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The Benefits to the Australian Pig Meat Industry from an Increase in Demand for a Hypothetical Low Cholesterol Pork Product

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Abstract

This is the third of a series of papers examining the potential economic effects from the introduction of a hypothetical low cholesterol pork product into the Australian market. Here, a newly updated pig meat model reported by Griffith *et al*. (2010) is used to model the industry wide impacts of the Bellhouse *et al*. (2010) survey results on consumer willingness to pay for this new pork product. Six different scenarios are examined that are combinations of a 10, 20 or 30 per cent increase in consumer demand, with and without a 10 per cent increase in the costs of producing the more valuable pork. The simulation results for the various scenarios indicate total annual industry benefits of some $450m for an increase in aggregate willingness to pay of 30 per cent and no cost increase, down to $88m for an increase in aggregate willingness to pay of 10 per cent and a 10 per cent cost increase. Australian consumers receive about 80 per cent of total benefits, pork producers receive about 7-8 per cent and all other market participants together receive about 12-13 per cent. If aggregate willingness to pay increased 10 per cent and cost of production increased 10 per cent, and if adoption was only 15 per cent of pork supply, then total annual industry benefits resulting from the development of low cholesterol pork would be around $13m. Pork producer surplus would be less than $1m p.a., and pork consumer surplus would be around $11m p.a. If actual willingness to pay was around 20 per cent, production costs increased by 10 per cent, and if adoption was still 15 per cent, total industry benefits would be around $35m p.a. and pork producer surplus would be around $2.25m p.a. These values provide a guide to the size of the annual investment that could be justified by pork producers to produce a pig that is low in cholesterol.

Introduction

While global meat consumption is increasing, and pork is consumed more than any other meat (Speedy 2003), the Australian pig meat industry has been hit hard by a drop in slaughter numbers and export value in recent times. The domestic processed pork market is dominated by imports. According to Australian Pork Limited (APL 2009), 70 per cent of all processed pork products sold in Australia contain some imported pig meat. Most pig meat imports arrive frozen and unprepared and are then processed here. Denmark, Canada and the United States are the main sources of supply. Relatively cheap imports have made it hard for the Australian pig meat industry to compete on the basis of cost.

At the same time, many developed and developing countries are facing what has been described in the media as an 'obesity epidemic'. The prospect of more widespread health problems in the future has increased the demand for 'low fat', 'cholesterol reduced' and other 'health enhanced' products. To take advantage of this market opportunity, the Australian Pork Cooperative Research Centre (Pork CRC) has R&D projects underway that aim to reduce the cholesterol content of pork. For example, D'Souza *et al.* (2005) report research that aims to use soybean lecithin in pig diets to increase the value of pork and pork products through improved quality and health properties. A component of the project focuses on reducing the cholesterol content of pork. It is also hypothesized that the reduced cholesterol product will be more tender (Ponnampalam *et al.* 2009). Improving the health attributes of pork is one way for the Australian pig meat industry to gain a share of the predicted rise in global meat consumption.

One of the issues facing the pig meat industry and the R&D agencies that fund the research is whether the investment in cholesterol reduced pork is likely to be worthwhile. The science may be excellent and the desired outcome may be achieved, but will the availability of a credible reduced cholesterol pork product have an economic impact in the domestic fresh meat market? Two recent papers published in this *Review* (Bellhouse *et al*. 2010, Griffith *et al*. 2010) have reported progress toward estimating the likely economic benefits to the Australian pig meat industry from having such a product available.

Bellhouse (2009) and Bellhouse *et al.* (2010) investigated the first necessary condition: whether there would be an increase in consumer willingness to pay and purchase, if reduced cholesterol pork was introduced to the Australian market. Using stated choice methods and data from a 2009 online survey of 861 participants, the results showed that some pork consumers would neither increase consumption nor pay more, some would increase consumption or pay more, and a small proportion would both increase consumption and pay more (summarised in Figure 1).

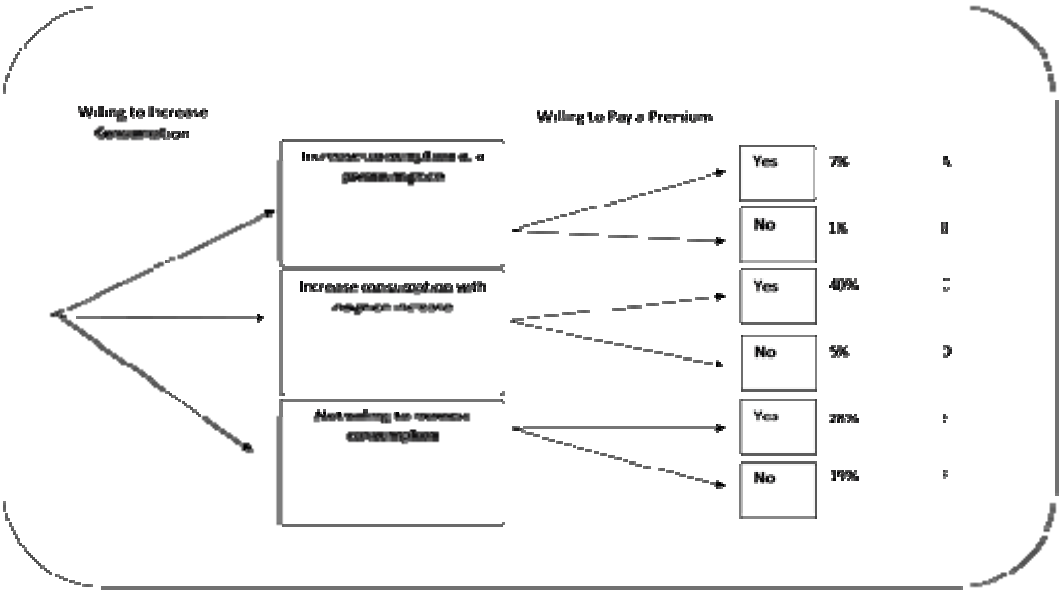

Figure 1. Types of consumer responses (Bellhouse *et al*. 2010)

Given that stated intentions to increase consumption or pay more were based on individual assessment of base price and type of cut, two different methods were used to determine the average shift in household consumption, price and expenditure. Under Scenario 1, the willingness to pay and purchase data for each respondent was combined to calculate their current fortnightly expenditure on fresh pork, and what this was likely to increase to if they had the option to purchase reduced cholesterol pork. This assumed that there would only be a price rise for those respondent groups indicated as A and E in Figure 1, with the majority of the increase in market size coming from increased consumption, and a small proportion coming from a group of consumers prepared to pay a premium for the product. Under these assumptions, Bellhouse *et al*. (2010) predicted a significant financial premium for the reduced cholesterol product at the retail level, with increased willingness to pay for and consume reduced cholesterol pork (Table 1). The demand for reduced cholesterol pork by the average pork consuming family was predicted to increase by up to 32 per cent and expenditure by the average pork consuming family was predicted to increase by up to 43 per cent, above current levels for regular pork. The average predicted willingness to pay for the lower cholesterol pork was $3.11/kg, or some 14 per cent above the average price of $22.25/kg for regular pork.

Table 1. Change in average household behaviour under Scenario 1

	Regular Pork	Reduced Cholesterol Pork
Times per fortnight household consumes fresh pork	1.63 meals	2.41 meals
Weight of fresh pork household consumes per fortnight	1.08kg	1.67kg
Household expenditure on pork	$24.03	$42.53

Under Scenario 2, it was assumed that reduced cholesterol pork was introduced to the market at a given price premium per kilogram, between $1.52 and $7.58, equivalent to the price premiums per package that respondents were asked to choose from in the survey. Information about respondents' willingness to pay and purchase at each premium was combined to predict the change in market size. The results are summarised in Table 2. This strategy appears much less successful in increasing market size than Scenario 1, with the greatest average additional spend being $5.61 per fortnight (an increase of 23 per cent), at a premium of $1.52 per kg (equivalent to $0.50 per 330g package, an increase of just 7 per cent). The average price premium is still $3.11/kg, or an increase of 14 per cent.

Table 2. Change in average household expenditure on pork under Scenario 2

Premium / kg	Regular Pork	Reduced Cholesterol Pork
$1.52 ($0.50 per 330g)	$24.03	$29.64
$3.03 ($1.00 per 330g)	$24.03	$25.46
$4.55 ($1.50 per 330g)	$24.03	$26.90
$6.06 ($2.00 per 330g)	$24.03	$26.66
$7.58 ($2.50 per 330g)	$24.03	$25.99

Even after allowing for possible overstatement by the surveyed respondents, the conclusion remains that there could be a significantly positive response in consumer demand for low cholesterol pork. The question that arises is, if this increased willingness to pay eventuated, what would be the economic impact in the Australian pig meat market and what would be the distribution of those benefits and/or costs across the various participants in the value chain?

Alternate Methods of Assessing the Market Impact

One method to assess market impact is to use a static value chain type of approach and use the predicted increase in retail value on a carcass basis to estimate the increase in carcass value at the wholesale and farm gate market levels. The average price premium for the hypothetical low cholesterol pork was $3.11/kg. Given data contained in Whitehall Associates (2004), the average retail carcass value for regular pork was taken to be $578, based on the return from a 70kg carcass sold for typical usage in various segments of the domestic market, using the July 2003 national average spot retail prices for common cuts.

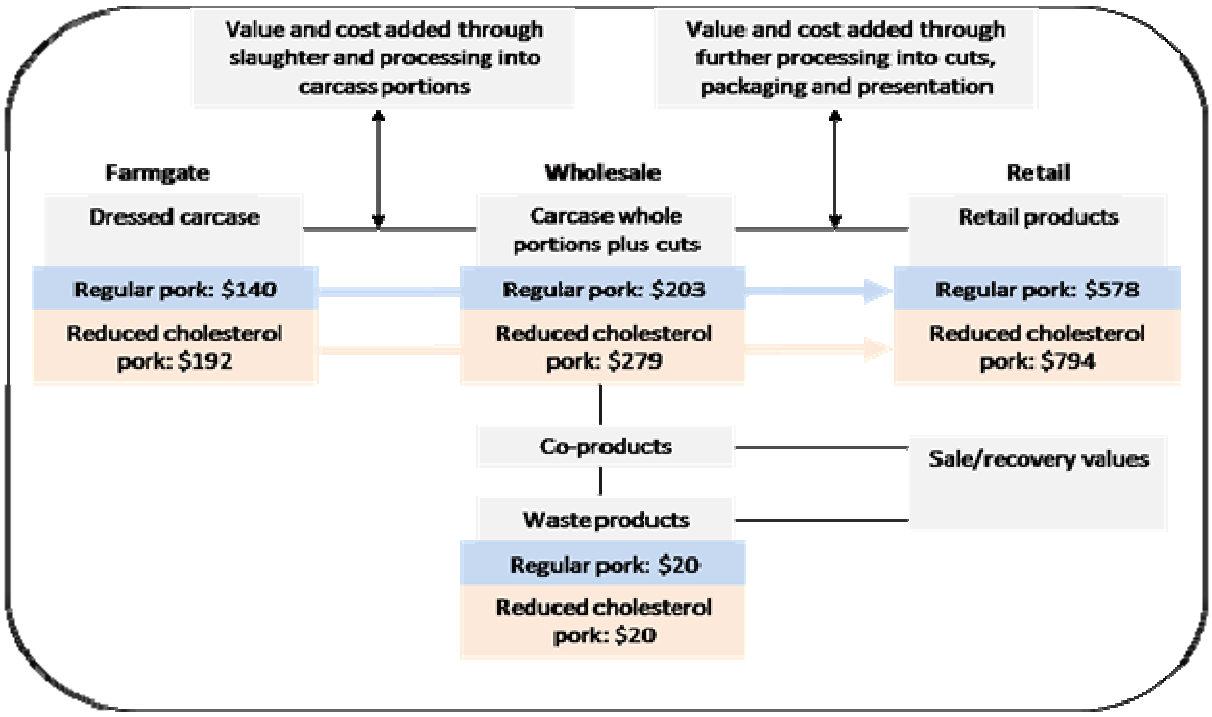

Figure 2. Value of regular pork and reduced cholesterol pork from farm gate to retail (after Whitehall Associates 2004)

Figure 2 is reproduced from Whitehall Associates (2004), with the addition of the predicted increase in carcass value at each step in the production and marketing chain. The key assumption in using this type of model is that the same ratios of farm gate:wholesale:retail prices hold for the new fresh pork product as for normal pork (as well as additional assumptions about carcass purpose, market conditions and cost structures, etc). It can be seen that the increase in value at the farm gate could be as much as $52 per carcass.

If this project to develop low cholesterol pork is successful, however, what we should be looking at is the economic effect of an outward shift in retail demand due to an increase in consumer preference or willingness to pay. Successful promotion programs are often modelled in this way. The outwards shift in demand could be due to consumers buying more pork, paying more for what they currently buy, or both. Under normal domestic market demand and supply conditions, this will cause retail prices to increase, and some of this increase will be transmitted down to wholesale and farm prices, according to the relative responsiveness of supply and demand at each market level. Higher prices at the farm level will then induce pig meat producers to supply more pork, and this will subsequently place downward pressure on prices at all levels, offsetting some of the initial gains made as a result of the increase in the willingness to pay of consumers.

This is a much more complicated process than that portrayed by the Whitehall Associates analysis, where prices and margins are fixed and market participants have no incentive to change their production or consumption decisions relating to pork itself, to the various inputs used to produce pork,

or to the various other outputs produced when pork is produced. This is what economists call a "fixed proportions" world.

To properly handle this more complicated process, a formal model of the pig market is required, which includes the necessary complexity to account for the interactions between demand and supply forces over time at different market levels. One such model is that developed by Mounter *et al.* (2004, 2005a, 2005b). Griffith *et al.* (2010) report the updating of the Mounter *et al* (2004) model using recent price and quantity data following a critical review of the appropriateness of assumptions about elasticity values and other market parameters.

In what follows, the newly updated model reported by Griffith *et al*. (2010) is used to model the industry wide impacts of the Bellhouse *et al*. (2010) survey results. Six different scenarios are examined that are combinations of a 10, 20 or 30 per cent increase in consumer demand, with and without a 10 per cent increase in the costs of producing the more valuable pork product. In Table 2 it is shown that expected upward shifts in the price direction (price premiums) range from 0-34 per cent, with the average upward shift in price being 14 per cent and the most likely price increase being 7 per cent. In Table 1 it is shown that much larger horizontal shifts in the quantity direction (increased consumption) would occur, which is to be expected given the typically elastic nature of the demand for pork in Australia (Griffith *et al*. 2001) (although some of these values have embedded in them general price increases for pork as well specific premiums for the new pork product). Thus a range of possible increases in pork demand from 10-30 per cent seems plausible.

Further, the new pork product will no doubt be more costly to supply with more expensive feed rations required, although no evidence is available as yet about what this increased cost may be. An assumption of a 10 per cent cost increase gives some idea of the extent to which increased production costs may apply and offset the willingness to pay values offered by consumers.

Results

The results for the six different scenarios show the benefits in terms of economic surplus measures to pork producers, pork consumers, all other participants in the Australian pig meat market, and in total. These benefits are shown in Table 3. The terminology used is explained in Mounter *et al*. (2004, 2005a, 2005b) and Griffith *et al.* (2010).

The surplus measures reported in Table 3 represent annual economic benefits to Australian pork producers, to Australian pork consumers, and to all other participants in the whole pig meat marketing chain as a group, such as Australian pork and bacon processors and retailers, Australian baconer producers, Australian bacon and ham consumers, and consumers of Australian pork exports in overseas markets and suppliers of Australian baconer imports from overseas markets (see Griffith *et al*. 2010, Figure 1 and Table 1 for the complete set of sectors included in this model). Total economic surplus is the sum of those three groups. These estimates of surplus are in terms of millions of dollars, annually, and are for the situation where the whole industry has changed and consumers can obtain and are prepared to pay for whatever amount of low cholesterol pork they choose to consume.

Table 3. Economic surplus to pork producers, pork consumers, other market participants and total surplus from six scenarios ($ million per annum)

Item	Scenario					
	1 (30% increase in demand, no change in cost)	2 (20% increase in demand, no change in cost)	3 (10% increase in demand, no change in cost)	4 (30% increase in demand, 10% increase in cost)	5 (20% increase in demand, 10% increase in cost)	6 (10% increase in demand, 10% increase in cost)
Pork producer surplus	32	21	10	26	15	4.4
Pork consumer surplus	364	234	113	319	192	74
Other market participant's producer surplus	56	36	17	47	27	9.2
Total surplus	452	291	140	391	234	88

Under these circumstances, the simulation results for the various scenarios indicate total annual industry benefits of some $450m for an increase in aggregate willingness to pay of 30 per cent and no cost increase, down to $140m for an increase in aggregate willingness to pay of 10 per cent and no cost increase. The shares of these totals going to the various sectors are respectively $32m to $10m for pork producers, $364m to $113m for domestic pork consumers and $56m to $17m for all other market participants in aggregate. Thus Australian consumers receive about 80 per cent of total benefits, pork producers receive about 7-8 per cent of total benefits and all other market participants receive about 12-13 per cent of total benefits.

If it is assumed that that it costs 10 per cent more to produce low cholesterol pork than normal pork, then under the same three consumer demand scenarios, total surplus values are about $60m less than the equivalent value without any increase in production cost. This means that production costs have a proportionally larger impact when the demand shift is relatively small.

Taking a conservative approach, assume that actual willingness to pay values would be toward the lower end of the scale (say 10 per cent), and that there would be an increase in production costs for low cholesterol pork (say by 10 per cent). Under this scenario (6), the gross industry benefits from the widespread availability of the new product would be in the order of $88m per year. Australian consumers would get by far the largest share of these benefits, around 85 per cent. Pork producers would get around 5 per cent of the total benefits, and the remaining 10 per cent of total benefits would be distributed across all other market participants. And, some of these other participants would lose

from the new pork product, such as baconer producers and bacon and ham consumers (see the detailed results in Mounter *et al*. 2004, 2005a, 2005b).

Realistically, the whole industry would not find sufficient incentive to switch over to low cholesterol pork production. Possibly only a small proportion of total pork supply would be affected. The estimated surpluses accruing to each segment of the market would correspondingly be lower. For example if only 15 per cent of producers supplied low cholesterol pork, then surplus values would be 15 per cent of the values estimated in Table 2.

So if scenario 6 was the most likely to occur, and if adoption was only 15 per cent of pork supply, then total annual industry benefits resulting from the development of low cholesterol pork would be around $13m. Pork producer surplus would be less than $1m, and pork consumer surplus would be around $11m, annually.

While a conservative approach is warranted giving the propensity of stated choice methods to overstate actual consumer behaviour, there are some other indications that willingness to pay may not necessarily be as low as assumed above. Bellhouse *et al*. (2010) report that 17 per cent of survey respondents had a household member on a cholesterol restricted diet and 10 per cent reported that concerns about the level of cholesterol in fresh pork reduced their purchase frequency. However, 44 per cent knew their blood cholesterol level and therefore could be considered to be cholesterol-aware. Further, this consumer segment is likely to increase in the future. So if actual willingness to pay was more like 20 per cent, and there was an increase in production costs for low cholesterol pork of 10 per cent (scenario 5), the gross industry benefits from the widespread availability of the new product would be in the order of $234m per year. For a 15 per cent adoption level, total industry benefits would be around $35m and pork producer surplus would be around $2.25m, almost three times larger than for scenario 6.

The size of the share of the total surplus that would go to the producers of low cholesterol pork each year gives a guide to the size of the investment that could be justified by pork producers to produce a pig that is low in cholesterol. Further, the difference in the benefits flowing to producers from the different willingness to pay scenarios suggests the amount of money that could be spent on promotion and health awareness programs to lift the average willingness to pay.

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