputs, farms have faced rising input costs, resulting in an overall terms of trade decline of 1 per cent a year between 1990-91 and 2007-08. Declining terms of trade can severely affect the incomes of exporters. Faced with declining terms of trade, finding ways to reduce costs by lifting productivity has been fundamental for the agriculture sector in remaining internationally competitive and increasing farm incomes.

Productivity growth in agriculture (and the economy) can also mitigate the adverse effect of other long-term challenges such as population ageing, sustainable water use and climate change (Productivity Commission 2008). Productivity growth will also help to address challenges such as global food security, water and resource availability and drought (Nossal, Zhao, Sheng and Gunasekera 2009). The renewed emphasis on lifting productivity growth by industry and Australian governments is an appropriate and necessary step towards a sustainable future for the Australian economy and society (Productivity Commission 2008).

Increased agricultural productivity is vital to address the needs of a rapidly expanding global population. The United Nations Food and Agriculture Organisation estimates food requirements will double by 2050 (FAO 2009), raising concerns about global food security. The increasing demand for food is driven by global population growth and higher living standards in developing economies, calling for higher quality and greater variety, of food for human consumption and increased feed for livestock.

4 Productivity measurement

While there is a general consensus about the notion of productivity, disagreements are common about the preferred form of estimates, suitable measurement techniques for inputs and outputs, and appropriate interpretations of productivity estimates. These challenges have created some misunderstanding about the concept of productivity itself.

Productivity measures the efficiency with which inputs are converted into outputs by calculating the ratio of output quantities to input quantities during a specific time period. Productivity growth compares the changes in this ratio over time, which effectively measures the change in output which cannot be accounted for by a change in input use. It is most commonly assumed this gap reflects technological progress.

Technological progress reflects changes in production technology or production processes as a result of new information or changed operating conditions. However, it is important to recognise that many other factors, including the choice of methodology and measurement errors, can also affect productivity measurement.

Productivity estimates generally require that quantities of inputs (and outputs) be aggregated to form an index. In this process, inputs costs and output values are used as weights to enable the aggregation of heterogeneous inputs and outputs. This is so productivity changes reflect changes in real outputs and real inputs used in production, rather than changes in relative prices. The ratio of the output index to the input index forms the productivity index.

There are two main measures of productivity growth. Partial productivity measures estimate output relative to a single input such as land or labour (e.g. tonnes of output per hectare or per worker). Alternatively, total factor productivity measures (TFP) compare total output with total inputs used in production. For ABARE's TFP estimates for agricultural industries, these inputs include land, labour, capital, materials and services. TFP is also sometimes called multifactor productivity (MFP).

TFP (or MFP) provides a more comprehensive measure of productivity performance than partial productivity measures because it takes into account many inputs to production, and is generally more useful for investigating the overall improvement in an industry or economy.

It is necessary to interpret productivity estimates with caution, particularly when making comparisons between estimates from different sources or industries where there are likely to be differences in data collection, scope and methodology (see box 1 for an explanation of the differences between ABS and ABARE productivity estimates).

Some of the key challenges for Australian productivity measurement are addressing input quality, short-term volatility and the suitable inclusion of services industries.

box 1 **Comparing productivity – ABARE, ABS and international estimates**

Comparisons in productivity growth are difficult because of differences in methods, data and observation periods (Mullen 2007).

The official MFP estimates for Australia are produced by the ABS using its national accounting data. Two estimates are produced: 'gross output' based estimates and 'value added' based estimates. The gross output estimates compare total outputs with total inputs of capital, labour and intermediate inputs, while the value added estimates consider only capital and labour inputs. The value added estimates are most easily added across industries and provide an indication of productivity improvements for the economy as a whole (ABS 2007; OECD 2001). A detailed explanation of these estimates can be found in the ABS information paper on MFP estimates (ABS 2007).

ABS productivity estimates for the agricultural industry refer to all agricultural outputs, including fishery and forestry production. ABARE also produces agricultural productivity estimates which only include the broadacre and dairy industries using data from its farm survey (the Australian Agriculture and Grazing Industries Survey and the Australian Dairy Industry Survey). Inputs of land, labour, capital and materials and services are included in the measurement. ABARE's TFP estimates are based on the 'gross output' method.

As ABARE is able to produce productivity estimates using comprehensive farm survey data, detailed investigation of drivers and constraints to productivity can be made for individual agricultural industries at the farm level. However, the estimates cannot be aggregated to a sectoral level (because of insufficient data), or directly compared with economy-wide productivity growth across market sector industries.

Both the ABS and ABARE use conventional index number methods to estimate productivity growth. This is the preferred method by most international statistical agencies and the OECD (OECD 2001).

Input quality

As a quantity index is used to measure inputs it is often difficult to appropriately reflect differences in input quality. For example, in practice, labour input is measured by the number of workers (i.e. head counts) or hours worked. But these two measures are imperfect because the labour force is not homogeneous. More educated labour is expected to raise productivity relative to less educated labour. However, such differences in labour quality are difficult to capture when aggregating workers or hours worked. Some productivity estimates attempt to adjust for input quality, although given the available data it is often difficult to do so.

Short-term volatility

Productivity growth trends are highly sensitive to changes in the choice of the start and end years used in the estimation. Short-term factors, such as seasonal conditions, can lead to large changes in input or output, which affect long-term averages. Because of the way productivity estimates are calculated, using index numbers, it is also not possible to test for statistical significance. This problem makes it necessary to examine productivity growth trends over relatively long periods.

Services and other industries

At this stage, the ABS can only estimate productivity growth for the market sector, where reliable output, input and price data are available. These industries include: agriculture, forestry and fishing; mining; manufacturing; electricity, gas and water; construction; wholesale trade; retail trade; accommodation, cafes and restaurants; transport and storage; communication services; finance and insurance; and cultural and recreation services. For non-market industries it is difficult to separate changes in price from changes in output quality and quantity. Industries excluded from the market sector are: health and community services; education; property and business services; government administration and defence; and personal and other services.

Given current data availability, it is also difficult to estimate productivity growth for alternative industry definitions, such as the food industry which would require food outputs to be aggregated from several ABS market sector industries including agriculture, manufacturing and, cafes and restaurants.

5 Productivity growth in the Australian economy

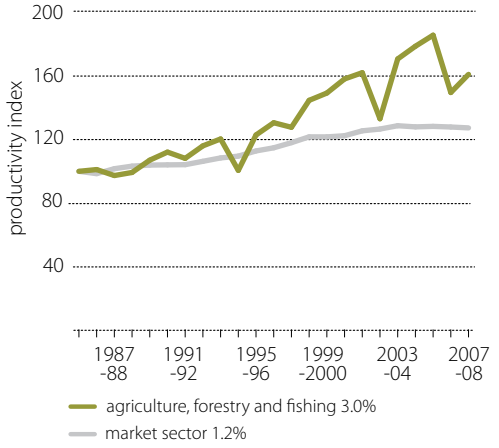
There has been an upward trend in productivity growth in Australia over the past two decades. Market sector productivity growth averaged 1.2 per cent a year between 1985-86 and 2005-06.

Productivity growth during the 1990s was particularly strong, a phenomena attributable in large part to extensive microeconomic reform during this period (Parham 2004). Unfortunately, the 2000s have seen productivity growth stall and even reverse in Australia, with the ABS estimating negative productivity growth in 2007-08 (ABS 2008). Productivity growth has softened in most industries, with agriculture, mining and manufacturing contributing most to the overall productivity slowdown.

Other OECD countries have also experienced stagnation in productivity growth. While Australia has kept pace with most of these economies, it has fallen behind that of the United States (Productivity Commission 2008).

Short-term movements are not typically a strong indicator of underlying productivity trends, as growth can be highly volatile. Nevertheless, the slowdown in productivity growth this decade suggests a revived focus on lifting productivity growth is necessary to facilitate a return to positive long-term growth.

a Value-added productivity growth in agriculture and the market sector



Source: Australian System of National Accounts (ABS 2008) (long-term growth rate estimated by ABARE from ABS data).

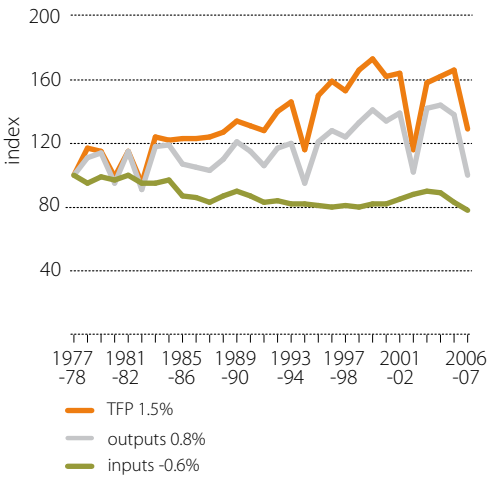
The role of agricultural productivity growth

The agriculture sector's share of national gross domestic product (GDP) is low at around 2.5 per cent. However, agriculture is a strong contributor to national productivity growth. Between 1974-75 and 2007-08, agricultural productivity growth accounted for 17.5 per cent of market sector productivity growth (estimate from ABS data).

Agricultural productivity growth has typically exceeded the market sector average. Over the past two decades (1985-86 to 2007-08), annual productivity growth in the market sector averaged 1.4 per cent compared with the agriculture sector's 2.8 per cent (ABS 2008) (figure a).

The 1990s saw particularly strong growth in agricultural productivity, largely because of microeconomic reform, favourable weather conditions and rapid advances in machinery, equipment and new crop varieties. The agriculture sector was a significant contributor to Australia's productivity highs during this period and, similarly, recent slowing agricultural productivity has been a key contributor to the slowdown in economy-wide productivity growth.

b Broadacre agriculture - growth inputs, outputs and TFP



Source: Nossal et al. (2009)

Australian agriculture is heavily influenced by seasonal conditions which can cause high volatility in productivity estimates. As seen in figure a, productivity dropped notably in the drought years of 1994-95 and 2002-03. ABARE broadacre farm data also show dramatic productivity falls in 2006-07, which was another major drought year (figure b). These falls in productivity have dragged down the long-term productivity growth estimates for the sector and the economy more broadly.

While drought has played a role in the productivity slowdown in Australia, other factors such as broader environmental and resource quality issues, population ageing and labour and skill shortages may have affected performance in the agriculture industry. Declining research investment, a trend observed in many developed economies (Pardey, Alston and Beintema 2006), is one key factor which may have contributed.

The contribution of these and other factors to the perceived productivity slowdown is unclear and has become a major focus of ABARE's current research. Current knowledge of the possible drivers and threats to productivity growth are discussed in the following sections. Many of these factors have relevance across many industries and the economy more broadly. A better understanding of these factors will assist in developing strategies to lift productivity growth.

Agriculture's productivity performance

Aggregate productivity growth estimates for the Australian broadacre and dairy industries have been published by ABARE since the mid-1990s. These estimates have been published at the national level and occasionally at a regional level. Productivity estimates are also calculated for individual broadacre industries, namely cropping, mixed crop-livestock, beef and sheep. ABARE's productivity and other statistical reports are widely used by government agencies, industry bodies and the research community to inform policy and analyse economic issues affecting the sector (Mullen and Crean 2007).

Productivity growth has been the main source of income growth in the agriculture sector, and has accounted for the entire increase in output by the sector over the past 30 years. In broadacre agriculture, as estimated by ABARE, total input use declined by 0.6 per cent a year, while total output increased by 0.8 per cent a year on average. This enabled productivity growth of 1.5 per cent a year on average, despite high volatility (figure b).

Fluctuations in agricultural productivity largely reflect seasonal conditions. While input use has decreased fairly steadily, there have been sharp movements in output such as during the drought years of 1980-81, 1982-83, 1994-95, 2002-03 and 2006-07 (Nossal et al. 2009). As many agricultural inputs are fixed in the short term, productivity is hampered by these downturns in output. Nevertheless, long-term productivity growth has remained positive.

Growth in productivity can arise in three ways: an increase in output greater than the relative increase in input use; a decrease in outputs by less than the relative decrease in inputs; or an increase in outputs associated with a decrease in inputs (or in fact no change in inputs). For the broadacre industries assessed by ABARE, each achieved productivity growth via different means (table 1).

1 Average annual input, output and TFP growth in broadacre industries, 1977-78 to 2006-07

	TFP growth	output growth	input growth
	%	%	%
Total broadacre	1.5	0.8	–0.6
Cropping	2.1	3.1	1.0
Mixed crop–livestock	1.5	0.1	–1.5
Beef	1.5	1.7	0.1
Sheep	0.3	–1.4	–1.8

Source: Nossal et al. (2009).

Between 1977-78 and 2006-07, Australia's broadacre cropping industry achieved productivity gains by increasing outputs more than the relative increase in input use. Mixed crop-livestock farms kept output fairly constant while reducing input use. Beef farms increased output while maintaining input use levels. In comparison, the sheep industry improved productivity by cutting back input use by a greater proportion than the reduction in output.

Examining the input and output movements which have determined productivity performance at the industry level provides a starting point for developing strategies to lifting productivity growth. For example, one unusual factor driving sheep industry productivity growth appears to be farmers leaving the industry during the 1990s. As prices for wool were relatively low at this time, some farms responded by shifting into crop production. This trend was further stimulated by the removal of the wool reserve price scheme which had impeded earlier adjustment. Output for the sheep industry fell. However, as input use decreased by a greater amount and productivity improved, it appears that farms remaining in sheep were more efficient. Structural adjustment in response to changing market prices was hence conducive to productivity growth in this industry.

6 What causes productivity growth?

Fundamentally, productivity growth occurs as new technology and knowledge allows production processes to become more efficient in converting inputs into outputs. There are three main ways in which greater efficiency may be achieved: using fewer inputs overall, using a different combination of inputs, or producing a different mix of outputs (box 2). Pathways to these adjustments that enable productivity growth are:

- adopting new technologies and knowledge
- increasing adoption rates of currently available technologies and knowledge
- exit of less efficient firms.

The scope for lifting productivity by targeting each of these pathways will vary across industries depending on the extent to which input and output decisions can be adapted, and the nature of the incentives currently facing firms.

The ability of firms to develop and/or adopt new technology and processes to increase productivity is affected by a variety of factors. While some factors can be influenced at the firm level, a wide range of factors are external to the firm.

box 2 **The mechanics of lifting productivity growth**

Using fewer inputs overall

For the broadacre agriculture industry, total input use fell by an average of 0.6 per cent a year between 1977-78 and 2006-07. Much of the ability for firms to use fewer inputs reflects improved input quality as skills and technology have improved. For example, as labour becomes more skilled, fewer workers may be required to produce a given output.

Using different input combinations

Productivity growth is driven by improvements in the way resources are organised to produce goods and services. By using inputs in different combinations, firms may be able to reduce overall input use. In broadacre agriculture, farms increased the use of materials and services which enabled them to reduce their requirements for other inputs such as labour and capital, such that overall input use was lower. Similar patterns have been observed in other industries where labour has been replaced with more efficient capital. There are limits to the ability of firms to substitute between inputs to increase productivity, although these limits are likely to change as technology improves.

Changing output mix

Productivity gains may also be made by altering the mix of outputs produced. In the agriculture sector, the shift from sheep into cropping is recognised as one determinant of the strong productivity gains during the 1990s. Relatively lower wool prices stimulated this shift towards cropping. Productivity increased because of the higher productivity of crop enterprises during this period and also because of higher productivity among remaining wool producers. The optimal mix of outputs can also change in response to market conditions, policy changes and other exogenous factors.

Firm-specific characteristics affecting productivity

Firms have an inherent capability to convert inputs into outputs using available technology and knowledge. This ability is based on firm characteristics such as business organisation, managerial abilities, access to capital, production scale and scope, and risk management. Productivity growth often occurs as a result of changes in these characteristics which might result from changes in preferences, incentives, new information or technology availability or other external factors.

Managerial abilities

Managerial skills can play a key role in productivity growth, particularly decisions regarding organisational structure, resource allocation, production scale and scope, marketing and other work arrangements. Of particular relevance is a manager's ability to optimise these arrangements to take advantage of changes in the external environment or the availability of new technologies or information.

Human capital

Securing an optimal supply of suitably skilled labour is vital for firms to improve productivity growth. Constraints which limit the ability of labour to move between industries in response to price changes or restrictions to attracting skilled labour from overseas can impede productivity.

Beyond labour availability, other aspects of human capital are also valuable to lifting productivity, such as education and training, physical and mental health, and age. Improving the skill level of the workforce is essential to enhancing innovation, strengthening competitiveness and boosting resilience.

In agriculture, developments in human capital have been inhibited by a number of factors. These factors include labour competition from other industries, an ageing population and declining rural populations, low participation levels in agricultural education and training (including low student numbers in tertiary agriculture courses), poor awareness of agricultural career pathways and a limited capacity of the current education and training system to deliver innovative training solutions (Industries Development Committee Workforce Training and Skills Working Group 2009).

To improve the productivity of human capital, investment in education and training needs to be supplemented with improvements in the accessibility of new information, knowledge and technology. Lifting the ability of firms to interpret and adapt technological developments to suit individual conditions will also help to improve productivity.

Size and scope of production

Large firms often exhibit higher productivity growth relative to small firms. Economies of scale, whereby costs of production decline as the scale of operations increase, is one reason large firms often perform better. Economies of scale are often highlighted as a means of improving productivity growth.

Another suggestion is that larger firms are better able to capture the benefits of new technologies which are often more suited to larger production systems. Current (yet to be finalised) work by ABARE indicates that for broadacre agriculture, the productivity advantages associated with increased size are the closely related to adoption of advanced technologies, rather than economies of scale.

Financial capability

Many of the ways to achieve productivity growth are costly, such as purchasing more efficient equipment or accessing information about new processes or practices and responding to changing external conditions. ABARE's farms survey results indicate farms which are more profitable are generally more innovative (in terms of adopting new technologies or processes), potentially indicating a greater ability to invest in production capabilities.

Financial capability is also influenced by access to credit and other sources of income. Farms with access to many dimensions of finance are likely to be more resilient to external changes and shocks, and consequently better able to remain viable during difficult times. They may also be better placed to improve productivity over time (Kokic, Davidson and Rodriguez 2006).

External drivers

External factors are those not under the control of the firm. For example, drought directly leads to lower productivity growth in agriculture industries by causing a fall in output. Changes in external drivers affect productivity over the longer term. The main external drivers affecting productivity growth in agriculture are outlined below.

R&D and innovation

Productivity improvements are often a result of new knowledge or technologies becoming available. R&D expenditure in developing new and better production methods and improved goods and services is central to achieving productivity growth.

Over the long term, agricultural TFP has been driven by the development and diffusion of innovations in capital and materials, breeds and crop varieties, production practices and firm organisation. During the 1980s and 1990s, many significant technological advances were made in the agriculture sector as a result of R&D. Lower R&D expenditure in recent decades may mean fewer innovations have been introduced, giving fewer opportunities for producers.

Fewer major innovations across many primary industries could also reflect a shortage of research scientists across a range of fields, lack of effective extension programs (to communicate research to users) and limitations to innovation because of natural resource management, business, financial and marketing systems (Industries Development Committee Workforce Training and Skills Working Group 2009).

The effect of R&D expenditure can be difficult to measure and monitor because of the long lags between investment in research and productivity gains. In agriculture these lags can be

up to 35 years (Mullen and Crean 2007). Nevertheless, research in Australia and globally has invariably indicated high returns to investment in agricultural R&D of between 15 and 40 per cent (Alston, Chan-Kang, Marra, Pardey and Wyatt 2000; Mullen and Cox 1995; Shanks and Zheng 2006).

Market conditions

Market conditions can provide a strong incentive for improving productivity. For example, international competition provides incentives to lift productivity to remain viable and can hence drive innovation and its diffusion across the economy. As productivity increases, real output prices fall, thereby improving competitiveness (given all other factors being equal) (Mullen and Crean 2007).

Growth in overseas demand for Australian products has also been an external factor responsible for productivity gains, particularly in agriculture. Demand for exports, such as the growth in live cattle exports from northern Australia to Asia in recent years, provides a strong incentive for firms to innovate and expand output. The northern beef industry achieved average productivity growth of 1.14 per cent a year over the past decade, compared with negligible productivity growth in the two decades prior (Nossal, Sheng and Zhao 2008).

Similarly, productivity growth responds to changing commodity prices. As relative prices change, firms are motivated to improve performance such as through changes in output mix. For example, relatively strong growth in lamb prices has renewed emphasis on lamb production in recent years.

Population growth, income growth and changing consumer demand will have further implications for long-term productivity as the goods and services demanded are likely to change. In agriculture, food demand will rise as well as the types of food demanded. For example, higher income is associated with higher demand for meat products as well as increased demand for environmentally friendly or organic products. These shifting patterns will also shift the incentives for producers to lift productivity growth.

Environmental conditions and climate change

The productivity capacity of a firm is heavily influenced by inherent resource endowments. In agriculture, land quality, soil fertility, water quality and availability, climate variability and climate change affect the capability of a firm to achieve productivity gains. Changes in these factors can also reduce the effectiveness of past strategies for making future productivity gains (Kokic et al. 2006). Changing conditions affect the types of innovations and management practices most suited to achieving productivity growth.

Since 2001-02, many agricultural regions of Australia have experienced higher than average temperatures and lower than average rainfall (BOM 2008). The shift in weather conditions has contributed to sharp falls in production and productivity growth in many agricultural industries, with flow on effects for the economy. The influence of climate change could see these effects become more frequent or more prolonged. ABARE research has found moisture availability to be the dominant determinant of broadacre farm productivity growth (Kokic et al. 2006).

Climate change poses a large threat to productivity growth, being projected to cause declines in crop yields, pasture growth and livestock production. Agricultural production costs are also expected to increase (Gunasekera, Tulloh, Ford and Heyhoe 2008).

While environmental factors are largely outside the farm manager's control, flexibility and adaptability to changing conditions could become increasingly important for productivity growth.

Regulatory and other policy settings

The productivity gains achieved by Australian agriculture and the broader economy during the 1980s and 1990s were associated with the significant microeconomic reforms during this period (Parham 2004), particularly in opening the economy to greater competition, trade and investment and the deregulation of many industries and institutions. Deregulation brought greater competition, labour market flexibility and financial market stability (Productivity Commission 2008). These reforms benefited productivity growth by improving the incentives for innovation and by improving flexibility and options for decision-makers to improve performance.

To enable productivity growth, regulatory systems should allow flexibility for firms in selecting optimal production processes in response to new knowledge or market developments. This may require further policy reform to remove constraints, improve market access, encourage competitiveness and enable industries to respond to emerging environmental and demographic changes.

Public infrastructure

Adequate and appropriate provision of infrastructure is imperative to long-term productivity growth. Australia's productivity performance has been in part because of the efficiency gains in information and communication technologies (ICT) and transport. However, there are still improvements to be made in these industries, particularly in rural areas (ABS 2006; Australia 2020 Summit 2008; House of Representatives Standing Committee on Transport and Regional Services 2007).

Investment in infrastructure provides support for many other sectors. For instance, Australia's grain rail networks were identified during 2005 as an issue for agriculture's export performance (Commonwealth of Australia 2005). The capacity for Australia's cropping industry to lift productivity would be increased if grain rail networks were improved to remove these bottlenecks. It is expected improved infrastructure would lower input costs for the grains and other industries, reduce their reliance on on-farm storage mechanisms and improve access to export opportunities.

Limited internet access in some rural areas may also be a constraint to productivity growth. Many industries, including agriculture, are increasingly reliant on ICT and web-based tools and services for assessing input and output choices, accessing market information, adopting innovations and improving managerial skills and knowledge. Ensuring adequate provision of infrastructure could yield large improvements in performance across many sectors.

7 Opportunities to lift productivity growth

There is potential to lift productivity growth in Australia. For government, this will mean implementing integrated policy solutions that provide appropriate incentives for innovation and removing constraints to change.

Specific opportunities to productivity growth where there is a role for government include: encouraging effective R&D investment, facilitating innovation uptake, removing policy constraints to growth and facilitating effective responses to climate change and other environmental pressures.

R&D investments

Despite high returns, there has been a stalling of public R&D expenditure in Australia over the past 30 years (as a share of GDP). In agriculture, public investment has fallen from 5 per cent of GDP a year between 1978 and 1986 to slightly more than 3 per cent in 2003. Although private sector funding has increased, this has not been sufficient to offset the decline in public sector investment (Mullen and Crean 2007).

R&D expenditure is the main source of innovation in the economy. It is possible the flattening of agricultural productivity is because the sector is approaching its limits in terms of the gains possible from current technologies. Technologies developed during the 1980s and 1990s led to capital-labour substitution and strong economy-wide productivity growth. Declining R&D expenditure has potentially slowed development in this area.

Public R&D expenditure needs to be well-coordinated and well-directed for productivity gains to be improved. In agriculture, one strategy for improving R&D effectiveness has been the recent establishment of the Rural Research and Development Council. The council is developing a National Strategic Rural R&D Investment Plan and a national performance measurement and reporting framework. The National Primary Industries Research, Development and Extension Framework is also being used by state and federal governments and industry groups to improve national research capabilities and cross-sector R&D.

Renewed emphasis on national R&D, including the effective allocation of resources, will be imperative to lifting productivity in agriculture and the economy over the long term.

Innovation adoption

Many innovations currently available are not adopted to their full extent, meaning that potential productivity gains are forgone. To supplement R&D, particularly in the shorter term, facilitating innovation uptake within firms and industries may be valuable.

Factors which may stimulate innovation adoption include continued government efforts toward improving labour skills, education, health, communication services and public infrastructure. These factors improve the ability of producers to take advantage of developments in technology and knowledge.

Improving access to information and a fuller extension of R&D outcomes is also imperative. There often remains a communication gap between research scientists and producers, and reducing this gap by better coordinating extension programs could have major benefits.

Incentives to innovate are also likely to come from external pressures, such as population ageing, climate change and evolving domestic and overseas market requirements.

Removing policy impediments

Policy settings can act as incentives or constraints to productivity growth. Some current policies are likely to be inhibiting productivity growth by constraining flexibility in production decision-making. Flexibility is conducive to lifting productivity growth, as it enables firms to better respond to external drivers coming from international competition, changed market access, consumer attitudes and variation in seasonal or other environmental factors.

Changing these policy settings could enable policy objectives to be met while providing a more flexible environment for firms and industry to take advantage of productivity gains. Part of this process requires improved dialogue between policy-makers, regulators, industry and the community to ensure regulation is effective in meeting its objectives over time, gives the community confidence and does not impose unnecessary costs or stifle desirable innovation.

Several current regulatory settings are likely to be acting as a constraint to productivity growth in agriculture. Research has shown that the native vegetation regulations in some states are costly and inhibiting productivity. Policy responses that allow more flexibility have the potential to provide a given level of ecosystem services at substantially lower cost (Davidson, Lawson, Kokic, Elliston, Nossal, Beare and Fisher 2006; Productivity Commission 2004).

Current drought policy also provides a disincentive to adjustment and productivity improvements. In particular, current policy has limited the incentives for farms to adapt farming practices in response to drier conditions (Productivity Commission 2009). These policy settings are currently under review. Reforms in this area could assist in stimulating productivity by encouraging adjustment and innovation, particularly in the area of risk management, drought preparedness and climate change management.

Improving efficiency in water allocation mechanisms will also continue to be important, particularly as water scarcity increases. Well-defined and tradable property rights will improve the ability of users to invest in new technologies and efficient water management techniques and to adjust enterprise mix to reflect water availability.

Addressing environmental pressures

Climate change poses a major threat to national productivity growth if firms are unable to efficiently adapt to, and mitigate, the effects of climate change on production processes. A similar situation exists in cases where firms face resource depletion, declining land quality, reduced water availability and other environmental pressures. Productivity growth will depend on the ability of firms to innovate in response to these new and growing environmental pressures.

Government responses to climate change (and other environmental pressures) will also have implications for productivity growth. Many sectors of the economy will face higher input costs as a result of the introduction of the Carbon Pollution Reduction Scheme (CPRS), which is scheduled to commence in 2011. In particular, prices will increase for electricity, fuel, freight and other emissions intensive inputs. ABARE has found that the CPRS is likely to lead to technological changes and changes in input and output mixes as relative prices change (Tulloh, Ahammad, Mi and Ford 2009). This will offer an incentive to innovate and develop lower cost inputs of lower emissions intensity, provided that this incentive is not distorted by policy settings in other areas.

8 Conclusions

This submission provides an insight into the factors that ABARE has found to be important to productivity growth from its research and analysis of the agriculture sector. While this sector contributes marginally to GDP, its contribution to productivity growth is notably more significant. Also, many drivers and threats to productivity growth in agriculture apply to many other industries and the broader economy.

Productivity growth appears to have slowed. A clear understanding of the drivers of productivity is useful in deriving strategies to reverse this trend. In particular, it is important to identify key threats to productivity that can be mitigated by government policy.

Drivers of productivity growth include both firm-specific and external factors. Firm-specific characteristics are largely under the control of the firm. However, government policy is often helpful in building the capability of firms and industries to lift productivity through providing appropriate incentives to innovate and adapt as circumstances change. External factors are more difficult for individual firms to influence. However, these provide the main incentives for change and productivity growth. International competition, consumer demand, export opportunities and environmental pressures provide major incentives for industry to improve productivity. Governments may have some influence over external factors, particularly through policy settings and public funding provisions.

ABARE has identified five areas which could enable significant improvements in productivity growth for the Australian economy. While these areas may present notable challenges, they also offer significant opportunity for policy efforts toward lifting productivity growth.

- There is an important role for governments and industry in supporting R&D and building capacity for technological progress. Revived emphasis on R&D will accelerate the development of new knowledge and technologies, which are the fundamental building blocks for productivity growth.
- Building innovative capabilities among firms (in adopting existing knowledge and technology as well as developing new technology) relies on developing characteristics such as managerial abilities, human capital and financial capacity. Government involvement in extension programs, education and infrastructure provision will continue to be an important driver of innovative capabilities.
- Removing impediments to adjustment can stimulate productivity growth. Some regulations currently in place across the economy may limit the ability of producers to make changes and respond to market developments. Policy settings which enable flexibility in decision-making among firms provide a broader set of opportunities for innovation. Continuing policy reforms that encourage competition and reduce regulatory constraints will therefore provide a stronger basis to enable productivity gains.

- Improving market access could potentially deliver strong productivity gains. International competition provides an incentive for industry to improve productivity to remain viable and can drive innovation and its diffusion across the economy. Improving market access would have benefits for productivity growth and competitiveness on world markets.
- Environmental pressures will continue to constrain productivity potential. In response, future R&D is likely to identify new technologies and knowledge which will enable output to grow while minimising use (and degradation) of resources. Government policy to better manage environmental services may create opportunities to simultaneously lift productivity and environmental health.

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