

## The farm productivity dilemma

A talk to the Hamilton Branch of the Grassland Society by Michael Carroll

### Introduction

As a levy payer and director of an R&D corporation I have spent considerable time reflecting on the conundrum that:

- the red meat industry and Australian tax payers have for many years been investing \$60 to \$80 m per annum in R&D,
- the ex-post cost/benefit analysis of this investment shows high returns with benefits being 3.4 to 3.7 times the investment<sup>1</sup>, and
- productivity measures show farmers have achieved great progress,

Yet farm performance studies show that farming returns aren't improving.

I've also wondered whether our investment in R&D and the productivity improvements we've achieved aren't the cause, or at least partly the cause, of the ongoing falls in our terms of trade.

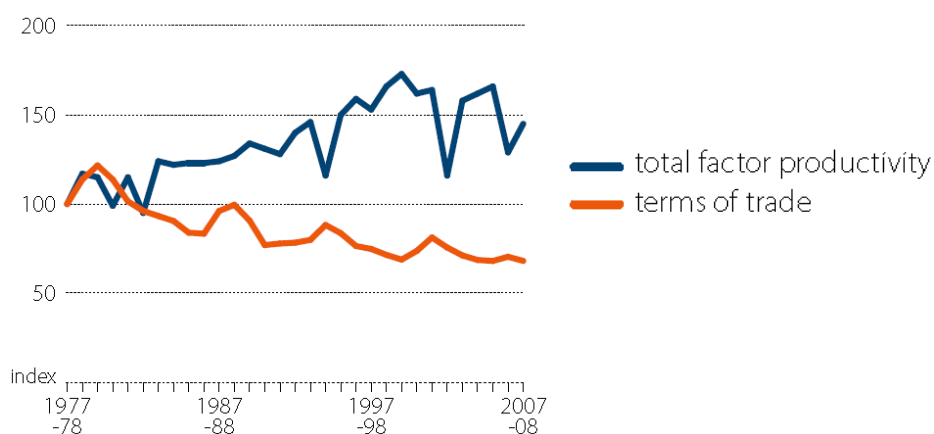
*Is it because as we improve our productivity we are prepared to give up the opportunity to earn a higher return by accepting prices that have not appreciated as much as our costs, that we undermine our terms of trade?*

To think through this question I've drawn on a range of economic studies to piece together some insights.

### Context – declining terms of trade offset with productivity gains

No chart sums up Agriculture more than the following. We operate in an environment where our costs appreciate at a faster rate than the prices we receive and offset this with increased output for every unit of input.

Figure 1. Farm Productivity and Terms of Trade

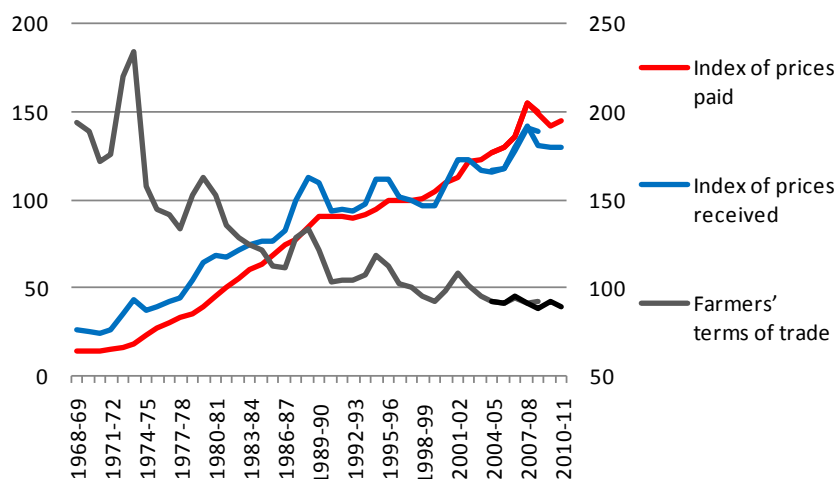


Source: ABARE

It appears to be an inevitable and ongoing trend that over time farmer's terms of trade decline. This imposes a relentless *Darwinian* pressure that means if you don't adapt you'll eventually go out of business.

<sup>1</sup> MLA's evaluation studies show R&D investments in improving cost efficiency and productivity on farm for beef and lamb achieved benefit:cost ratios of 3.4 and 3.7 respectively.

Figure 2. Farm Terms of Trade

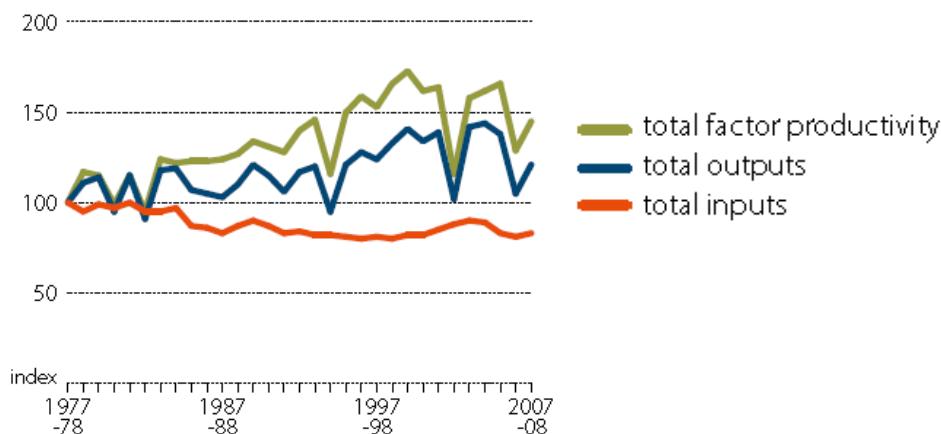


Source: ABARE

The standout increases in costs over the last 5 years have been fertiliser, electricity and insurance.

The other trend on the opening chart is the ongoing increase in agriculture’s productivity. We have an admirable track record in increasing our output relative to the inputs we use. On labour productivity agriculture leads the country having achieved three times the growth of the “all industries” average over the last ten years.<sup>2</sup>

Figure 3. Annual Productivity Growth 1977/78 to 2007/08



Source: ABARE

Productivity growth, measured using total factor productivity (TFP) indices, measures the increases in output in excess of additional input use<sup>3</sup>. The following table separates the output and input components for different enterprises. The additional production comes about through efficiency gains, mostly associated with new technologies and better production and management methods.

<sup>2</sup> Phil Ruthven, IBIS World, AICD Company Director, Volume 26 Issue 5

<sup>3</sup> Total Factor Productivity (TFP) is estimated by taking a ratio of an aggregate output index to an aggregate input index. Compared with partial measures such as yield or labour productivity, TFP provides an indication of overall productivity progress. However, it should be noted that non-market inputs such as soil quality are not included, and that TFP estimates also reflect peripheral factors such as measurement constraints, seasonal variability and changes in industry scale.

Figure 4. Annual Productivity Growth 1977/78 to 2007/08

	TFP growth %	output growth %	input growth %
Total broadacre	1.4	0.8	-0.6
Cropping	1.9	2.1	0.2
Mixed crop-livestock	1.4	-0.1	-1.6
Beef	1.5	1.6	0.2
Sheep	0.3	-1.5	-1.7

Source: ABARE

What I always assumed is that the productivity gains we’ve achieved have been in response to our declining terms of trade. It makes sense that the adversity that the decline in our terms of trade inflicts upon us leads to innovation. As the saying goes “Adversity is the mother of invention”.

But is it a cause and effect? Or is our adaption and innovation and the consequent increase in productivity the cause of falling real produce prices and contributing to the ongoing decline in our terms of trade?

### A market economy self limits the returns we can generate

We operate in a market economy where we’re all motivated, albeit to varying degrees, to increase our wealth.

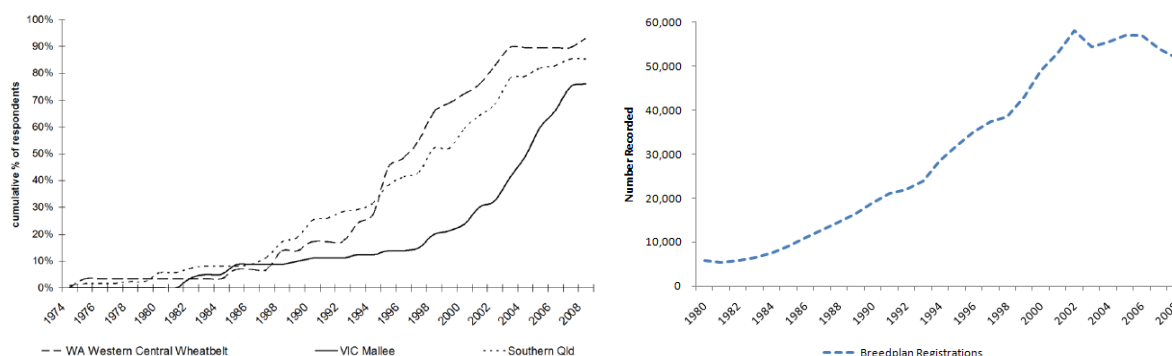
So if we see

- new technologies and practices that will improve our returns, or
- different enterprises that look more profitable than those that we’re currently running, or
- a complete alternative to farming that offers greater investment value,

Then we change.

Some move quickly while others take some convincing and time to adjust. The following charts show the adoption time frame of two new technologies; minimum tillage in crop production and objective measurement in cattle selection.

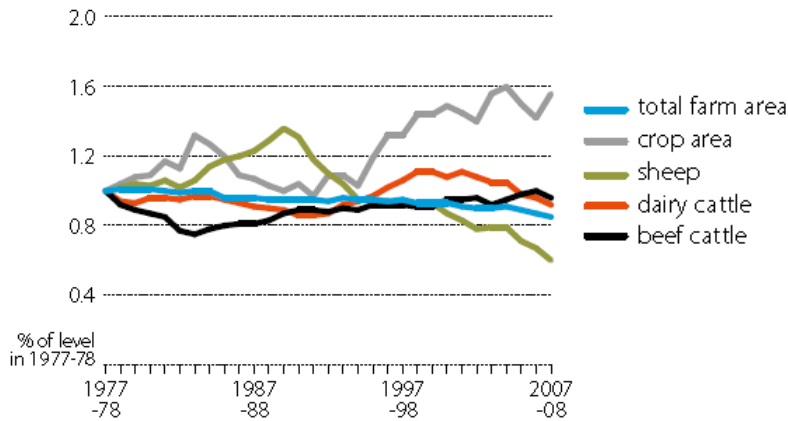
Figure 5. Adoption of Minimum Tillage and Angus Breedplan



Source: D’Emden, 2009 Future Farm Industries Presentation, Rob Banks MLA

The following chart shows the constant process of enterprise adjustment at work as farmers reassess their profit potential. Most marked is the switch between cropping and sheep. There is some truth in the adage that “nothing fixes low prices better than low prices”. If returns tend towards low levels then production contracts. If returns tend towards higher levels then people switch enterprises and production ramps up as higher input practices become economic.

Figure 6. Changes in farm land use and livestock numbers

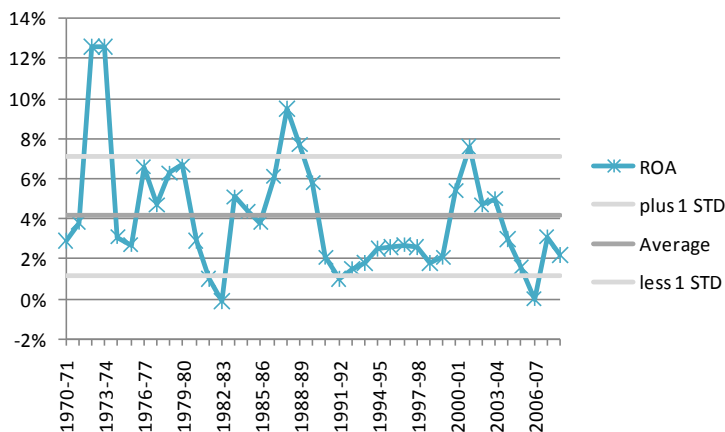


Source: ABARE

So markets have a way of finding a level. No one gets away with making too much profit for too long before others “jump on the band wagon”. Adam Smith’s invisible hand places a cap and floor on the returns we can extract from farming.

Consequently farm returns tend to show a pattern of mean reversion. The following 39 years of data from the Hamilton Farm Monitor group shows that return on assets has averaged 4.1% with a standard deviation of 3%. If history repeats itself there is a 67% probability that average returns will fall between 1% and 7%<sup>4</sup>.

Figure 7. Return on Assets



Source: South West Farm Monitor Project

### A market economy – supply and demand responding to price signals

So where has all the value of our past productivity gains gone? Agriculture has lead Australian industry with a 1.4% p.a. productivity gain over the last 30 years and yet we seem destined to averaging just over a 4% return on our assets.

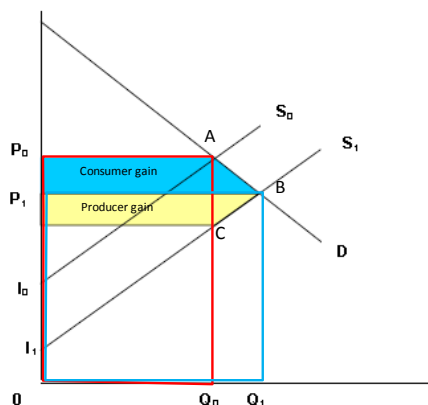
Several economic studies using equilibrium displacement models shed some light on this and the following supply and demand chart provides a simple example. The market is in equilibrium at point A where the supply curve  $S_0$  intersects the demand curve  $D_0$ , resulting in quantity  $Q_0$  and price  $P_0$ .

<sup>4</sup> If fact in only in 9 out of the last 39 years (24%) was the ROA more or less than one standard deviation of the mean.

Say a new technology emerges which decreases the variable cost of production by the amount AC then the industry supply curve shifts to the right from  $S_0$  to  $S_1$ <sup>5</sup>. As more producers adopt the technology and respond to the incentive of lower costs to expand output, a new equilibrium is reached at point B resulting in quantity  $Q_1$  and price  $P_1$ . These price and quantity changes allow changes in gross industry benefits (and benefits to particular market segments when more than one market level is modelled) to be estimated.

These industry benefits are calculated as changes in the producer gain and consumer gain. In this case, the consumer’s share of the gains from the new technology is equivalent to the blue shaded area in the diagram below and producer’s share is equivalent to the yellow shaded area.

Figure 8. Market equilibrium with a cost-reducing technology

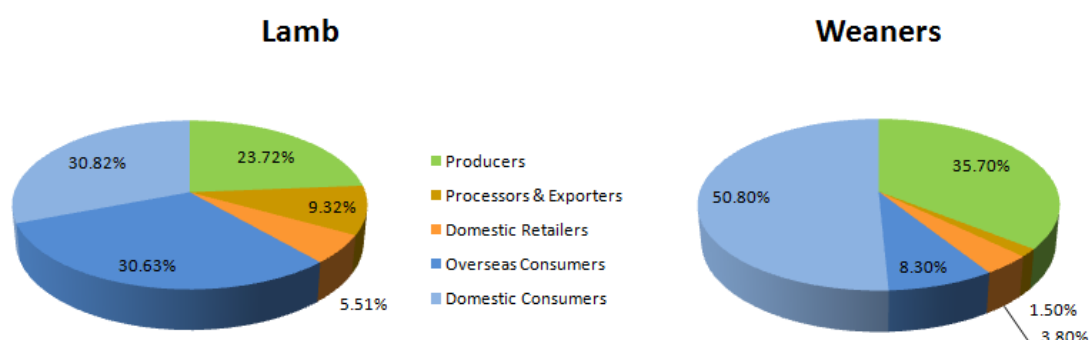


Source: Mounter et al, Garry Goucher & Associates in collaboration with the CRRDC

Mounter et al (2008) found that a 1% cost reduction in lamb production results in a \$9.23 m gross benefit to the lamb industry. However producers only receive 24% of this value. Most of it – 61% - goes to consumers. 8% goes to processors and 6% to retailers and the balancing 2% to various other “middle men”.

Zao et al (2002) found that a 1% cost reduction in weaner cattle production results in a \$19.6 m gross benefit to the cattle industry. However producers only receive 34% of this value. Most of it – 59% - goes to consumers. 4% goes to retailers and the balance to various other “middle men”.

Figure 9. Distribution of benefits to various parts of the Value Chain



Source: Mounter et al, Zhao et al

<sup>5</sup> There is discussion amongst economist about the nature of the supply curve shift in response to cost reducing technology. If the curve pivots to become flatter then the producers share of the benefit is reduced.

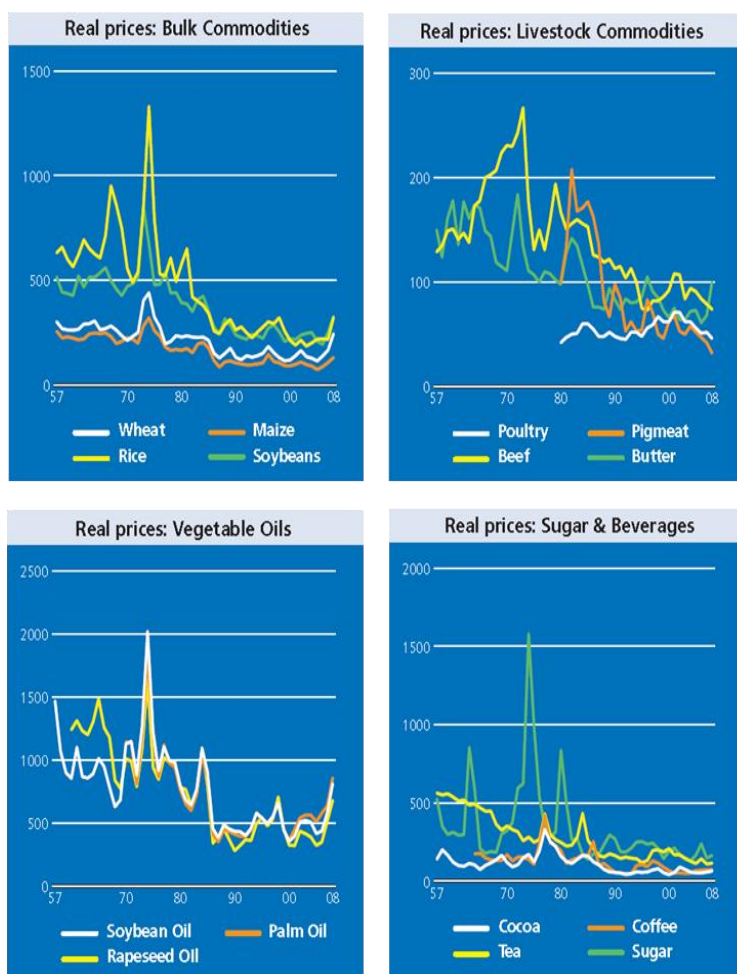
### The consumer value transfer

If these models are correct and consumers capture 60% of the value in greater quantities of food at lower prices there must be some evidence of this.

The following collection of charts are sourced from the United Nation’s Food and Agriculture Organisation. It shows the international price trends for 15 different agricultural products, adjusted for inflation over the last 50 years. And although the series ends at height of the 2007/08 “food crisis” the long term trend for “real” food prices is clearly down.

That “crisis” appears to have abated for the time being and the upward ticks on these graphs have in virtually all cases reverted to levels consistent with a downward trend.

Figure 10. Annual food prices in real US dollar terms (1957-2008)<sup>6</sup>



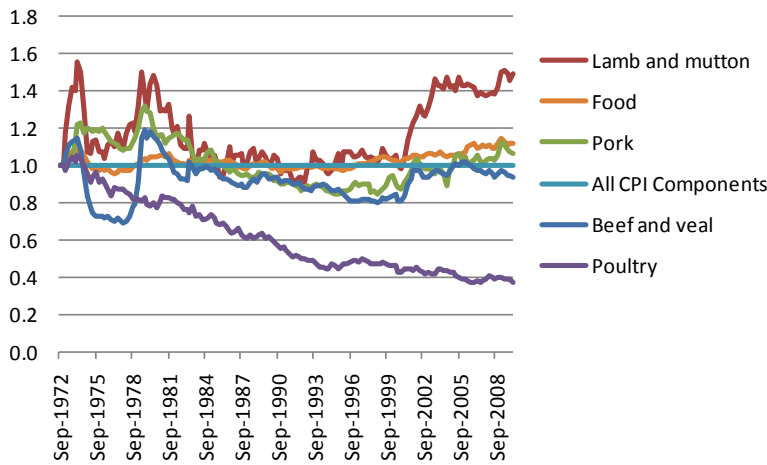
Source: Food and Agriculture Organization of the United Nations

Closer to home 30 years of ABS data suggests we haven’t seen such an obvious downward trend except for poultry meat. Beef and Pork have fairly closely tracked the CPI, and Lamb prices have performed very strongly.

As net exporters of agricultural produce these charts also highlight the importance of productivity in maintaining international competitiveness.

<sup>6</sup> Note: Real prices refer to nominal prices adjusted for changes in US Producer Price Index (2000 = 100)  
 Sources: Cocoa (ICCO); coffee (ICO); cotton (COTLOOK A Index 1–3/32”); maize (US No. 2, yellow, US Gulf); rice (white rice, Thai 100% B second grade, f.o.b. Bangkok); soybeans (US No. 1, yellow, US Gulf); sugar (ISA); tea (total tea, Mombasa auction prices); Wheat (US No. 2, soft red winter wheat, US Gulf); beef (Argentina, frozen beef cuts, export unit value); butter (Oceania, indicative export prices, f.o.b.); pig meat (USA, pork, frozen product, export unit value); poultry meat (USA, broiler cuts, export unit value); rape oil (Dutch, f.o.b. ex-mill); Soya oil (f.o.b. ex-mill).

Figure 11. Real meat prices in Australian dollar terms

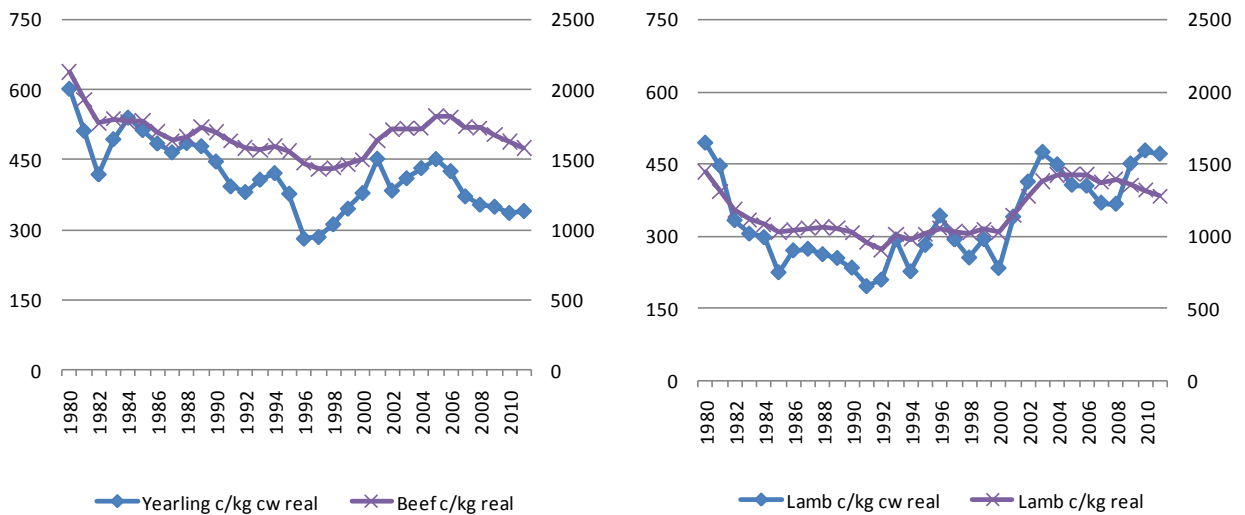


Source: Australian Bureau of Statistics

I think that perhaps what we’re seeing here is the difference between the prices of international bulk commodity markets and that of more refined retail food products in a highly developed economy.

The following chart plots the retail prices from the last chart against sale yard prices. It does appear that they track each other reasonably closely; however farm prices are certainly more volatile than consumer prices.

Figure 12. Real Beef and Lamb Prices – Sale Yard versus Retail



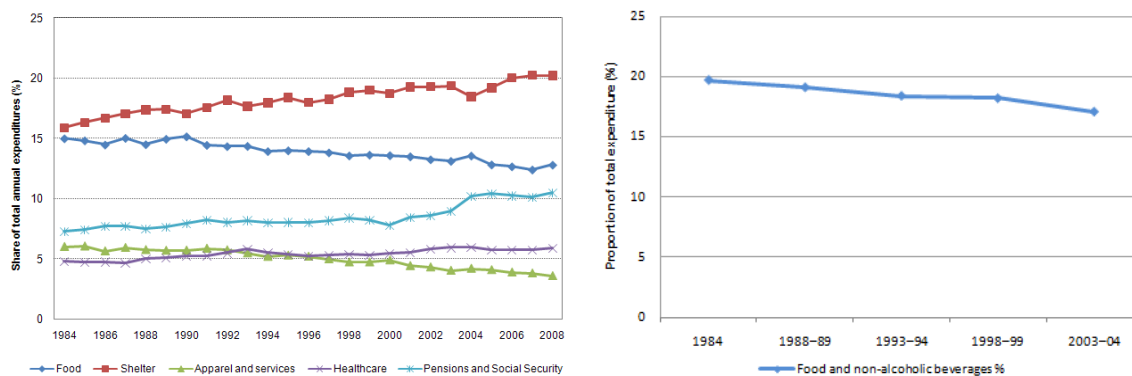
Source: ABARE, ABS, MLA

Declining, or at least flat, food prices have been accompanied by food consuming less and less of the household spend.

Looking firstly to the US, where a longer and more current times series is available, the share of total household expenditures allocated to food has decreased from 15.0 percent in 1984 to 12.8 percent in 2008.

In Australia ABS data shows a similar trend. Over the 20 years to 2004 food’s share household expenditure has fallen by over 2.5% points.

Figure 13. Changes in shares of household expenditures for selected components



Source: US Bureau of Statistics, Australian Bureau of Statistics

In addition to the real cost of foods declining and food consuming a decreasing proportion of household expenditure other benefits are transferred to consumers such as:

- Less seasonality in food availability,
- Increased quality, and
- Improved food safety.

These consumer benefits contribute to improvements in the nation’s standard of living, better health and nutrition and increasing life expectancy.

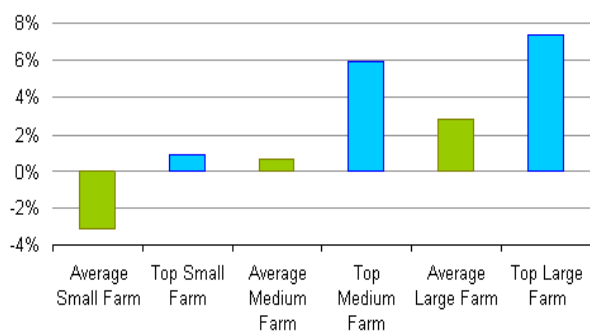
### The value to farmers

The two economic studies I referred to earlier suggest farmers receive 24% to 34% of the gross value of farm productivity gains; around half the value that consumers receive.

While I suspect the farmers share quickly dissipates, it is worth thinking about who this value flows to and in what form it flows. The financial returns from farm come in two forms – the operating return and capital growth. The capital growth component is usually greater than the operating return.

Considering the operating returns first, the following chart shows the return on assets being generated by small, medium and large farms and in each band the top quartile and average.

Figure 14. Farm Return on Assets by scale and performance



Source: ABARE, M Carroll

Clearly there is a scale effect, however there is also a big range in profitability across the size bands. I find it particularly encouraging that the best of the medium sized farms well and truly outperform the average

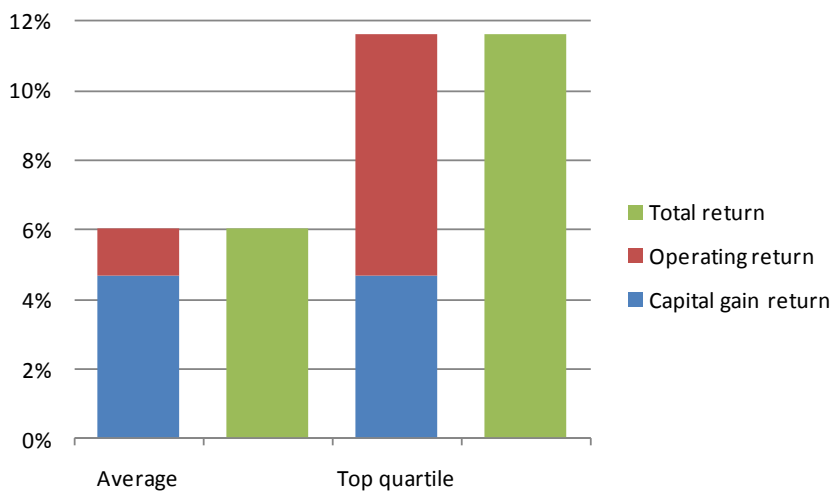
large farm. Logically it is only those who are relatively early to identify and adopt more productive farming practices that benefit in terms of operating profit.

By the time most people adopt the more profitable practices it is more a matter of having to simply to stay in business as the excess value will probably have been competed away and transferred to the consumer.

So the farm businesses that capture the operating value of our R&D investment and the resulting productivity gains are those who are quickest to identify the opportunities and adopt them.

However typically over half the returns from farming are in the form of capital gains and here everyone wins. It is the most profitable farms that are expanding most aggressively and who can justify paying the highest price for land. And in setting property values based on operating returns which are considerably higher than the average they effectively underwrite the property market for everyone.

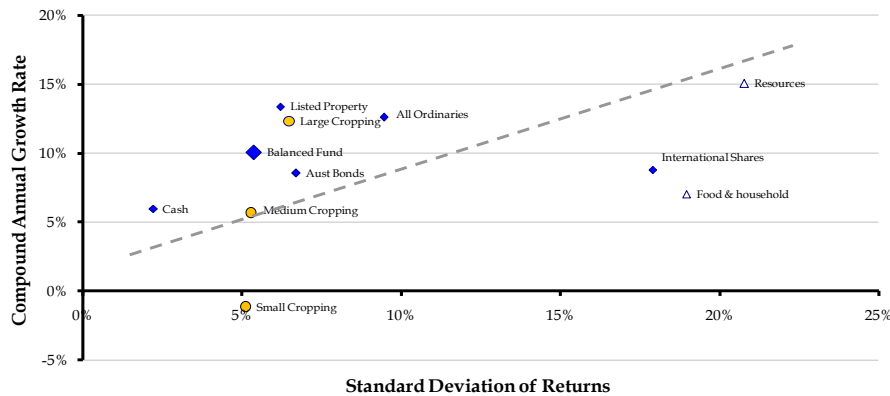
Figure 15. Farm Operating and Capital Appreciation Returns



Source: ABARE, M Carroll

I have long contended that agriculture is a good investment. If you can achieve top quartile or scale performance then it stacks up well against more conventional investments.

Figure 16. Grain Farm Investment Performance compared to Other Opportunities



Source: ABARE, M Carroll

The chart above compares the investment performance of small, average and large grain growers based on turnover bands for the 15 years to 2006. Large grain enterprises compare well to other investment opportunities such as equities. Similar analysis of all broadacre enterprises did not show such a marked scale effect, however they have shown that top quartile enterprises compare well to other investment opportunities.

## Conclusions

It appears that we are destined to an ongoing decline in our terms of trade.

As to whether we are victims of our own success with our productivity achievements being a cause of the decline in our terms of trade, it appears to me that the answer is the same as the riddle, *“which came first, the chick or the egg?”*.

In any event, just as it would be impossible to get the farmers of the world to unit and agree to only accepting prices that reflect similar appreciation to their costs, so also would it be impossible to get the farmers of the world to agree to a “standstill” on any further productivity gains. Countries and individual farmers would not be able to resist the temptation to break ranks – a “prisoner’s dilemma”.

It is quite clear that our only option is the continued pursuit of increased productivity. Those who are first to recognised and adopt more profitable practices will reap the rewards, however the gains will dissipate over time as they’re transferred on to the consumers of our produce. For most farmers they will have to change, but by the time that they do it will be matter of survival, however they can take heart in that our most productive farmers have underwritten appreciation in the value of their property.

Farmers can however take heart that their research and development and investment and productivity pursuits have conferred substantial benefits to the consumers of their produce. A significant part of our increased standard of living, better nutrition and health even increasing life expectancy is likely to be due to the real cost of foods declining, food consuming a decreasing proportion of household expenditure, less seasonality in food availability, increased food quality and improved food safety.

### Key References:

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Thanks to Liam Lenaghan for reviewing and providing comments