The impact of Australian ethanol policy on agriculture: examining limiting factors

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Paper presented at the 56th Australian Agricultural and Resource Economics Society Conference 7-10 February 2012, Fremantle, Western Australia.*

Abstract

Government subsidies have fuelled proposals for new ethanol projects that plan to use Australian grains as their feedstock. Additional ethanol production will intensify competition for grain in the Australian market, particularly during drought periods. This is likely to affect Australia's largest grain user, the livestock industry. Past empirical work has found that expansions to ethanol production will cause grain prices to increase, as a result of restrictions on grain imports. However, this study finds two factors that could moderate such increases in the price of grain: the reliance of ethanol producers on low cost feedstock to remain economically viable, and the possibility of using imported cassava instead of domestically produced grains for ethanol production.

1. Introduction

From the beginning of the Australian ethanol industry in the early 1990s to the present, ethanol production has not affected agricultural industries because it is a small industry that has produced a large part of its output from waste starch or molasses, which are not in much demand elsewhere. However, over the past few years a series of additions to government assistance measures for the ethanol industry have encouraged proposals for new production facilities that plan to use grain as their feedstock. This new source of demand for grain would affect other grain using industries, such as the livestock feeding industry. The prominence of the livestock industry in Australia's grain demand, combined with restrictions on grain imports means that the livestock industry is very vulnerable to increases in the price of grain.

The unintended effects of government subsidies for ethanol have received considerable attention internationally. But, in Australia, the potential impact of continued government assistance to the ethanol industry has not been greatly highlighted. Surprisingly, the International Institute for Sustainable Development (Steenblik 2007) found that government subsidies for the biofuels industry in Australia are at around the same level as in the United States. In addition, this study found that the import tariff on ethanol in Australia is among the highest in the OECD, compounding the distortionary effects of government subsidies.

* This paper is based on research undertaken while completing a Master of Environmental and Resource Economics at the Australian National University in 2007.

There have been numerous international studies of the impacts of ethanol production on grain markets, many by government and international agencies. For instance, OECD (2007) found that the production of ethanol using current technologies could not replace a significant part of transport fuel needs without raising food prices, and the International Food Policy Research Institute (IFPRI 2008) found that increases in biofuels production between 2000 and 2007 contributed to 30 per cent of the increase in grain prices over that period.

In the US, studies of the impact of ethanol production on corn markets have generally found that the greater production of ethanol exerted upward pressure on corn prices, with negative consequences for livestock industries and food prices (see for example Tokgoz et al. 2007 and Elobeid et al. 2006). Since the US is a major corn exporter, any changes in the US corn price as a result of ethanol production will also have an impact on the world grain market. The findings of these studies are not directly applicable to smaller economies, such as Australia, which in international grain markets is generally characterised as a 'price taker'. It may be argued that large changes in Australia's grain exports could affect world prices. However, this possibility is outside the scope of this paper. It is assumed here that any effects of ethanol promoting policies will be purely domestic.

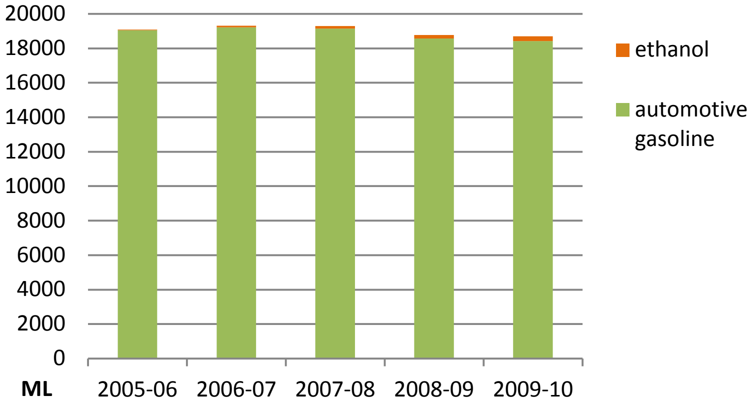
In Australia, the Centre for International Economics modelled the impact of Australian ethanol production on agricultural industries in two reports (CIE 2005; 2006). These studies analysed several ethanol production scenarios, ranging from a production target of 350 million litres to a mandate of 10 per cent ethanol in all petrol, under both average seasonal conditions and drought conditions. The key findings from these analyses were that grain prices in Australia could increase by up to 30 per cent under average seasonal conditions and by up to 250 per cent under a severe drought. The effects of these higher grain prices were to reduce the returns to livestock industries, to reduce exports of livestock products and grain, and to increase fuel prices. Yet these studies assumed that there would be no imports of ethanol or ethanol feedstocks, and that ethanol producers would remain viable under high grain prices. These assumptions exacerbate the modelled effects of ethanol production on grain prices as they remove price ceilings that might otherwise be provided by these three factors.

Given current ethanol policy, this paper will examine whether the potential impact of ethanol production on the livestock industry might be limited by the economic viability of ethanol production or by the possibility of importing either ethanol or ethanol feedstocks. The following two sections will provide an overview of the Australian ethanol industry and the government assistance measures for ethanol. Section 4 will discuss the potential impact of ethanol production on agriculture. Section 5 will then analyse the factors that may limit that impact, and the final section will provide some concluding remarks.

2. The Australian ethanol industry

The Australian ethanol industry is currently very small, consisting of three production facilities. However, ethanol production has been increasing at an average rate of 55 per cent a year over the past five years, reaching 284 million litres (ML) in 2009-10 (RET 2011b; Geoscience Australia and ABARE 2010). Ethanol is currently used for blending with automotive gasoline (petrol) in 10 per cent ethanol blends. In 2009-10 Australia's total use of automotive gasoline and ethanol was 18,699 ML, of which ethanol represented 1.5 per cent (figure 1).

Figure 1: Ethanol production and petroleum fuel use



Source: RET 2011b; Geoscience Australia and ABARES 2010

Currently, ethanol is produced from waste wheat starch, grain sorghum and molasses, a by-product of sugar refining. Over the past three years there have been a number of proposals for new ethanol production facilities which plan to use grains as their feedstock. Most of these facilities would be located in inland areas close to domestic sources of grain. If all these proposed facilities go ahead as planned and produce at full capacity, they would require 3.8 million tonnes of grain a year (table 1).

Table 1: Ethanol production capacity and feedstock use

Location	Feedstocks	Capacity ML/yr	Feedstock use at full capacity kt/yr
Current production capacity			
Manildra Group, Nowra, NSW	Waste wheat starch and grain	300	500*
CSR Distilleries, Sarina, Qld	Molasses	60	240
Dalby Biorefinery, Dalby, Qld	Sorghum	80	200
Proposed new ethanol facilities using grains			
Primary Energy, Gunnedah, NSW	Grain sorghum, wheat	120	300
Primary Energy, Pinkenba, Qld	Grain sorghum, wheat	160	400
Primary Energy, Kwinana, WA	Wheat	160	400
Agri Energy, Swan Hill, Vic	Wheat, sorghum, corn	100	250
Agri Energy, Condobolin, NSW	Wheat, sorghum, corn	200	500
Grainol, Kwinana, WA	Grains	190	500
Grainol, Bunbury, WA	Grains	190	500
Western Downs Ethanol, Miles, Qld	Grain sorghum, wheat	80	200

*It is assumed a recent expansion to production capacity of 200ML is based on grain feedstock, while the previous capacity of 100ML is based on waste starch.

Source: Biofuels Association of Australia, company media releases and a phone survey of individual companies. Feedstock use was estimated based on the average of yields reported by companies.

3. Government support measures for ethanol

Several forms of government support have assisted the development of the Australian ethanol industry, including capital grants, production grants, import tariffs, distribution grants and research and development grants.

Although there is no national ethanol use mandate, the NSW government has implemented an ethanol mandate since October 2007. The mandate currently requires a minimum of six per cent of the volume of petroleum fuel supplied to petrol stations in NSW to be ethanol, such that not all petrol must be blended with ethanol as long as ethanol sales represent six per cent of all petrol sales on a volume basis. From 1 July 2012, the NSW Government plans to increase the ethanol mandate to 10 per cent and modify it to require all regular grade petrol to be blended with 10 per cent ethanol (NSW Government 2012). The Queensland and Victorian Governments have also considered introducing ethanol mandates, but have not announced plans to do so.

The main form of financial support for the ethanol industry is a production grant which offsets the excise that applies to petroleum based fuels. Currently, excise is levied on petrol and diesel at the rate of 38.143 cents a litre. Biofuels such as ethanol and biodiesel are levied at this rate, but domestic producers of ethanol, and both domestic and foreign producers of biodiesel, are eligible for production grants that offset this excise (RET 2011a). Since the production grant is not available to imported ethanol, it creates a tax on imports relative to domestically produced ethanol.

The Australian Government had announced plans to gradually reduce the production subsidy for ethanol in the 2004 Energy White Paper (RET 2004). The production subsidy was to be reduced from June 2011, but in June 2011 it was instead announced that there would be a 10 year moratorium on the current arrangements (RET 2011a). Previously, the production grants for biofuels were to be reduced incrementally, such that the effective rate of tax on domestically produced ethanol would increase annually up to a final rate of 12.5 cents a litre in 2015. The gradual introduction of tax on ethanol was then extended, such that the final rate of 12.5 cents a litre would not be reached until 2020 (The Treasury 2010). In energy content terms, this final excise rate would still provide a 50 per cent discount on the rate levied on petroleum based fuel. As part of the previously planned changes to taxation arrangements for ethanol, the effective tax on imported ethanol was to be reduced to 25 cents a litre in 2011 and to 12.5 cents a litre in 2015 (The Treasury 2010). However, the moratorium on current arrangements guarantees the continuation of the full subsidy on domestic ethanol and the full tax on imported ethanol until December 2021.

The continuation of the federal subsidy for ethanol and the increase in the NSW ethanol use mandate could provide incentives to expand ethanol production capacity. These support measures allow producers to operate commercially at a higher cost of production than would otherwise have been the case and partially insulate producers from changes in market conditions. As noted in section 2, several new ethanol production facilities have been proposed over the past three years. These plans have not so far proceeded, partly due to the uncertainty around government policies. However, the new certainty in the continuation of subsidies may now be sufficient for new production facilities to proceed, provided the subsidies allow producers to be economically viable. The economic viability of ethanol production will be analysed in section 5.

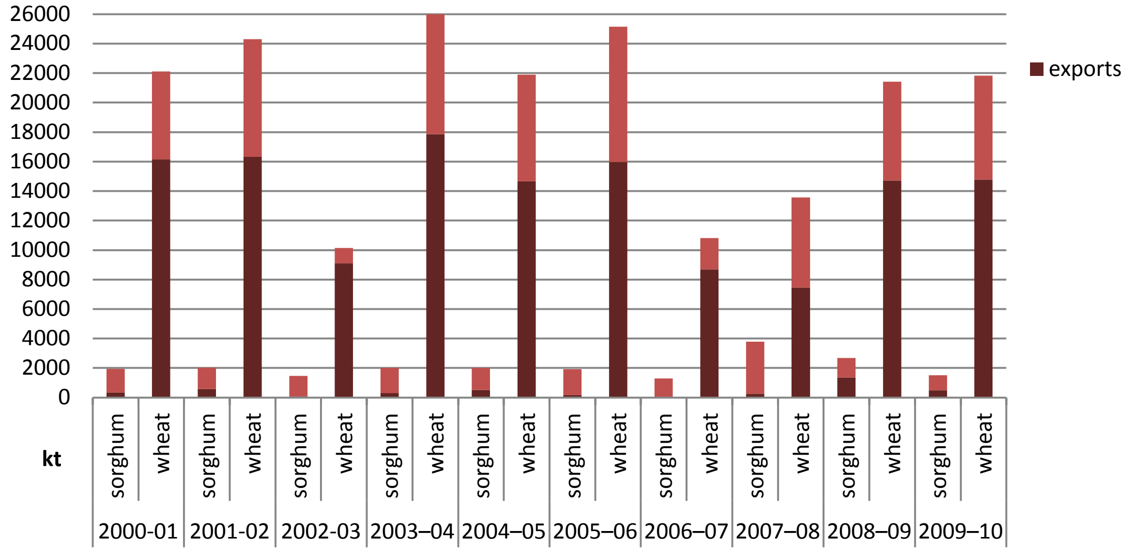
4. Potential impacts of ethanol production on other grain users

Ethanol producers in Australia will compete for grain supplies with a range of existing users: animal feed manufacturers, users of feed grains in the livestock feeding industries, and food and industrial product manufacturers. The livestock feeding industries are the largest users of grain in Australia, consuming around 7–11 million tonnes of grain a year (ABARES 2011b). In recent years, there has been significant growth in the demand for feed grains from the traditional intensive livestock industries and also from the dairy industry, where production has tended to shift to inland areas.

Additional grain demand for new ethanol production facilities is not likely to have a significant impact on grain availability at a national level, as Australia typically has a large exportable surplus of grains during average seasonal conditions. In average seasons, it is likely that additional grain demand for ethanol production would be met by diverting grains from the export market to the domestic market, provided domestic grain users offered an equivalent price. However, during drought periods, there would be a greater likelihood that grain supply would be insufficient to meet demand from both livestock and ethanol, both because supply would decrease and because demand for livestock feeding typically increases during drought. If domestic grain prices were to rise due to the combination of drought and additional demand for grain by the ethanol industry, the direct economic impacts on the agriculture sector would include economic transfers from livestock producers to grain producers.

Between 2005-06 and 2009-10, Australian sorghum production averaged 2.2 million tonnes a year and exports averaged 465 thousand tonnes a year; wheat production averaged 18.6 million tonnes and exports averaged 12.3 million tonnes (figure 2). However, there has been considerable variability in grain production and exports due to drought conditions. For example, in 2006-07 sorghum exports were only 46 thousand tonnes and wheat exports were 8.6 million tonnes. A potential requirement of 3.8 million tonnes of grain for ethanol production would represent 25 per cent of Australia's exports of sorghum and wheat in 2009-10. If a drought similar to that of 2006-07 was experienced, the ethanol industry's potential grain requirement would represent around 44 per cent of sorghum and wheat exports.

Figure 2: Australian wheat and sorghum production



Source: ABARES 2011a

While both wheat and sorghum can be used for ethanol production, ethanol producers are likely to demand sorghum rather than wheat, as it is typically a lower priced grain (ABARES 2011a). Sorghum is also an important source of stock feed for the livestock industries in southern and central Queensland and northern NSW. Competition between the ethanol industry and the livestock industry for sorghum may result in an increase in the price of sorghum. This would be likely if the ethanol industry were to use 3.8 million tonnes of grain a year, since this requirement would exceed Australia's total sorghum production. Yet, increases in the price of sorghum would be limited by the maximum feedstock cost that ethanol producers would be able to incur before becoming unprofitable. This will be explored further in section 5.

At the regional level, increases in ethanol production capacity may affect overall grain availability, as the proposed new ethanol production facilities are mostly located near domestic sources of grain, where the livestock feeding industry is also located. Ethanol producers competing for grain supplies with the livestock feeding industry would have a competitive advantage in bidding for grain due to the production grants they receive. This may result in the livestock industry having to source grain from further away and incurring higher transport costs.

5. Limits to the impact of ethanol on agriculture

Given the continuation of ethanol subsidies and the increase in the NSW ethanol use mandate, the impact of ethanol production on the livestock industry could be limited commercially by either importing ethanol or by importing feedstocks to produce ethanol domestically. Importing ethanol would reduce demand for grain by the Australian ethanol industry and under average seasonal conditions ethanol imports could cap grain prices at export parity. On the other hand, if domestic ethanol plants were to use imported grain, grain prices would be capped at import parity. The magnitude by which domestic ethanol revenue exceeds production costs will also limit potential increases in grain prices.

This section will first estimate the economic viability of domestic ethanol production, before assessing whether imported ethanol would be competitive against domestic ethanol and whether imported feedstocks would be competitive against domestic feedstocks.

5.1 Economic viability of domestic ethanol production

The economic viability of domestic ethanol production is determined by the revenue that ethanol can obtain in the fuel market, the costs of production, and taxes or subsidies applicable to ethanol.

The price that Australian ethanol producers are able to obtain for their product is determined by domestic petrol prices, since ethanol is sold as an alternative to petroleum based fuel. High petrol prices over the past few years have been favourable for ethanol producers. In 2009-10, terminal gate prices for petrol, including fuel excise and GST, averaged $1.17 a litre (AIP 2011). The price paid to ethanol producers would be based on the pre-tax petrol price adjusted for the lower energy content of ethanol, which is 68 per cent that of petrol. In 2009-10, the price which ethanol producers could obtain is estimated to have been $0.46 a litre. In addition, ethanol producers receive a production grant of 38.143 cents a litre. With this subsidy, the unit revenue obtainable by ethanol producers is estimated to be $0.84 per litre (table 2).

Table 2: Estimated ethanol unit revenue, 2009-10

average pre-tax petrol price a	$/L	0.67
pre-subsidy ethanol price b	$/L	0.46
ethanol unit revenue c	**$/L**	**0.84**

a Australian terminal gate price, excluding GST and fuel excise. b The energy density of ethanol is 68 per cent that of petrol. c Including the ethanol production grant of 38.143 cents a litre.

Agricultural feedstock costs are the largest component of ethanol production costs. As discussed in section 2, the grain feedstocks currently used to produce ethanol in Australia are grain sorghum and wheat. The cost of feedstocks for ethanol producers is determined by their price and by the quantity of ethanol that can be produced from each tonne of feedstock. Gross unit values for Australian sorghum averaged $214 a tonne in 2009-10, while wheat unit values averaged $218 a tonne (ABARES 2011a).

Ethanol producers would also have to pay grain transport and storage costs. Transport costs will vary greatly depending on the proximity of the ethanol facility to the source of feedstock. Based on the Stock Feed Manufacturers Council estimates of transport and storage costs ranging from $20 to 50 a tonne in 2005 (SFMC 2005), a transport and storage cost of $40 a tonne is assumed in this paper. This contributes an additional 10 cents per litre of ethanol produced to feedstock costs. However, ethanol producers in close proximity to grain suppliers may incur much lower transport and storage costs.

In addition to these feedstock costs, ethanol producers would incur labour, energy and other variable costs and capital costs. Based on estimates provided in Short and Riwoe (2005) and information provided by proponents of new ethanol production facilities, non-feedstock variable costs are estimated at around 9 cents a litre and amortised capital costs are estimated at around 10 cents a litre (table 3).

Table 3: Estimated ethanol production cost, 2009-10

		wheat	**sorghum**
Feedstock price	$/t	218	214
Feedstock transport & storage	$/t	40	40
Ethanol yield per tonne of feedstock	L/t	350	400
Feedstock cost	$/L	0.74	0.64
Other variable costs a	$/L	0.09	0.09
Amortised capital costs b	$/L	0.10	0.10
Gross cost of production	**$/L**	**0.93**	**0.82**
By-product price	$/t	180	180
By-product yield per litre of ethanol	t/L	0.9	0.9
By-product revenue c	$/L	0.16	0.16
Net cost of production	**$/L**	**0.76**	**0.66**

a Includes labour costs, energy costs and costs of non-feedstock inputs. Based on information provided in Short and Riwoe (2005) and from ethanol project proponents. b Estimates based on capital costs provided by biofuels projects proponents. Assumes a discount rate of six per cent and plant life of 20 years. c Estimated revenue from distiller's grains.

After including feedstock costs, transport and storage costs, other variable costs and capital costs, the cost of ethanol produced from wheat in 2009-10 is estimated to be $0.93 a litre and the cost of ethanol produced from sorghum is estimated to be $0.82 a litre (table 3).

Ethanol production plants can partially offset production costs through the production of by-products such as distiller's grains, which is a high-protein product used in animal feed. In 2005, the price of distiller's grains in contracts to feed manufacturers was $120 a tonne (SFMCA 2005). This paper assumes a distiller's grains price of $180 a tonne, which is the 2005 price inflated by the increase in the price of soybean meal (a comparable high protein animal feed) from 2004-05 to 2009-10. Combining this with a distiller's grains yield of 0.9 kilograms per litre of ethanol, the production of distiller's grains would offset ethanol production costs by 16 cents a litre. After allowing for revenue from distiller's grains, the cost of producing ethanol from wheat and sorghum in 2009-10 is estimated to have been $0.76 a litre and $0.66 a litre respectively (table 3).

However, there are several limitations to the inclusion of this by-product revenue. First, a by-product revenue of 16 cents per litre of ethanol assumes ethanol producers will be able to sell the entirety of their distiller's grains production. However, distiller's grains is used in limited quantities by the livestock feed industry, as it does not provide starch and can only be used in combination with other feed products as a protein additive. Second, distiller's grains must be dried prior to selling to facilitate its transport and storage, which requires additional capital equipment (SFMCA 2005). The capital costs of $0.10 a litre assumed in this paper do not include the costs of distiller's grains production equipment, as no data was available. Due to these limitations, the net cost of production presented in table 3 should be considered to be a lower estimate of ethanol production costs and the gross cost of production should be considered to be an upper estimate.

If these estimated production costs are compared against the unit revenue that could be obtained for ethanol (tables 2 and 3), it can be seen that at 2009-10 average prices, ethanol production from sorghum is estimated to obtain positive net revenue, while ethanol production from wheat is only viable when by-product revenue is taken into account.

This analysis is based on average gross unit values, which, for wheat, include both high and low grade wheat. Ethanol producers and animal feeders are likely to use low grade wheat, which is available at lower cost. Consequently, the cost of producing ethanol from low grade wheat is likely to be below $0.93 a litre. Gross unit values for low grade wheat are not available; however, as a proxy, feed wheat prices delivered to the Sydney region (including delivery costs) averaged $237 a tonne in 2009-10 (ABARES 2011a). At this price, the cost of producing ethanol from wheat (excluding by-product revenue) would be $0.87 a litre, which is only slightly above estimated unit revenue.

It is important to note that without the 38.143 cents a litre excise-offsetting subsidy that is currently available to Australian ethanol producers, ethanol production from either sorghum or wheat would result in a loss of between $0.20 and $0.30 a litre, even if by-product revenue is taken into account. Therefore, the continuation of the production subsidy for ethanol guarantees the economic viability of ethanol production.

As noted in section 4, an increase in the ethanol industry's use of sorghum may result in an increase in its the price, and the economic viability of ethanol production will affect the magnitude of any such increase. This is because ethanol producers will only continue to use sorghum if it is sufficiently low cost to ensure their profitability. Based on the estimated net cost of ethanol produced from sorghum (including revenue from distiller's grains), ethanol producers would be able to pay sorghum prices up to 33 per cent higher than 2009-10 prices and remain economically viable. This may be considered as the maximum increase in the price of sorghum that would allow ethanol producers to continue using sorghum. Although, based on 2009-10 prices, ethanol producers would substitute toward wheat before paying this higher sorghum price. Thus, at the national level, substitution toward wheat is likely to limit increases in grain prices.

5.2 Importing ethanol

The current effective tax on ethanol imports is likely to make importing ethanol economically unviable. Nevertheless, it is useful to examine whether this is the case and if so, by what margin the cost of imports exceeds revenue obtainable in the domestic market.

As Brazil is the world's largest ethanol exporter and the lowest-cost producer, it is assumed that ethanol would be imported from Brazil. In 2009-10 the price of Brazilian ethanol exports (f.o.b.) averaged US51 cents (Brazilian Government 2010). The cost of transporting ethanol from Brazil to Australia would have to be added to this price. The rates for tankers that carry chemicals (including ethanol), travelling from Brazil to the Asia-Pacific were at around US$95-100 cents a tonne in mid-2010 (ICIS Pricing 2010). The midpoint within this range of US$97.5 a tonne has been assumed as the 2009-10 transport cost in this paper, which is equivalent to US8 cents a litre. At the 2009-10 average Australian exchange rate of US88 cents, this would bring the cost of ethanol imports from Brazil to 66 cents a litre (table 4).

Table 4: Estimated ethanol import price

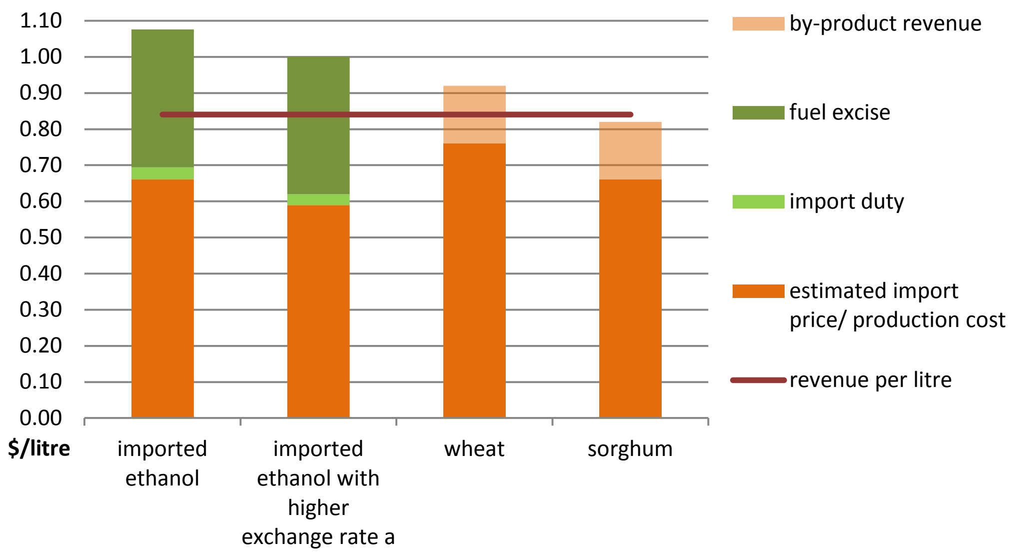
		2009-10 a	**higher exchange rate** b
export price	US$/L	0.51	0.51
shipping cost	US$/L	0.08	0.08
exchange rate	US$/$A	0.88	0.99
landed price	**A$/L**	**0.66**	**0.59**
import duty inclusive price	A$/L	0.69	0.62
imported ethanol excise	A$/L	0.38	0.38
Brazilian ethanol import price	**A$/L**	**1.08**	**1.00**

a 2009-10 ethanol export price, Australian exchange rate and ethanol import tariff. b Average exchange rate during 2010-11, all other prices remain at 2009-10 level.

A five per cent ad valorem duty applies to ethanol imports, which would increase the cost of imports to 69 cents a litre. Including the fuel excise of 38.143 cents a litre that is levied on imported ethanol, the final price for ethanol imports from Brazil in 2009-10 would be $1.08 a litre (table 4). This is higher than the price which domestic ethanol is estimated to obtain in 2009-10 of $0.84 a litre (table 2). Therefore, at 2009-10 average prices it would not be economically viable to import ethanol from Brazil for domestic use.

The estimated price of ethanol imports is also significantly higher than domestic ethanol production costs when the fuel excise on imported ethanol is taken into account. However, the cost of imported ethanol would be lower than domestic production costs without the tax on imports (figure 3).

Figure 3: Estimated cost of imported and domestic ethanol, 2009-10



a Average exchange rate during 2010-11, all other prices remain at 2009-10 level.

It is important to consider how a higher Australian exchange rate may affect this analysis, as the exchange rate has increased significantly since 2009-10 and changes in the exchange rate can have a large impact on the cost of imports. As a basis for comparison, table 4 also provides estimated ethanol import costs using the 2010-11 average exchange rate of US$0.99. At this exchange rate, and with all other prices at 2009-10 levels, the estimated cost of imports would fall to $1.00 a litre (including import duty and fuel excise). But, despite the higher exchange rate, ethanol imports would remain uncompetitive in the domestic market and would exceed domestic production costs by a significant proportion (figure 3).

This analysis shows that the tax on imports is likely to ensure importing ethanol remains unviable. Therefore, ethanol imports cannot provide a limit to the impact of increasing ethanol use on Australian agricultural industries under current policies.

5.3 Importing feedstocks

In the absence of ethanol imports, importing feedstocks for ethanol production could soften the effects of ethanol production on the livestock industry by providing a substitute for the use of Australian grains.

Quarantine protocols are a key determinant of the feasibility of importing feedstocks in Australia, because imported grain is subject to stringent pest and disease control measures. Quarantine protocols require imported grain to be processed in a grinding and pelleting plant if it is to be consumed in metropolitan areas near the port where it is unloaded. Imports for use beyond a 50 kilometre radius of the port require heat treatment of at least 85 degrees for eight hours to kill any fungal spores or potentially active seeds within the grain (AQIS 2007). This cooking process shortens the potential storage time for the grain, because it goes mouldy within a day or two of cooking, and impedes its transport to inland areas where the livestock feed using industries are mainly located (ALFA 2007). However, imports of starch are permitted under quarantine restrictions without heat treatment, since starch is a highly processed product.

The lowest cost option for importing starch into Australia would be cassava starch from Thailand. The price of cassava starch in the world market is consistently lower than the price of potato, corn or wheat starch (FAO 2011). Thailand is the largest exporter of cassava, accounting for 84 per cent of the world's cassava exports. In 2009, Thailand exported 4.4 million tonnes of dried cassava and 1.7 million tonnes of cassava starch (FAO 2011). The roots of the cassava plant have a high starch content and have been used to produce ethanol in Thailand and China (ISO 2007).

Cassava starch can be used to produce ethanol with the same technology as ethanol production from grain, but the direct use of starch would provide a higher yield ethanol yield, as ethanol yield is directly related to the starch content of the feedstock. The ethanol yield of starch is around 640 litres per tonne (ISO 2007), while the ethanol yield of sorghum or wheat is around 400 and 350 litres per tonne respectively (Wylie 2006).

Dried cassava chips can also be used to produce ethanol. However, quarantine restrictions similar to those for grains may apply to cassava chips. Imported dried cassava chips would require a manufacturer's declaration detailing their production process, including the drying temperature and duration, location of crop plantations and location of processing. Quarantine officers would determine whether the cassava chips required treatment after inspecting the manufacturer's declaration (AQIS 2007). This uncertainty in the feasibility of importing cassava chips for inland use may mean cassava starch it the only viable option. Nevertheless, this paper considers both options.

In 2009, the price of cassava starch exports from Thailand (f.o.b.) was US$273 a tonne, while the price of dried cassava chips was much lower at US$139 a tonne, as there is less processing involved in their production (FAO 2011). As a basis for comparison, table 5 provides cost estimates for corn imported from the United States, although importing corn would not be feasible for inland use due to quarantine restrictions, as discussed above. The world price of corn averaged US$160 a tonne in 2009-10 (ABARES 2011a). However, after taking into account the higher ethanol yield of cassava, the cost of cassava starch per litre of ethanol produced is similar to the cost of corn, at around US$0.40 cents a litre, and the cost of cassava chips is significantly lower at around US$0.25 a litre.

The cost to ethanol producers of importing cassava also depends on the Australian exchange rate, transport costs and port charges. The cost of shipping grain from Australia to Malaysia was around US$31 a tonne in 2010 (IGC 2011). This is likely to be comparable to the costs that would be incurred by shipping starch from Thailand to Australia. The costs of shipping corn from the United States to Australia would be higher; as an approximation, ocean freight prices for shipments from the United States to Japan were around US$54 a tonne in 2010 (IGC 2011). After including these shipping costs and port charges for handling grain of around $14 a tonne (GrainCorp 2011), the cost of importing cassava in 2009-10 is estimated to be $0.53 per litre of ethanol produced in the case of starch and $0.37 a litre in the case of dried chips. The cost of corn imported from the United States is estimated to be $0.67 per litre (table 5). This shows that cassava starch is a low cost feedstock available for importing. However, it will only be commercially viable for use in Australia if it is competitive against domestic feedstocks.

Table 5: Estimated import costs of cassava and grains, 2009-10

		cassava starch	cassava chips	corn
world price	US$/t	273 a	139 a	160
shipping cost	US$/t	31 b	31 b	54 c
price at port	US$/t	304	170	214
exchange rate	US$/$A	0.88	0.88	0.88
price at port	A$/t	345	193	243
port handling cost	A$/t	14	14	14
landed price	A$/t	359	207	257
starch content	%	85	70	60
ethanol yield	L/t	680	560	385
feedstock cost	$/L	0.53	0.37	0.67

a Latest price data available is 2009. b Average shipping rates for grain shipments from Australia to Malaysia. c Average shipping rates for grain shipments from the US to Japan.

Based on 2009-10 prices, the cost of cassava per litre of ethanol produced is estimated to be below the cost of using domestic sorghum or wheat. The cost of sorghum and wheat in 2009-10 is estimated to be $0.54 and $0.62 per litre of ethanol produced, respectively; while the cost of cassava is estimated to be $0.53 per litre if cassava starch is used and $0.37 per litre if dried chips are used (table 6).

Table 6: Estimated costs of ethanol feedstocks in Australia, 2009-10

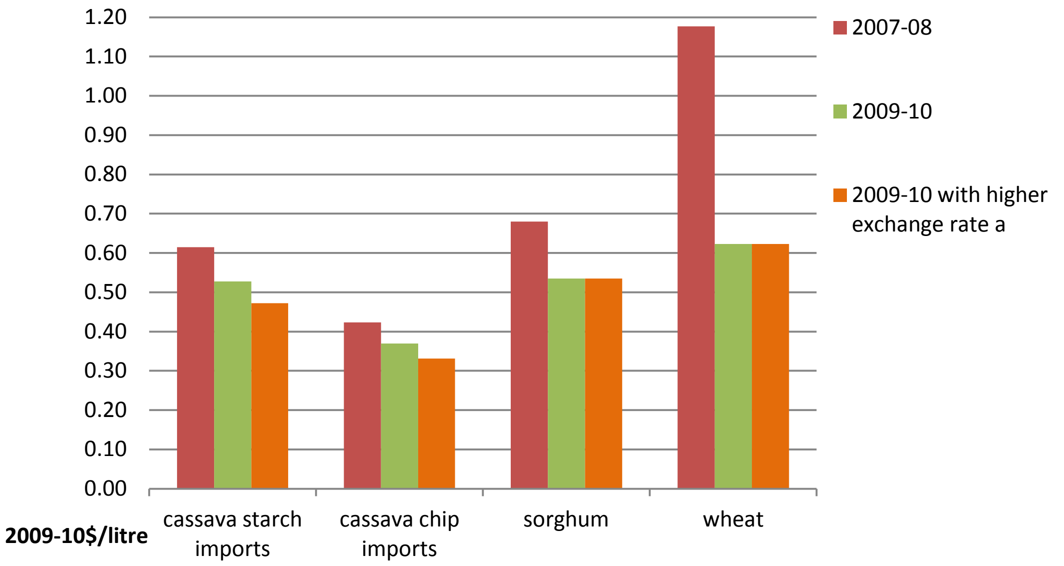
		cassava starch imports	cassava chip imports	wheat	sorghum
price	A$/t	359	207	218	214
ethanol yield	L/t	680	560	350	400
feedstock cost	$/L	0.53	0.37	0.62	0.54

The cost of transporting the feedstocks to the ethanol plant has not been included in these feedstock costs, as domestic transport costs would vary widely depending on the location of the ethanol facility. It is important to consider whether the cost of transporting cassava starch to some ethanol plants located further inland may make using cassava starch more costly than using domestic grains, as this would mean that the impacts of ethanol production on the livestock industry may not be avoided in some regions. Road freight rates for bulk grain were around 10 cents a tonne per kilometre in 2009-10 (BITRE 2011). At this transport price, the cost of using cassava starch would be higher than the cost of both wheat and sorghum if cassava starch were transported for around 600 kilometres further than domestic grain. If quarantine requirements allowed importing cassava chips for inland use, cassava chips would have to be transported around 1000 kilometres further than domestic sorghum for it to be a more costly feedstock than sorghum. As examples of the possible distance imported feedstock would have to be transported, the distance from Brisbane to Dalby, where an ethanol plant is currently located, is around 200 kilometres, and the distance from Sydney to Condobolin, where a new ethanol plant has been proposed, is around 450 kilometres.

Imported feedstock would have to be transported a significantly longer distance than this for it to be more costly than domestic grain. Therefore, it can be concluded that transport costs are not likely to make cassava more costly than wheat for inland ethanol plants, although they may make using cassava starch more costly than domestic sorghum. If cassava chips are used, they would be likely to be cheaper than both wheat and sorghum, even if they had to be transported inland.

Another consideration is how different feedstock prices would affect the viability of importing cassava. In 2009-10 the cost of using imported cassava starch is estimated to be around the same as the cost of using domestic sorghum. However, in 2009-10 domestic grain prices were relatively low compared with the previous three years, as seasonal conditions had begun to improve after several years of drought. In 2007-08 wheat prices were 89 per cent higher than in 2009-10, in real terms, and sorghum prices were 27 per cent higher (ABARES 2011). The cost of cassava imports in 2007-08 was also higher, by around 19 per cent in the case of cassava starch and 14 per cent in the case of cassava chips, after including shipping costs and port charges at 2007-08 prices and using the 2007-08 average exchange rate. Despite the higher import costs, in 2007-08 the cost of cassava starch is estimated to have been 10 per cent lower than the cost of domestic sorghum and 48 per cent lower than the cost of wheat (figure 4).

Figure 4: Estimated cost of imported cassava and domestic feedstocks



a Average exchange rate during 2010-11, all other prices remain at 2009-10 level.

The Australian exchange rate also has a large influence on the viability of importing feedstocks. Under the higher 2010-11 average exchange rate and 2009-10 feedstock prices, the cost of imported cassava starch is estimated to be 12 per cent lower than domestic sorghum and 24 per cent lower than wheat, despite the relatively low domestic feedstock prices. The cost of imported cassava chips would be 38 per cent lower than sorghum and 47 per cent lower than wheat (figure 4).

This analysis shows that importing cassava starch for ethanol production could be a viable option for meeting ethanol production targets while minimising the effects on the Australian livestock industry. Although changes in feedstock prices and the exchange rate can have a significant effect on the viability of importing cassava, the above analysis shows that at a minimum, cassava starch is likely to be profitable during times of drought when domestic grain prices are higher. If quarantine restrictions do not impede importing dried cassava chips for inland use, using cassava chips for ethanol production would be economically viable even during times of relatively low domestic grain prices.

6. Conclusions

Government subsidies, import tariffs and capital grants fuelled proposals for new ethanol projects that plan to use Australian grains as their feedstock. The recent guarantee that subsidies will continue for a minimum of 10 years and the planned increase in the NSW ethanol use mandate could provide the required certainty for these projects to proceed. If new proposals proceed as planned, there would be a significant increase in domestic grain demand, which may have negative impacts on the livestock industry.

At the national level, grain prices are not likely to increase significantly because Australia has a large exportable surplus of grains overall and both ethanol producers and livestock feeders are able to substitute between grains to some extent. However, the price of lower cost grains, such as sorghum, would rise to the level of higher priced grains, such as wheat, as the exportable surplus of sorghum would be exhausted by additional demand for ethanol production. Any increase in domestic sorghum prices would benefit grain producers but would detriment other grain users such as the livestock industry.

At the regional level, increased ethanol production from grain may result in some grain producing regions switching from being net grain exporting regions to net grain importing regions. Several proposed new ethanol production facilities are located in grain producing regions along with the livestock feeding industry. The competitive advantage that the subsidy for ethanol provides may result in livestock feeders having to source their grain from other regions and incurring higher transport costs.

During drought periods, there would be a greater likelihood that grain supply would be insufficient to meet demand from both livestock and ethanol, both because supply would decrease and because demand for livestock feeding typically increases during droughts.

Ethanol imports are not likely to serve as a limit to these impacts, due to the 10 year continuation of the current tax on imports. Ethanol imports from Brazil, the world's lowest cost producer, are not currently competitive against Australian ethanol and they are likely to remain so, since the tax-inclusive price of ethanol imports exceeds the unit revenue obtainable in the Australian market by a significant proportion.

However, importing cassava to produce ethanol could limit the impact of ethanol policy on the livestock industry. This paper has found that importing cassava is economically viable under current prices. Imported dried cassava chips are estimated to have a significantly lower cost than domestic grain, even when the cost of transporting cassava from the port of arrival to the ethanol plant is taken into account. However, cassava chips may be subject to quarantine restrictions, depending on the process by which they were produced. Cassava starch would not incur quarantine restrictions, but it has a higher cost than cassava chips. Nevertheless, the cost of cassava starch is estimated to be lower than the cost of domestic wheat, and during drought conditions, it is also estimated to be lower than the cost of sorghum. Drought periods are when domestic grain supply is likely to be most constrained and competition in the domestic grain market is likely to be greatest. Therefore, at a minimum, cassava starch can limit additional costs imposed by ethanol production on the livestock industry during drought periods.

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