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IMPROVING COMPETITIVENESS OF THE AUSTRALIAN SUGAR INDUSTRY BY ANALYSING CANE SUPPLY ARRANGEMENTS ACROSS THE VALUE CHAIN

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Abstract

The term “value chain” describes the collection of activities that are performed to design, produce, market, deliver and support a product. The Australian sugar industry value chain has a number of distinct stages involved in the transformation of the cane crop into raw and refined sugar and other manufactured products. These stages include production, processing and distribution functions. Despite its linear direction, a critically important feature of the sugar industry value chain is that it is not a collection of independent activities but a system of interdependent activities. In the Australian sugar industry, there remains a significant degree of segregation in the organisation of growing, milling, and marketing activities, despite the fact that these sectors are linked. These linkages reflect the need to coordinate activities between growers, millers and marketers, and do not appear to have been fully exploited in the way that a more vertically integrated industry would. A key question is what opportunities exist to manipulate the whole value chain to enhance industry profitability and competitiveness? To address this question, this paper explores the strengths and weaknesses of value chain analysis as a framework to review the competitive position of the Australian sugar industry and identify opportunities for improvements. It is concluded that there is a need to examine more novel approaches that could achieve further efficiency gains across the entire sugar industry value chain. This will involve going beyond traditional measures of competitiveness and focussing on improving the organisational efficiency of the industry.

Introduction

The term “value chain” describes the collection of activities that are performed to design, produce, market, deliver and support a product (Porter, 1985). The sugar industry value chain has a number of distinct stages involved in the transformation of the cane crop into raw sugar. The key elements of the sugar industry value chain are:

- Sugarcane production
- Cane harvesting, infield transport and haulage to mill
- Raw sugar manufacture
- Sugar transport and storage
- Marketing and distribution to customers

The sugar industry value chain is essentially linear: cane from farms is processed at raw sugar factories into raw sugar that is distributed to refineries and other users. Each major function in the sugar industry is largely carried out by separate economic entities. There is a high degree of vertical integration through the value chain although this is not of the type normally covered by the accepted economic definition.

Despite its linear direction, a critically important feature of the sugar industry value chain is that it is not a collection of independent activities but a system of interdependent activities. These linkages reflect the need to coordinate activities between growers, millers and marketers, and do not appear to have been fully exploited. In the Australian sugar industry, there remains a significant degree of segregation in the organisation of growing, milling, and marketing activities, despite the fact that these sectors are linked. Examples of where linkages arise include where the same function can be performed in different ways, or when the cost of performing direct activities is improved by greater efforts in indirect activities.

Confronted with increasing cost/price pressure and international competition, the Australian sugar industry has traditionally strived for technical efficiency in all components of the value chain. The economic efficiency of the industry has also improved significantly over the past decade. Despite the industry's success in developing technical innovations aimed at increasing productivity or lowering cost, the gap between Australia's performance and that in other countries has shrunk (Fry, 1997). This suggests there is a need to examine novel options for further efficiency gains across the entire sugar industry value chain. For example, modified cane supply and harvest scheduling arrangements can potentially enhance whole industry profitability and competitiveness (Muchow *et al.*, 1998). A key question is what further opportunities exist to manipulate the whole value chain to enhance industry profitability and competitiveness? This paper aims to explore the issue of better integration of economic research into all these areas to benefit whole industry profitability.

Value chain analysis

The purpose of value chain analysis (VCA) is to enable companies to analyse their competitive position. The process is aimed at defining the various steps in the product supply chain and the type of traders active within it so the cost of each activity can be assessed and value can be created (Booth, 1997). The cost structures of different products and services at different stages of the process are also identified. In short, VCA defines the different steps where a company's value-adding capability rises or falls. VCA defines the entire chain through which goods are supplied to a customer. The supply of goods to a consumer requires several parties to work in concert within a chain. In the global sugar market, this implies that the Australian sugar industry is a value chain competing for market share with other international value chains. The supply of goods to the consumer requires several parties in the sugar industry to work in concert within the value chain.

VCA was originally used as an accounting analysis tool to shed light on the profitability of separate steps in complex manufacturing processes. The term 'value chain' was first popularised by Porter (1985) who said a value chain disaggregates a firm into its strategic relevant activities in order to understand the behaviour of costs and potential sources of differentiation.

VCA is effectively a benchmarking tool. Decisions on whether to invest in a particular industry sector require an understanding of the organisation's own cost, their likely rate of improvement and how they compare to those of new entrants and existing firms. By examining the value chain up-stream and downstream, the implications of extending or limiting the operations of any section of the chain can be understood. Breaking up the value chain exposes the units within it to market pressure and show where value is being created within the chain. Such an approach exposes cross-subsidisation within the value chain.

VCA can also facilitate commercial negotiations to be conducted in a transparent manner to stakeholders. VCA provides the possibility of negotiating around a cost model, not a price, which is an approach that encourages the dialogue necessary to support partnerships. Partners can jointly identify changes to trading practice and then negotiate on the share of benefits. This could be particularly relevant to the miller-grower relationship in the sugar industry. Harvesting and transport operations are important operations at the mill-grower interface.

There does not appear to be any published cases of VCA applied to an agricultural commodity value chain. Organisations and industries which are suited to value chain analysis have input variables, processing or transformation functions, and outputs which are products or services. The sugar industry value chain has a number of distinct stages involved in the transformation of the cane crop into raw sugar. These include production, processing and distribution functions, which suggests that cane/sugar supply arrangements could be analysed in a VCA framework. The Australian sugar industry is a price-taker. VCA has been described as an appropriate tool to examine the competitiveness of price-taking firms or industries (Reddy, 1998). Theoretically, when firms are price takers their competitive advantage lies in the cost drivers. That is, if they can lower costs while maintaining the market price, they will be able to widen their margins and increase profitability.

There are limits to the value chain approach. It is important to recognise, however, that the flow of sugar from farms to the final customer, and its transformation from a cane crop to raw sugar is not strictly a chain, and it is more appropriate to conceptualise it as a system. A system implies a complex of factors that are interrelated and interact, while a conceptual boundary may be erected around the complex as a limit to its organisational autonomy (Dent, 1971). The systems view of research is a holistic one which implies that an isolated study of parts of the system will not be adequate to understand the complete system because the separate parts are linked in an interacting manner. A limitation of the VCA approach is that the theory and practice of VCA does not appear to extend beyond compartmentalised analysis of the one-way flow of product and does not analyse the linkages or interdependencies among these flows.

Competitive analysis of the value chain - putting the Australian sugar industry in perspective.

Sugar is produced in over 100 countries. However, exports (which account for around 30%, or 36 million tonnes, of global production) are concentrated within three countries: Brazil, Thailand and Australia. Their combined production makes up 55% of the volume of sugar traded on the world market (Chapman and Milford, 1997). Australia exports approximately 85 per cent of its total sugar production.

Since 1986, global sugar production has increased by 1.8% *per annum*, reaching 119.1 million tonnes by 1995. Growth in consumption until at least the year 2000 is likely to continue to be close to 1% *per annum*. This has implications for Australia in that it will restrict the overall world market for our sugar (Chapman and Milford, 1997). Since most of the growth in consumption is expected to be in countries in Australia's immediate region, we can look forward to continuing demand for our sugar provided our marketing and service package is acceptable to customers (Chapman and Milford, 1997).

Prices

The direct exposure of the Australian industry to the world sugar price drives the industry's competitive position. Even though Australia is one of the world's largest exporters, it still has little control over world prices. It should be noted, however, that when the market is segmented into regions and subperiods of the year, Australia's influence on the market increases significantly. Australia exports less than 4 per cent of global production, but in the second half of the year it supplies more than 80 per cent of the sugar traded in the Asian region (Warren Males, pers. com., 1998). In most countries, the domestic market absorbs most of the production at a significant premium when compared to the world market price. Australia's domestic market is the smallest of any of the major exporters.

Many sugar industries enjoy high levels of protection, with the majority of domestic markets protected by import tariffs, while domestic prices are often set at levels well below the price of internationally traded sugar. As a result of this protection, over production is encouraged which places downward pressure of global sugar prices (BCG, 1996). There is broad agreement that global sugar prices are volatile and have been depressed as a result of these policies (BCG, 1996). In contrast, Australian producers have received no protection since the removal of the \$55/tonne import tariff on 1 July, 1997. Despite the volatility of world sugar prices, Australia has expanded production. Expansion will only occur if price expectations are reasonable (Chapman and Milford, 1997). Cane production appears to be relatively inelastic to downward movements in sugar prices because the sugar industry is generally not short term in its planning horizons.

Benchmarking Australia's competitive position

Fry (1997, 1998) has performed benchmarking studies of the competitiveness of international sugar industries, in terms of both technical and cost efficiency of the components of the value chain.

Technical competitiveness:

Australia's high yields in the field and good factory recoveries are targets for other producers, although the gap between Australia's performance and that in other countries has shrunk. In terms of the sucrose per hectare per year, Australia's yields are significantly higher than our major export competitors, Brazil and Thailand. Only four countries achieve overall factory sugar recoveries of over 85% and only Swaziland and Australia come close to breaching the 90% mark. Again, Thailand and Brazil perform poorly relative to Australia. Overall, the scope for yield improvements in the field is much greater than that for higher recoveries in the factory, with Australian mills coming close to the realistic economic limits on recoveries.

Cost competitiveness:

Economic and technical efficiency are not necessarily synonymous. While it is important to consider technical efficiency, on the global sugar market, the reality is that low cost producers have the best prospects for survival. Fry (1997) asserted that low cost producers in Australia, Thailand, Brazil, India and southern Africa will therefore continue to grow in importance, while the role of high cost producers in Europe, the US, the Caribbean and Eastern Asia will diminish. When field and factory costs are combined, Thailand and Australia are the most cost-competitive industries. Australia's special advantage is its low cost for getting sugar into export vessels.

Fry (1998) noted that the decline of the Hawaiian cane industry, which had long achieved the highest levels of productivity (in terms of yields of sugar per hectare) and the ability to process cane throughout the year, demonstrates that technical excellence counts for very little if production costs are too high. On the other hand, the Thai sugar industry has grown into one of the main exporters in the world, despite low yields, poor cane quality, and mediocre factory recoveries. Low technology/low input/low output industries can be economically competitive. The Thai industry shows that technical efficiency to one industry is not necessarily efficiency to another. Both industries can be efficient yet have entirely different positions on the production possibility frontier. The structure of the production process is driven by the relative prices of the different factors of production and the productivity of each. For example, Australia has relatively inexpensive capital and expensive labour hence the Australian industry is relatively capital intensive in its production processes. It makes little sense for the Thais to adopt the same process because their labour is inexpensive relative to capital (Warren Males, pers. com., 1998).

Limitations of the benchmarking approach

The purpose of benchmarking is to enable operational improvements by identifying, adopting, and deploying the best practices of world-class organisations. However, in the context of improving Australia's competitive position, there are a number of limitations in the benchmarking approach. Organisations use benchmarking information about better practices to implement a change in their own practices. The comparison of the Australian sugar industry's performance to those of direct competitors is obviously less useful for a leading industry such as Australia's.

The benchmarking studies of Fry (1997, 1998) have focussed only on the cost and technical efficiency of individual components of the value chain. The future for maintaining Australia's competitive position lies beyond analysing the traditional measures of competitiveness, and there appears to be a need to explore the organisational efficiency of the Australian industry, in areas such as harvest season length and cane supply arrangements. Research into the Australian sugar industry value chain needs to focus more on prescriptive as opposed to descriptive analysis.

The other limiting feature of previous competitor analyses of the international sugar industry is their essentially static nature. Dynamic analyses which consider the possibilities of change and uncertainty in an economic relationship on a year to year basis (eg climate-driven production variability, sugar price variability, exchange rate variability) would be more appropriate.

Previous studies have not accounted for the heterogeneity of the individual units that make up various components of the value chain. Australian sugarcane farms and mills are characterised

by a large range of physical and financial circumstances which must be recognised, especially for any dynamic analysis of the Australian sugar industry value chain. Various firms in the Australian sugar industry respond differently to changed circumstances, such as price and production variability, depending on factors such as the maturity of the various district sugar industries ie whether districts are in an expansionary or contraction phase.

Chapman *et al.* (1997) employed a different approach to considering the competitiveness of the Australian industry. They examined the transaction costs associated with the administered relationship between sugarcane growers and millers in the Queensland sugar industry under current arrangements as well as the economic ramifications of deregulation of this contractual arrangement. Transaction costs are those associated with planning and negotiating when two or more parties do business, the costs of changing plans, renegotiating terms, and resolving disputes, and the costs of ensuring that parties perform as agreed. An element of transaction cost economics is establishing the relative efficiencies of different organisational forms. The authors examined transaction costs in the context of deregulation of the Queensland sugar industry, but opportunities to examine transaction costs in other contexts could also be considered.

Improving competitiveness by exploiting linkages across the value chain

Exploiting the linkages and interdependencies within the sugar industry value chain, which are often subtle and go unrecognised, will become critical to maintaining the competitive advantage of the Australian sugar industry. Linkages imply that a firm's (or industry's) cost or level of differentiation is not merely the result of efforts to reduce cost or improve performance of each value-adding activity individually. Therefore, cognisance needs to be made of the linkages to improve value chain management to increase profitability.

Exploiting linkages often requires optimisation that cuts across conventional organisational lines. Higher costs in the production or harvesting of cane could result in better quality sugar or lower marketing costs but such trade-offs may not be measured in any one sector's information and control systems. Managing linkages is thus a more complex organisational task than managing value-adding activities themselves. Given the difficulty of recognising, developing and managing linkages, the ability to do so often leads to a sustainable source of competitive advantage, particularly over Brazil and Thailand. While not the case for Thailand, the level of vertical integration in Brazil's sugar industry, means that it could also make significant gains from better management of its linkages in the value chain (Milford, pers. com., 1998). It is therefore important that the Australian industry moves rapidly to manage and exploit value chain linkages.

Exploiting linkages to achieve competitive advantage usually requires information or information flows that allow optimisation or coordination to take place. Thus, information flows are often vital for gaining competitive advantage from linkages. Recent developments in information systems technology are creating new linkages and increasing the ability to analyse and exploit old ones. Data quality and accessibility is therefore critically important for assessing opportunities to improve the efficiency of the value chain.

The research challenge is to identify opportunities to exploit linkages to improve the competitive position of the sugar industry. The prospect of a changed regulatory environment also provides the impetus for this research. The regulation of industries such as sugar is designed to ensure that all units operate under similar rules and therefore limits competition. There has been a definite

attempt in the sugar industry in recent years to reduce the level of government intervention and to open up the industry to more competition. The consideration of competitive advantage becomes more relevant under such circumstances.

Obvious linkages to target are those where trade-offs are involved or coordination of activities across the value chain can be improved. There is a need for considerable economic analysis into the consequences of doing things in the sugar industry in different ways. Such research needs to value-add, and examine scenarios that exploit interdependencies across all sectors of the industry, using a dynamic framework. Possible scenarios for evaluation include: (i) changing the production season for sugar particularly early season production; (ii) changing cane pricing arrangement; (iii) modifying crush start and finish times; (iv) changing harvesting rates, crushing capacity and storage capacity and (v) impacts of price variability including exchange rate movement.

Methodological challenges

The VCA / benchmarking approach provides useful insight into the competitive position of the Australian sugar industry, but, given the limitations of this approach described above, a more appropriate methodology to assess the consequences of manipulating links in the sugar industry value chain needs to be identified.

Mathematical programming is one such approach that can be used to optimise profits across the whole sugar industry value chain. To date, there have been no serious attempts at using mathematical techniques to optimise across several value chain components for the Australian sugar industry. Mathematical techniques have been applied, however, to optimise cane supply from the point of cutting in the field to delivery at the mill gate. This allowed the exploitation of yield and CCS variation during the harvest season, and the specification of constraints associated with harvesting, transport and crushing capacity, to evaluate options for improved profitability (Higgins *et al.*, 1998; Higgins and Muchow, 1998).

There are a number of limitations associated with the application of mathematical programming models to optimising the whole industry value chain. Computing power is limited even with today's computers. A model that addresses a full industry value chain can require an enormous number of meaningful decision variables that cannot be adequately represented.

To optimise the whole sugar industry value chain, we have to take a much broader approach than just optimising the cane supply. It is not simply sufficient to build a whole industry model from the individual activities in the cane supply optimisation model. The problem requires aggregation and redefinition of activities and some consequent loss of detail to be able to present a realistic and useful model of the whole industry value chain.

Since the cane supply options optimisation model itself is not broad enough for full value chain analysis, it could be taken as one module with information links to other modules. A cane transport scheduling model could be another module, while sugar price, exchange rate and climate forecasting models may be others. That is, some modules would be optimisation models if most suitable for the task while other modules would be socioeconomic, environmental and forecasting models.

One analogy is a sophisticated airline scheduling system developed by SABRE Decision Technologies which links passenger demand forecasting models with aircraft assignment and routing models (Cook, 1998). This airline system has increased total revenue by several hundreds of millions on dollars for United, Delta, Lufthansa, Swissair, and Air France.

The information links would allow the interdependencies between value chain components to be correctly assessed and modelled. Through these links, modification to any part of the sugar industry value chain (e.g. crush start time) would automatically update all value chain modules to give the full industry analysis. The key research areas over the coming years will be to identify and model the module information links as well as to construct the modules. As discussed above, some of the individual modules are already available. Developing the modules and links would be a multidisciplinary research and industry effort involving economists, operations research scientists, agronomists, crop-soil modellers, climate forecast scientists and industry partners.

The path forward

Not only is the Australian sugar industry characterised by climate-driven production variability, Australia is a price taker and therefore exposed to the volatility of world sugar prices. Against this dynamic background is a need to exploit linkages and interdependencies across the components of the industry value chain to enhance the competitive position of the industry. This will involve going beyond traditional measures of competitiveness and focussing on improving the organisational efficiency of the industry. The path forward is to identify an alternative methodology, which goes beyond benchmarking to approaches which optimise the benefits from exploiting value chain linkages. This needs to be closely linked with industry's desire to evaluate alternative ways of doing business.

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