The Importance of Productivity Growth in Australian Agriculture

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This paper was drawn from a paper Dr Mullen gave as President of the Australian Agricultural and Resource Economics Society to to the 51st Annual Conference of AARES, February 13 – 16, 2007, Queenstown, NZ

Why is productivity growth important?

Productivity has been in the news in this election year. To highlight the importance of the issue Alan Wood (Australian 20.6.07) quoted Blinder and Baumol : "Nothing contributes more (than productivity) to reduction in poverty, to increases in leisure, and to the country's ability to finance education, public health, environment and the arts".

In an international context, Pardey *et al*. (2006) noted concerns that both productivity growth and investment in agricultural R&D are falling, particularly in developed economies, with implications for food security in developing countries reliant on technology 'spillovers', whose populations will continue to increase for several decades.

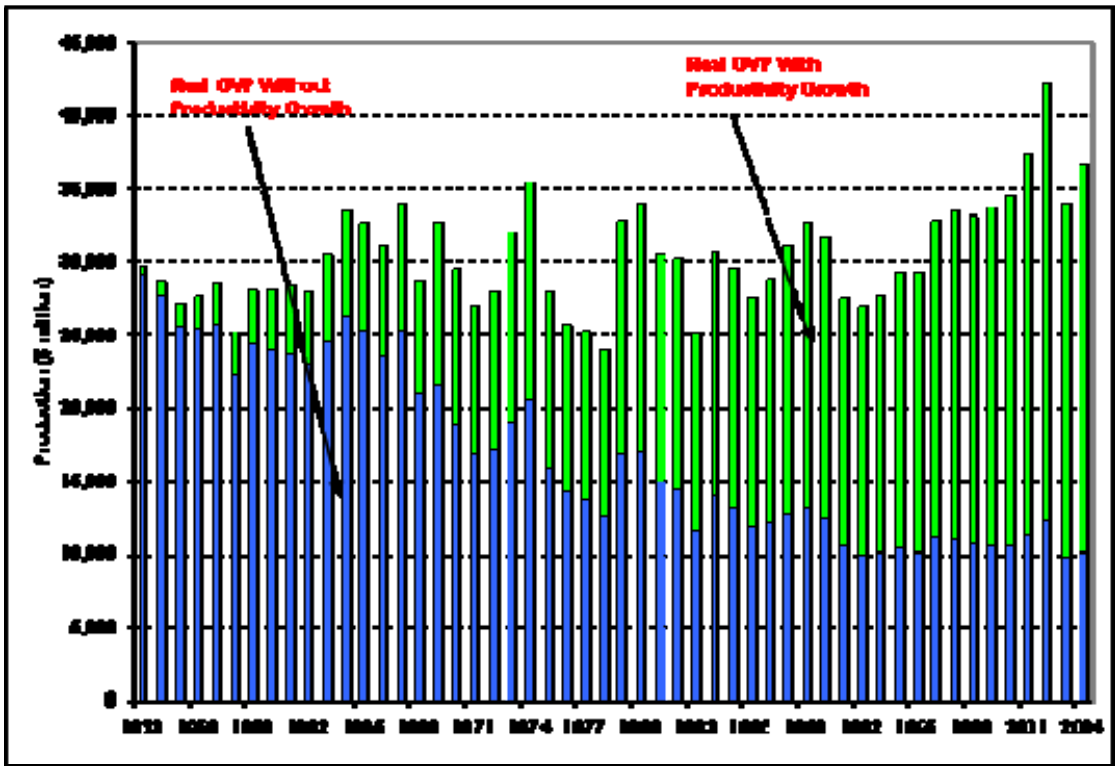
As explained more fully below, productivity in broadacre has likely grown at the rate of 2 percent per annum from 1953 to 1968 and a the rate of 2.5% since. Of this growth in productivity, perhaps up to 0.5 percent per annum can be attributed to factors such as public infrastructure and the education levels of farms. Perhaps the remaining 2 percent can be attributed to technical change, arising from public and private investments in research and extension where a significant component of both activities is related to the adaptation of foreign knowledge 'spillins'.

Following Mullen (2002)[1] and applying these assumptions, the gross value of agricultural production (GVP) in Australia in real terms grew slowly from just under A$30 billion pa in the early 1950s to about A$35 billion pa post 1997 (Figure 1). However, if agriculture had remained static and continued using 1953 levels of technology, real agricultural output may have only been about A$10 billion pa in 2004. Seventy per cent of the value of farm output in 2004 came from various sources of productivity growth, including improvements in infrastructure and communications, higher quality inputs, and new technologies developed and implemented as a result of agricultural research and extension activities.

Despite this generally favourable situation, there are a number of good reasons for further analysis of agriculture's productivity performance. First, average sector performance masks much greater diversity in performance at a commodity level. Second, the international competitiveness of the Australian agricultural sector and component industries is at least partly dependent on trends in its productivity relative to that of its competitors. Finally, there has been little growth in public

investment in agricultural research in Australia in recent decades – in common with the situation in other developed countries. While productivity growth has remained high, there remain concerns that it may slow once the long lags, inherent in R&D investment, begin to take effect.

Figure 1: The value of productivity growth in the Australian agricultural sector: 1953–2004.

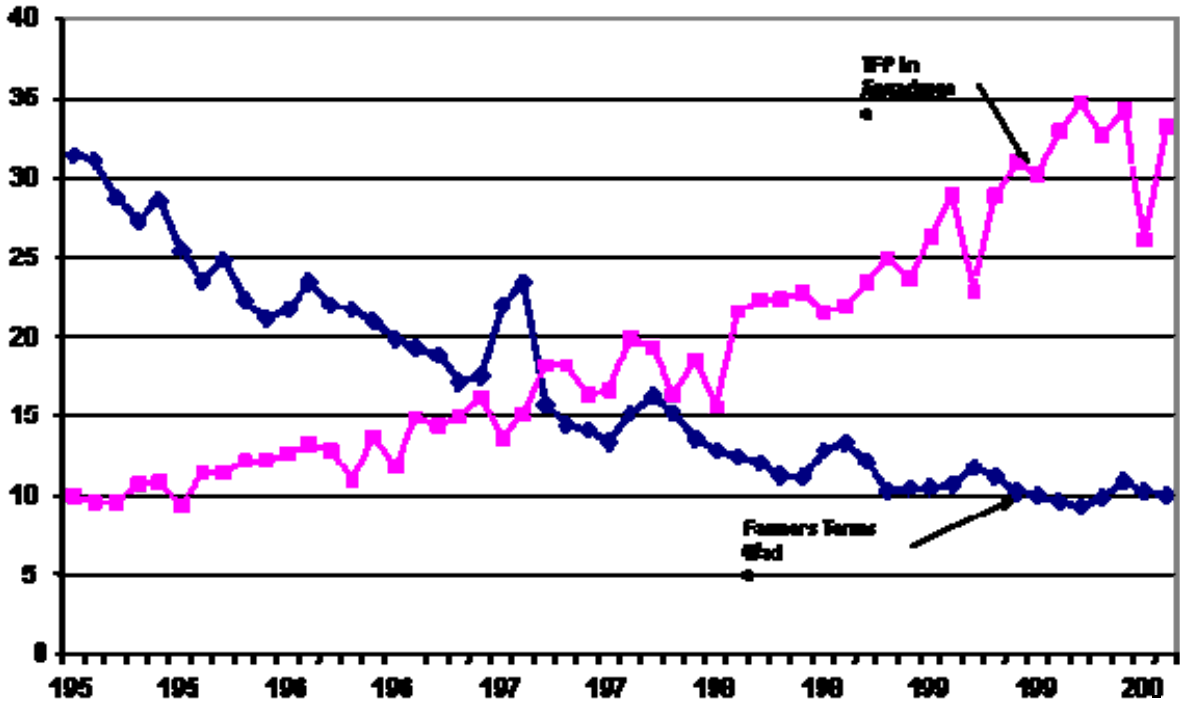


Source: Adapted from Australian Bureau of Statistics (ABS, 7503.0), various issues

Trends in Productivity Growth

Productivity for Australian broadacre agriculture, measured as the growth in agricultural output less the growth in inputs from ABARE (Australian Bureau of Agricultural and Resource Economics) farm survey data, rose almost 3.5 times from 100 in year 1953 to 343 in 2002. It then declined to 261 in 2003, reflecting the drought in that year, before reaching 332 in 2004 (Figure 2). The index is highly variable, falling in 18 of the 50 years, reflecting seasonal conditions. The average annual rate of growth over the entire period was 2.5 percent per annum, however prior to 1968, the 'watershed' year identified by Stoeckel and Miller (1982), productivity was only growing at a rate of 2 percent per annum.

Figure 2: Total factor productivity (TFP) in Australian broadacre agriculture and farmers' terms of trade: 1953–2004.



Source: ABARE, various sources and years

Productivity growth has been compared with the terms of trade as a partial indicator of whether Australian agriculture is becoming more competitive. The conventional wisdom has been that the terms of trade for Australian agriculture have been declining inexorably. However, while the trend in the terms of trade did decline for about 40 years from 1953 (Figure 2), since the early 1990s, the rate of decline has been much slower, at least for the sector as a whole. While the TFP index grew from 100 in 1953 to almost 350 in 2004, the terms of trade declined from about 320 to 100, at the rate of 2.3 percent per annum over the period 1953 to 2004, only slightly lower than the rate of productivity growth in broadacre agriculture. However, the rate of decline was 2.7 percent per annum from 1953 to 1990, and from 1991 to 2006, it was only 0.9 percent per annum. There has been little decline in the terms of trade over the last 15 years, a fact not yet recognised in much literature.

Table 1: Enterprise Productivity Growth Derived from ABARE Studies

	Males *et al.* (1990)	Knopke *et al.* (1995)	Knopke *et al*, (2000)	ABARE (2006)
	1978-89	1978-94	1978-99	1989-2004
Crop Specialists	5.5%	4.6%	3.6%	2.4%
Wool Specialists	0.2%	0.8%	0.6%	0.4%
Beef Specialists		1.6%	2.1%	2.5%
All Broadacre	2.2%	2.6%	2.6%	2.2%

Given the likely impact of the drought in recent years, evidence of a decline in the rate of growth of productivity from Figure 2 is not strong. The ABARE data has also been used to assess trends in productivity for industries within the agricultural sector (Table 1). These estimates provide some support for the proposition that productivity growth has slowed, at least for specialist croppers. Males *et al*. (1990) reported productivity growth of 5.5 percent per annum for specialist crop farmers for the period 1978 to 1989. Since then the two studies by Knopke *et al*. (1995; 2000) suggested that productivity growth for crop specialists slowed to 4.6 percent per annum for the period from 1978 to 1994 and to 3.6 percent per annum for the period from 1978 to 1999, while productivity growth in broadacre agriculture as a whole remained unchanged at 2.6 percent per annum.

A study undertaken by ABARE for the Victorian DPI (Department of Primary Industries) (ABARE, 2006) found that productivity growth in broadacre agriculture had declined to 2.2 percent per annum. However, the analysis was conducted over a relatively short period from 1989 to 2004 and drought was a major influence in latter years of this period.

Most recently, Kokic *et al*. (2006) using panel data found that from 1989 to 2004, annual productivity growth in the grains industry averaged 1.9 percent and for specialist croppers, averaged 1.8 percent. Annual growth for the grains industry increased to 2.6 percent when adjusted for the poor seasonal conditions over this period.

Productivity growth in the sheep industry, at least as estimated using ABARE survey data, has always been disappointing, at 1 percent per annum or less in recent decades. The productivity of beef specialists has been better than that of sheep specialists but less than that of those predominantly involved in crop production. The estimates from Table 2 suggest that productivity in the beef sector may have been increasing. Productivity grew at the rate of 1.8 percent per annum from 1978 to 2002 but the growth rate was 2.1 percent per annum from 1989 to 2002 and 2.5 percent per annum to 2004 for specialist beef producers.

Hence, although there is some evidence that productivity growth in the grains industry may be drifting down, while that for livestock specialists has been increasing[2], evidence of a marked decline in the productivity of Australian broadacre agriculture generally is yet to emerge.

How Does Productivity Growth in the Australian Agricultural Sector Rate?

The Productivity Commission (PC) has been estimating productivity growth in major sectors of the Australian economy such as agriculture (Table 2). These estimates are based on Australian Bureau of Statistics (ABS) data from the National Accounts for the sector using a value added approach to estimating productivity[3]. Note that this is a very different dataset from the ABARE broadacre farm survey data.

Table 2: Annual productivity growth in sectors of the Australian economy: 1975–2005.

	1975–82	1982–85	1985–89	1989–94	1994-99	2000-05
Agriculture	1.6	1.1	1.4	2.6	4.3	2.7
Mining	-1.7	0.5	2.6	2.5	1.2	-2.8
Manufacturing	2.1	1.8	1.7	1.6	1.3	1.3
Electricity, gas & water	2.0	3.2	4.2	3.7	1.8	-2.7
Construction	1.4	0.4	-0.3	-0.2	0.4	2.2
Wholesale trade	-0.7	-0.9	-0.5	1.2	3.2	1.5
Retail trade	1.0	0.6	-0.2	0.1	1.0	1.0
Accommodation, cafes & restaurants	-0.9	-1.3	-1.9	-1.6	-0.3	1.6
Transport & storage	2.2	1.2	1.0	1.4	1.9	2.1
Communication services	6.5	4.9	4.8	4.9	3.7	1.1
Finance & insurance	-2.0	-1.0	0.2	0.7	0.8	0.2
Comm. Rec. Services	-1.4	-2.2	-2.9	-3.1	-3.3	0.9
Market Economy	1.1	0.8	0.4	0.7	1.8	0.9
Agriculture/ Market economy TFP	1.4	1.4	3.5	3.7	2.4	3.0

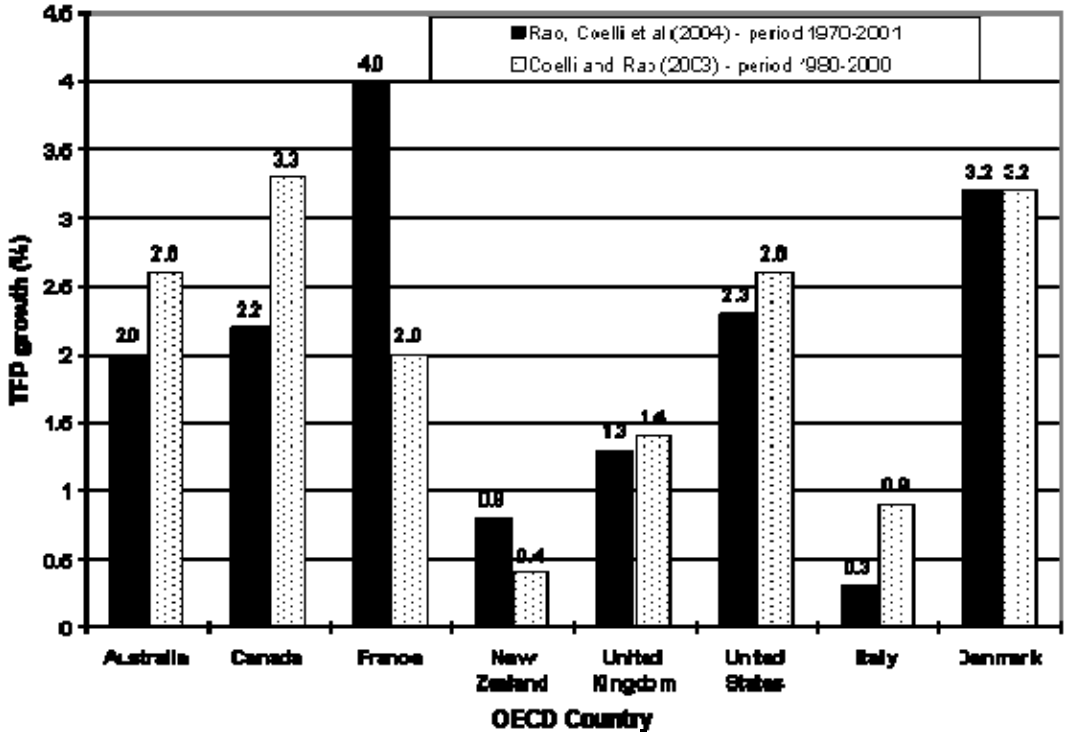
Source: Adapted from Parham (2004) and the PC website (http://www.pc.gov.au/commission/work/productivity/index.html)

Since 1994 productivity growth in agriculture has been higher than in any other sector of the Australian economy. Up to 1994, productivity growth in the electricity, gas and water sector and in the communication services sector, generally exceeded that in agriculture and so did the growth rate in manufacturing, although to a lesser extent. The most recent estimates from the PC for 2000 to 2005 show a sharp drop in productivity for the economy as a whole and for the agricultural sector. However, agriculture fared better than other sectors, despite a series of droughts. The rate of productivity growth in agriculture has accelerated from 1.4 times to between 2.4 and 3.7 times that in the rest of the economy since the 1985-89 period. Studies by Bernard and Jones (1996) and Martin and Mitra (2000) suggest that the agricultural sectors in few OECD countries perform as well relative to their economies as does the Australian agricultural sector.

International comparisons of productivity are difficult to make because of differences in methods, data, and observation periods. Multilateral studies such as those by Coelli and Rao attempt to account for these issues, however single country studies may give a more accurate analysis because they exploit more fully data sources peculiar to the country of study. International comparisons are reviewed in Mullen and Crean (2007).

With these qualifications in mind, Australia's recent performance compares favourably with other countries. For example, Coelli and Rao (2003) for the period 1980 to 2000 found that Australian agriculture achieved a TFP growth rate of 2.6 percent per annum – higher than the Rao *et al*. (2004) estimate of 2.0 percent per annum for the period 1970 to 2001 and higher than estimates from earlier studies. This rate of growth is similar to that achieved by the USA and well above average for the group of OECD countries (Figure 3).

Figure 3: Agricultural productivity growth rates – selected OECD countries.



Source: Rao et al. (2004); Coelli and Rao (2003)

The lack of international farm survey data comparable to that collected by ABARE appears to be the main reason for the lack of comparative international studies of particular agricultural industries. However, there appears to be some evidence to suggest that Australia's rate of crop productivity growth of 3.6 percent per annum compares favourably with other countries, which ranged from 1.4 to 2.8 percent per annum. Livestock productivity appears to be low relative to the livestock sectors in other countries, although productivity in the Australian beef industry has risen.

To sum up, strong growth in agricultural productivity relative to the Australian economy as a whole and relative to productivity growth in the agricultural sectors of other countries, and a slowing in the decline in the terms of trade facing farmers may mean Australia's ability to compete on world markets may have improved over the last decade.

Sources of Productivity Growth

In a companion paper, the contribution of domestic R&D to productivity growth in broadacre agriculture is reviewed. However, it should not be overlooked that there are other sources of productivity growth including:

- Efficiency gains;
- Scale economies;
- Farmers' education;
- Investments in public infrastructure such as transport and communication;

- Microeconomic reform;
- 'Spillins' of research from other sectors and other countries;

Concluding comments

Productivity growth in Australian broadacre agriculture has been strong over several decades. While there is evidence that productivity growth amongst specialist crop farms has fallen from very high levels, productivity in the beef industry has risen. For broadacre farms in general, there is little evidence of a decline in growth, despite some weakness in recent years associated with drought conditions.

Within the Australian economy, productivity growth in agriculture has been around 3 times that in economy as a whole and has markedly outpaced the decline in the terms of trade facing farmers over the past 15 years. International comparisons are difficult to make but the evidence available suggests that Australian agriculture has performed well against the agricultural sectors of most other counties.

Taken together, these trends suggest that productivity growth in broadacre agriculture has been at a rate likely to have made the sector more competitive relative to agricultural sectors in other countries, noting that the final outcome is also influenced by trade and farm support policies in these countries and by exchange rate conditions.

Given its importance, productivity is a focus of government policy. Governments use a range of instruments including direct investment to foster productivity growth through R&D. In a companion paper, trends in investment in agricultural R&D are examined and evidence concerning the returns from investment in R&D is assessed.

References

ABARE (2006). Unpublished report commissioned by DPI Victoria.

Australian Bureau of Statistics, (various) "Research and Experimental Development, All-Sector Summary, Australia", Catalogue No. 8112.0.

Bernard, Andrew B. and Jones, Charles I. (1996). 'Productivity across Industries and Countries: Time', Review of Economics & Statistics, 78, 135.

Coelli, T. and Rao, P. (2003). Total factor productivity growth in agriculture: A Malmquist index analysis of 93 countries,1980-2000, CEPA Working Paper 022003.

Knopke, P., O'Donnell, V. and Shepherd, A. (2000). Productivity gains in the Australian grains industry. ABARE Research Report, 2000.1, ABARE, Canberra.

Knopke, P., Strappazzon, L. and Mullen, J. D. (1995). Productivity growth: Total factor productivity on Australian broadacre farms, Australian Commodities, Vol. 2, pp. 486-497.

Kokic, P., Davidson, A. and Boero Rodriguez, V. (2006). Australia's grains industry: Factors influencing productivity growth, ABARE Research Report 06.22 prepared for the GRDC, Canberra.

Males, W.P., Davidson, H., Knopke, P., Loncar, T. and Roarty, M.J. (1990). Productivity growth and developments in Australia's primary industries, Discussion paper 90.8, ABARE, Canberra.

Martin, W & Mitra, D. (2000). Productivity growth and convergence in agriculture and manufacturing, Economic Development and Cultural Change, 49(2), 403-422.

Mullen, J.D. (2007). 'Productivity growth and the returns from public investment in R&D in Australian broadacre agriculture', Presidential Address at the 51st Conference of the Australian Agricultural and Resource Economics Society, February 14-16, 2007, Queenstown, New Zealand.

Mullen, J.D. (2002). Farm management in the 21st Century', Australian Agribusiness Review, 10 Paper 5 at http://www.agribusiness.asn.au/Review/2002v10/Index.htm

Mullen, J. D. and Cox, T. L. (1995). The returns from research in Australian broadacre agriculture, Australian Journal of Agricultural Economics, 39, 105-128.

Mullen, J.D. and Crean, J. (2007). Productivity growth in Australian agriculture: Trends, sources, performance, Australian Farm Institute.

Pardey, P.G., J.M. Alston, and R.R. Piggott eds. (2006). Agricultural R&D Policy in the Developing World: Too Little, Too Late? Washington DC: International Food Policy Research Institute.

Rao, P., Coelli, T. and Alauddin, M. (2004). Agricultural productivity growth, employment and poverty in developing countries: (1970-2000) Employment Strategy Paper. Centre for Efficiency and Productivity Analysis (CEPA), School of Economics, University of Queensland, Brisbane.

Stoeckel, A. and Miller, G. (1982). Agriculture in the Economy. In Agriculture in the Australian Economy Williams, D. B. Sydney University Press, pp. 166 - 185.

Wood, A. (2007). 'Productivity takes a political beating', The Australian, 20.6.07, available at http://www.theaustralian.news.com.au/story/0,20867,21934314-31478,00.html