



Wine Economics Research Centre Working Paper No. 0310

Contributions of the Innovation System to Australia's Wine Industry Growth

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February 2010

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Abstract

Australia's wine industry has been through major structural changes over the past six decades and has grown especially rapidly since the early 1990s. Investments in generic promotion and in grape and wine research and development have been significant features of the industry throughout that period, and have grown in importance following the formation in the early 1990s of the Australian Wine Export Council and the Grape and Wine R&D Corporation which coordinates the investing of grapegrower and winemaker national levies and matching federal government funding for such generic promotion and R&D. This paper summarizes that recent history, and concludes by speculating on the scope for and likely approaches to innovation in the future.

Keywords: wine R&D, generic wine promotion, grape and wine innovation

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Contributions of the Innovation System to Australia's Wine Industry Growth

Kym Anderson

During the past two decades, Australian wines have become increasingly noticeable to the average wine consumer in the northern hemisphere, following a dramatic expansion in Australia's vineyard area, winery capacity and wine exports. The industry originated with white settlement two centuries earlier, but remained miniscule until the first exports began in the second half of the nineteenth century. Since then, efforts to innovate through trial and error on the part of producers have been increasingly enhanced by systematic investments in grape and wine research and development (R&D). Those investments were further expanded after 1955 when the Australian Wine Research Institute came into being, and even more so after the 1980s when the Grape and Wine R&D Corporation was created to coordinate the investing of grapegrower and winemaker levies and matching federal government funding. Simultaneously, the industry has engaged in generic promotion of exports, beginning with the formation of the Wine Overseas Marketing Board (later to become the Australian Wine Board) in 1929 but expanding considerably following its conversion to the Australian Wine and Brandy Corporation (AWBC) in 1980 and the AWBC's creation of its Australian Wine Export Council in 1992.

This paper seeks to assess the roles that innovation system has played in the industry's recent growth, particularly through generic promotion and R&D. It begins with a brief summary of salient features of the industry's long-run trends and cycles and especially its most recent growth spurt. It then lays out the evolving nature of the institutions that provided generic promotion and R&D outputs of relevance to the industry. The speed and success of the export take-off in the 1990s was due in no small part to the substantial prior and on-going investments nationally in pertinent research and development and related education and

extension activities. The paper concludes by speculating on the scope for enhancing the roles of generic and firm-level promotion and R&D in the future of the Australian wine industry.

Growth of the Australian wine industry: a brief history

It was claimed more than 100 years ago that “Many of the leading wine merchants of London and other important commercial centres admit that Australia promises to become a powerful rival in the world’s markets with the old-established vineyards of Europe” (Irvine 1892, p. 6). Even though another seven decades passed before the Australian wine industry began to fulfil that earlier promise, it has since shot into prominence. Domestic demand growth from the 1960s helped, but since 1990 Australia has trebled its share of global vine area and has raised its share of global export sales more than eight-fold. Following the quadrupling of its output it is now the world’s fifth largest wine producer by volume and the fourth largest by value (after France, Italy and Spain and ahead of Argentina – see OIV 2009).

In the decade to the mid-1980s, Australian wine exports were less than US\$15 million per year and the country was a net importer of wine. By contrast, nearly two-thirds of Australia’s much larger volume of wine is now sold abroad (Figure 1), valued at around US\$2.5 to 3 billion. Wine now generates about the same export revenue for Australia as the dairy industry and next behind the country’s two biggest farm export items (beef and wheat), having recently displaced wool from that third position.

Australia’s wine exports have boomed several times in the past. In each case those booms subsequently plateaued and the expanded acreage meant grapegrowers and winemakers went back to receiving low returns. Indeed the industry’s prospects were sufficiently dire as recently as 1985 as to induce the government to fund a vine-pull compensation scheme to encourage grapegrowers to move to alternative crops. Yet, like a phoenix, the industry has risen again and grown with renewed vigour and a strong export focus.

The long history of fluctuating fortunes gave reason to expect Australia’s latest wine boom would be followed by yet another crash, at least in wine export (and thus winegrape)

prices if not in wine production and export volumes –as indeed has begun to happen (Figure 2), with the export volumes rising since 2002 only for the two cheapest price ranges (Figure 3). Each of the first four booms in the Australian wine industry finished with a plateau in vineyard area (and winery output) growth. These were periods when returns to grapegrowers and often also winemakers were depressed for years because of the rapid growth in new plantings during the boom. This phenomenon is of course not unique to Australia. On the contrary, it has periodically been the case in grape and wine markets elsewhere in the world for at least two millennia (see Johnson 1989).

Yet the industry's past history also is encouraging, because it shows the current boom to have several positive features that contrast with those of earlier booms. Some of these features are summarized in Table 1. The first boom, from the mid-1850s, was mainly driven by domestic demand growth following the gold rush that induced a trebling in Australia's white population in the 1850s. However, the wine produced from that excessive expansion was unable to be exported profitably, largely because of high duties on inter-colonial trade within Australasia plus poor marketing and high transport costs in exporting the rather crude product of that time to the Old World. Hence returns slumped quite quickly in that first cycle.

The second boom, from the 1880s, was due to a mixture of domestic and export demand growth, the latter involving better marketing and lower ocean transport costs for what were higher quality but still mostly generic bulk (rather than winery bottled and branded) dry red wines. The relatively open British market absorbed one-sixth of Australia's production early in the 20th century, before the first world war intervened. That boom was part of a general internationalization of world commodity markets at that time – something that returned but in much-diminished form after that war.

The acreage boom induced by soldier settlement after World War I provided the basis for the third boom, from the mid-1920s. That third boom was helped by irrigation and land development subsidies, a huge fortified wine export subsidy, and a new 50 per cent imperial tariff preference in the British market for fortified wines. The decline in domestic consumption, induced by the export subsidy and the Great Depression, added to wine exports in the 1930s – which by then accounted for more than one-fifth of production. The subsequent removal of the export subsidy, and the huge hike in UK tariffs on fortified wine in the latter 1940s, then caused a severe decline in export orientation. As well, the return to

normal beer consumption after war-induced grain rationing kept down domestic wine sales growth. From the First World War until the late 1960s most winegrapes were destined for fortified wine or for distillation as brandy.

The fourth boom, following two post-war decades of slow growth in the industry, was entirely domestic. It emerged as Australian consumer tastes became more Southern European, as licensing and trade practice laws changed with income growth, as corporatization of wineries led to more-sophisticated domestic marketing and new innovations (including wine-in-a-box), and as Britain's wine import barriers rose again with its accession to the European Community in 1973. Initially domestic demand grew for red table wine. Then the cask or wine-in-a-box attracted a new clientele of white non-premium table wine drinkers, causing Australia's per capita wine consumption to treble during the fourth cycle (Table 1). The economy-wide recession of the early 1980s subsequently slowed domestic demand growth and caused wine prices to slump to the point that the Federal and South Australian governments intervened with vine-pull subsidies in the mid-1980s. As a result, the national area of vines in 1988 was reduced to that of two decades earlier.

The fifth and latest boom, which began in the late 1980s, differs from the earlier booms in several respects. One difference is that the current boom is overwhelmingly export-oriented (Figure 1), since Australia's per capita wine consumption has been grown very little over the past two decades (despite a one-fifth decline in beer consumption and a nearly 50 percent rise in spirits consumption, to 3.1, 4.6 and 2.3 litres of alcohol, respectively). This contrasts with the first and fourth booms at least, which were primarily domestic. It also differs from the inter-war boom, when exports were more a way of disposing of soldier-settlement induced surplus low-quality winegrape production than a pre-planned development strategy.

Secondly, the current boom is mainly market-driven, which is not unlike the first two booms but contrasts markedly with the third (inter-war) boom that evaporated once government assistance measures (the export subsidy and the preferential UK tariff) were withdrawn. What triggered the growth in export demand for Australian wine was the change in liquor licensing laws in the United Kingdom in the 1970s, allowing supermarkets to retail wine to the post-war baby boomers (by then adults). Given also Australia's close historical ties with Britain, it is not surprising that Australian companies recognised and responded to

this new market opportunity. They were able to do so faster than EU suppliers because the latter have been hamstrung by myriad regulations and insulated from market forces by price supports. To exploit this rapidly growing market required large volumes of consistent, low-priced branded premium wine. Land- and capital-abundant Australia had the right factor endowments to supply precisely that. High labour costs were overcome for larger firms by adapting and adopting new techniques for mechanical pruning and harvesting, thereby generating large economies of size, especially in warm irrigated areas. That stimulated a number of mergers and acquisitions among Australia's wine firms that resulted in several large and four very large wine companies. This has provided them the opportunity to reap scale economies not only in grape growing and wine making but also in viticultural and oenological R&D, in innovative brand promotion and related marketing investments, and in distribution including through establishing their own sales offices abroad rather than relying on distributors. It has also enhanced their bargaining power with wholesalers and retailers. The volumes of grapes grown and purchased from numerous regions by these large firms enable them to provide massive shipments of consistent, popular wines, with little variation from year to year, for the UK and now also North American and German supermarkets. The signing of the EU-Australia Wine Agreement in 1994 provided additional market surety to wine exporters at the outset of that surge in sales to Europe. Indeed some types (e.g., Lindemans Bin 65 Chardonnay) were specifically developed for and only sold in those markets initially, being released in Australia several years later only after there had been a sufficient expansion in production of the required grapes.

The third major difference between now and the past is that the quality of wine output has improved hugely during the past two decades, relative to the cost of production. Moreover, for the first time, the industry is in a position to build brand, regional, and varietal images abroad to capitalize on those improvements in the quality of its grapes and wines. That image building has been partly generic, with the help of the Australian Wine Export Council's activities in Europe and elsewhere. It has come also from the promotional activities of individual corporations and their local representatives abroad as those firms became ever-larger and more multinational via mergers and takeovers during the past dozen or so years. That promotion has been helped by being able to point to the legislated wine quality standards in the Australian and New Zealand Food Standards Code, and to the fact that Australian

wines over-delivered in terms of value for money in Northern Hemisphere markets in the latter 1990s and early this decade before exports from other Southern Hemisphere and Southern European producers began to offer stiffer competition.

And the fourth feature distinguishing the current situation is the quality upgrading that has been taking place in Australia's domestic as well as export markets. As recently as 1994, two-thirds of domestic sales of Australian wine were in soft packs ('bag-in-a-box') of two to five litres, whose retail price (including the 41 per cent tax) was as low as US\$1.40 per litre. That share now is down to barely one-third, and the average quality of wine in soft packs is considerably greater than in previous decades. The average quality of Australia's bottled wine sold on the domestic market also has risen steadily since the 1980s. Hence even though Australia's per capita wine consumption has risen little over the past quarter century, expenditure has gone up substantially. Australia's average export price also rose by 2.3 per cent per year in US dollar terms over the period 1990 and 2001, compared with the global average of 0.7 per cent. However, that rise for Australia was exceeded by Argentina (7.3 per cent), Chile (5.8 per cent) and New Zealand (4.6 per cent – see Anderson and Norman 2003). Clearly, other exporters have been raising the quality of their exports at least as much as Australia, albeit from different bases.

Since 2001 the average export price even in nominal terms has fallen for Australia, and the volume of wine exports has grown only for wines priced below A\$5 a litre fob (Figures 2 and 3). The situation has worsened further since the global financial crisis hit in 2008, and the subsequent strengthening of the Australian dollar since then has made the exporters' task even tougher. Australia's grapegrowers and winemakers therefore are having to strive harder than ever to maintain their competitive edge. They perceive innovation in its various forms as crucial for their economic survival, to which we now turn.

The innovation system in Australia's wine industry

The ability of a country's vignerons to compete in global markets depends on the country's comparative advantage in wine, which changes over time at a rate that depends, among other things, on own- versus other-country technological and institutional innovations (Abramovitz 1986; Nelson 2008; Cusmano, Morrison and Rabellotti 2010). Standard international trade theory stresses the importance of resource endowments as the key determinant of comparative advantage at a point in time. The crucial natural resources needed for successful winegrape production include climate, land with the appropriate *terroir* and, where rain is insufficient, affordable supplemental water. Also essential are skilled viticulturalists and oenologists, and stocks of production knowledge pertinent to their country. The latter can be enhanced by investments in own-country research and development or in adapting imported technologies. For differentiated products such as wine, consumption patterns also matter. Both at home and abroad, the purchase decisions of consumers are influenced by tastes and preferences. These can be altered to some extent by advertising and through the writings of wine journalists. Hence skills in marketing, and levels of investment in market knowledge and promotion, also are important in maintaining and improving the international competitiveness of a country's vignerons.

During the past two decades, the Australian wine industry improved its competitiveness in no small measure by large investments not only in vineyards, wineries and wine marketing but also in the creation and dissemination of production and market knowledge. Plenty of that is done at the firm level, but there are high rewards from supplementing that through collaboration, especially when many firms are new to the industry and when new markets abroad are being targeted. One of the hallmarks of the export-oriented success of Australia's wine industry since the 1980s has been the very considerable degree of integrated collaboration agreed to among its firms, including in the development of supportive industry-wide institutions to create public goods in the form of generic promotion and R&D.

To build and retain a competitive edge internationally, strategies are needed to obtain and make good use of available information faster and at a lower cost than do competitors, to generate new knowledge pertinent to domestic producers, and to cost-effectively disseminate that among the country's firms. The information required relates not just to consumer, retailer and distributor demands but also to appropriate new technologies as they affect all aspects of

grapegrowing, winemaking, wine marketing and associated financing. Much of the pertinent information and knowledge has a public-good nature. It is that fact, together with the spillovers that can occur from private-firm generation of information through such activities as promotion and technical research, which ensures collaboration between firms within the industry can have a high payoff. We consider firm-level collaboration first, and then collaboration at the industry level and its associated institutional innovations.

Collaboration and innovation at the firm level

Two levels of collaboration between wine firms are important: vertical (that is, between the grapegrower, other input suppliers, the wine maker, and the wine marketer), and horizontal. The various channels through which it can occur include mergers and acquisitions, but there is also a range of other alliances.

As with so many horticultural products, processing of winegrapes and then marketing/distributing the wine is necessary before the product reaches the final consumer. Many winegrape producers have chosen to do some or all of those manufacturing and service activities themselves. But there are far more winegrape growers than there are wineries, with the former dependent on the latter to process their highly perishable and virtually non-internationally tradable product. That dependence is not a problem during boom periods, when widespread signing of long-term (up to ten-year) contracts is common so as to enhance security of supply for wineries and security of demand for grapegrowers. But when there is excess supply, as in recent years in Australia, the vulnerability of the non-winemaking grapegrower increases. Even so, the greater emphasis on producing and promoting consistent high-quality wine (with widespread use of price bonuses and penalties according to measured grape quality attributes), and the fact that much of that quality is determined in the vineyard, has ensured the two-way relationships between wineries and contract grapegrowers is more secure now than it was before the present boom (that is, pre-1990s).

Another form of vertical integration is occurring between wine making and wine marketing. An example is e-commerce, which is lowering the cost, especially for smaller wineries, of using email, the internet and twitter to market their wines directly. Some Australian firms even experimented with selling their entire release by tender over the

internet when prices for premium wines were rising rapidly at the turn of the century. The exemption of small wineries from the Australian Government's wine sales tax for own-marketed wines has added to the incentive to explore these new options. Another example is wineries getting involved in tourism, going beyond standard cellar-door activities to restaurant and entertainment services.

Turning to horizontal collaboration, New World wineries are beginning to diversify their markets abroad as their production grows. Knowledge about the various market niches and the distributional networks in those foreign markets is expensive to acquire, however. Hence new alliances between Australian and overseas wine companies are being explored with a view to capitalizing on their complementarities in such knowledge. The purchase by the owner of Mildara Blass (Fosters Brewing Group) of Napa Valley-based Beringer, the alliance between Southcorp/Rosemount and California's Mondavi, BRL Hardy's absorption into the second-largest US wine company, Constellation Brands, and the purchase by New Zealand's biggest wine firm (Montana) of the second largest (Corbans) and Montana's subsequent absorption into Allied Domecq – and the purchase of Allied in 2005 by Pernot Ricard (owner of Orlando Wines) – are all cases in point early this century. These may achieve the desired result much quicker than direct foreign investment in new production facilities, although that has been happening increasingly too. As well, in this era of floating exchange rates, cross-border operations can be a form of currency hedge; and ownership abroad can also serve as a form of insurance against a major disease outbreak (e.g., Phylloxera or Pierce's Disease) in the home country. Horizontal mergers and acquisitions are also taking place domestically, most notably with the takeover in 2005 of Southcorp by Foster's to form perhaps the world's largest premium winemaker. A key objective is to get economies of scale and higher productivity growth not only in marketing but also in producing. This is especially important if firms wish to move beyond the boutique size and penetrate the large-scale (particularly supermarket) distribution and retail networks.

This innovation-inducing trend is occurring in many industries as part of globalization. The value of cross-border mergers and acquisitions in particular grew at 25 per cent per year from 1987 to 1995, and at 50 per cent in the latter 1990s (UNCTAD 2001, p. 10), before slowing down somewhat in the past decade. Some left-behind wineries will be disadvantaged by the new alliances among more-progressive firms, but an alternative possibility is that even

they could benefit as those merging ones improve their export performance. That could happen either by getting in the slipstream of the progressive firms' success abroad in promoting Australian wine, or in supplying a less-crowded domestic market while the merging firms focus more on markets abroad.

More worried are Australia's specialist grapegrowers. They are aware that the big wine corporations have valuable so-called 'knowledge capital' that is internationally mobile and hence tends to relocate to places where it can earn the highest rewards (Carr, Markusen and Maskus 2001). During the 1990s/early 2000s Australia's grapegrowers enjoyed an exceptionally high proportion of the benefits of the growth in demand for commercial premium wine, in the form of high prices for their grapes. Were those high prices to continue, large wine firms (which source three-quarters of their grapes from independent growers) would have found it more profitable to expand their crushing capacity in lower-priced countries rather than in Australia, thereby causing winegrape prices to tend to equalize across countries even though the grapes themselves are not traded internationally. Such developments help to keep profits of Australian-based multinational wine companies and targeted grape growers abroad higher than they otherwise would be, while lowering profits to Australian grapegrowers, other things equal. However, multinational wine corporations from abroad have invested in Australia, which has an offsetting, positive effect on Australian grapegrowers. The demands by all such wineries for ever-better performance from their contracted growers is an on-going stimulus for growers to seek out innovations.

Horizontal collaboration stimulated by the digital revolution is also occurring at the retail level. How are the savings from increased marketing efficiencies via supermarketing and e-commerce distributed between the consumer, marketer, winemaker and grapegrower? Wittwer and Anderson (2001) explored this question with a model of the world's wine markets. They suggested that in the short run the innovative distributors would gain most but that, over time as competition among distributors and retailers drives down consumer prices, the gains would be shared among consumers and producers. Given even further time, the benefits to producers would encourage increased plantings and winemaking capacity such that consumers would end up with the lion's share (all but one-eighth) of the benefits. That prediction certainly seems to be consistent with the experiences of the past decade in Australia.

Collaboration at the industry level: institutional innovation

In addition to collaboration to improve the efficiency of grape growing, wine making and wine marketing at the firm level, the Australian wine industry during the past two decades has enjoyed a high and envied degree of collaboration also at the industry level. The key motivations for that collaboration are to internalize externalities and to overcome the free-rider problem of collective action. Efforts traditionally have been directed in three key areas: the generic promotion and maintaining of quality standards of Australian wine sales domestically and especially overseas; investments in research, education and training, and statistical information; and lobbying governments (most notably for lower taxes on wine consumption at home and lower barriers to imports overseas). Maintaining and expanding those activities requires a non-stop flow of deliberate and skilful leadership, something that the Australian wine industry has been fortunate to have had in relative abundance compared with both other Australian industries and the wine industry abroad. That entrepreneurial leadership was particularly noticeable during the development through the Winemakers' Federation of Australia of a shared vision for the industry called *Strategy 2025* (AWF 1995). It was developed to provide a 30-year vision for the future so as to stimulate a steady flow of investment. At the time the targets in that document were considered by many observers as rather optimistic, since they involved a three-fold increase in the real value of wine production, 55 per cent of it for the export market. Getting half way to those targets required having a crush of 1100 kt to produce 750 million litres of wine at a wholesale pre-tax value of A\$3 billion (A\$4/litre). Yet so convincing was that document, and so intense and rapid was the subsequent investment, that the industry was more than half-way towards most of its 30-year targets in just six vintages – and since then has had to deal with the challenge of finding new markets for that much larger output. By 2009 the national stock of unsold wine (exacerbated by the global financial crisis that began a year earlier) was so large that industry leaders began calling for up to 20 percent of vines to be pulled out. Even in that tense situation, though, the four peak industry bodies coordinated in releasing a considered report on the state of the industry and why such major adjustments are needed (WFA et al. 2009).

Long-run strategic planning by firms and the industry is made easier with an active system of producer organizations. The Australian wine industry has an excellent system involving more than 80 organizations at the national, state and regional levels, with a well-developed hierarchy of interaction between them (see www.wineaustralia.com).

Among the four peak bodies is the Australian Wine and Brandy Corporation (AWBC). One of its tasks is to ensure that exported wine meets the product standards of the country of destination, so that the reputation of the industry as a whole is not jeopardised by any sub-standard shipments. Another is to supervise the Label Integrity Program. A third is to establish the regional boundaries for the purpose of legally registering Geographical Indications. A fourth is to lobby directly and via Australia's Department of Foreign Affairs and Trade for greater market access abroad through a lowering of tariff and non-tariff import barriers. And very important has been its role, via its Australian Wine Export Council, to invest in generic promotion. Initially that was focused broadly on 'Brand Australia' but, with the more-recent *Directions to 2025* strategy paper (AWBC and WFA 2007), that campaign has become more refined and is now directed towards four segments of the market with an explicit objective of encouraging consumers to 'trade up' to progressively higher prices. The four are known as Brand Champions (the easy drinking commercial segment that spearheaded Australia's export drive in the 1990s), Generation Next (appealing to younger social drinkers attracted by innovative packaging and style), Regional Heroes (varietal wines that have a sense of place of origin), and Landmark Australia (high-quality, globally recognised iconic wines).

A further task for AWBC that was expanded significantly in the decade following the release of *Strategy 2025* is the systematic provision of strategic information on market developments at home and abroad. The smaller an industry, the less likely such data will be available at low cost. Yet for capital-intensive industries such as wine with long lead times and large up-front costs, information on planting intentions of others in one's own country and elsewhere is especially pertinent for those contemplating investing, given that full bearing may not occur until 5+ years after beginning to invest. The grape and wine industry recognised this and spent some of its R&D funds on commissioning the Australian Bureau of Statistics to collect more information including on growers' planting intentions in the coming year, and the Australian Bureau of Agricultural and Resource Economics to use that

information each year to project supplies several years ahead. In addition, each year the Winemakers' Federation of Australia organises a Wine Industry Outlook Conference and the Winegrape Growers' Council of Australia (re-constituted in 2006 as Wine Grape Growers Australia) organises a National Winegrape Outlook Conference, so such projections information can be shared and discussed. As well, the Australian Wine Industry Technical Conference held every third year keeps producers up to date on new technologies, as does the annual National Wine Industry Environment Conference (first held in 2000) and the annual Wine Marketing Conference (first held in 2001).

Collaboration in investing in research, education and training

At the outset of Australia's white settlement, vine experimentation was by trial and error of individual interested entrepreneurs. An early influential viticulturist was James Busby, who emigrated from near Bordeaux in France to Australia in 1824 where he was appointed to run an agricultural school which specialised in viticulture. In 1831, Busby undertook a three-month tour of Spain and France and returned with a collection of vine cuttings and started the first source block in Sydney's Botanic Gardens, along with duplicate blocks in Victoria and South Australia. By the 1850s large areas of vineyard were being developed in Victoria, New South Wales and South Australia, but it was South Australia that became the main wine State from the 1880s onwards, largely because the other two states were hit with phylloxera (introduced to Australia on planting material after it had destroyed most of the vineyards in the United States and France). South Australia escaped the infestation due to a far-sighted quarantine policy that is still in place.

Australia's investment in formal grape and wine education and training dates from the establishment of Roseworthy Agricultural College (now part of the University of Adelaide) in 1883. Viticulture was compulsory and oenology was an optional field of study in its Diploma in Agriculture, with a Diploma in Oenology being added in 1936. Formal wine research began in 1934 with funding to the University of Adelaide from (what soon became) the Australian Wine Board. With those funds, John Fornachon was appointed to find the cause of bacterial spoilage in fortified wines. The Board's annual reports indicated high rates of return

from that and subsequent initial research investments, so when the industry was faced with the question of what to do with a fund of A\$1 million that had accumulated following the war-time suspension of wine export subsidies, it opted for a wine research facility. This eventually led in 1955 to the creation of the Australian Wine Research Institute (AWRI) adjacent to the University of Adelaide's Waite agricultural research campus, and John Fornachon became its first Director (Halliday 1994, Ch. 9). Twenty years later, a second tertiary institution in Wagga Wagga, New South Wales (now Charles Sturt University) began courses in wine science and viticulture, under the direction of Brian Croser.

It took more than another decade before the appointment of the first professor of oenology, Terry Lee, who took up his appointment at the University of Adelaide while continuing as the Director of AWRI. In his Inaugural Lecture, he pointed out that AWRI had not had sufficient funding to undertake viticultural research. A viticulturalist was first appointed to AWRI only in 1990, and Australia's first professorial Chair in viticulture was established at the University of Adelaide in 1991. Meanwhile, the industry in 1988 established its own Grape and Wine Research and Development Corporation (GWRDC, although called a Council until 1991), and it successfully bid in 1991 for federal funding to support the establishment of a Cooperative Research Centre for Viticulture (which subsequently enjoyed a second period of 7-year funding before being wound up in 2006).

The GWRDC is funded by producer levies which the Federal Government matches dollar-for-dollar up to a maximum of 0.5 per cent of the gross value of output of grapegrowers (in the case of growers) and of the input of winegrapes (in the case of wineries). Producers initially opted for low levies, but in 1999 growers and wineries agreed to raise the research levy rates by more than one-third, to A\$2 per tonne of grapes produced and A\$3 per tonne of winegrapes crushed. In 2005 the wineries raised their rate again, to A\$5 per tonne of winegrapes crushed. Since winegrape prices averaged around A\$700 per tonne over the five vintages to 2009, and wine sold for an average of around A\$4.50 per litre (or \$4500 per tonne), the current rates are equivalent to less than 0.3 percent of the gross value of grape production and barely 0.1 percent of the gross value of wine production, or well under 1 percent of value added in these two activities. Wineries and even some of the larger vineyard owners also undertake their own research, and universities, state departments of agriculture and the Commonwealth Scientific and Industrial Research Organization invest funds

additional to those from GWRDC in grape and wine research and the basic sciences underlying it. Even so, these research intensities represent modest investments in R&D compared with the averages for OECD countries of around 2 percent of agricultural and 3 percent of manufacturing value added (Pardey et al. 2006).

Notwithstanding the modest level of research funding, the impact and payoff from those investments is impressive. Data from the Web of Science database suggest Australia is four times as intense in producing research papers on viticulture and oenology (exceeded only by Portugal and Spain), adjusted for the size of each economy; and was 2.8 times as intense in the mid-1990s when adjusted for the output of wine (exceeded only by the United States – Table 2). The latter intensity has since dropped as Australia's wine production rapidly expanded, but it may be higher if the quality of publications were to be taken into account. In terms of research payoff, a benefit-cost study found that the 2002 portfolio of GWRDC research projects was expected to yield a 9:1 benefit/cost ratio, and that a sample of past projects yielded ratios ranging from 7:1 to 76:1 (McLeod 2002).

Formal education in viticulture and oenology has spread from the University of Adelaide and Charles Sturt University to several other tertiary education institutions, and each has added wine marketing courses. As well, numerous Technical and Further Education (TAFE) campuses are offering practical viticultural training both for employees and for boutique vineyard/winery proprietors and hobby farmers. And many high schools in wine areas are offering wine-oriented material in their agricultural science courses.

The payoff from investments in R&D is higher the more readily and rapidly new information is disseminated, trialled and adopted. That requires not only education and training but also – for on-going lifetime learning – active journal, magazine and website publications, specialized publishers/distributors, and regional, state and national associations of producers (see the comprehensive listings in Winetitles 2009) whose culture is to share new information, ideas, and results of field experimentation. The role of grower liaison officers employed by the wineries to interact with contract growers, in disseminating new information and helping to boost and appraise grape quality, has been considerable too. Those officers now insist on the use of diaries to record irrigation, spraying and fertilizing activities, they encourage lower yields so as to intensify grape colour and flavours, and they help monitor baume (sugar) levels in the grapes to optimize harvest dates. In short, 'precision

viticulture' is being continually fine-tuned as producers continue to strive for quality improvements.

While Australia has been a leader in wine R&D investments and in the rapid adoption of new technologies, Southern Hemisphere and Southern and Eastern European suppliers are rapidly catching up, including through international technology transfer. Australia is contributing to and benefiting from that in at least three ways. One is via Australian viticulturalists and winemakers exporting their services through spending time abroad as consultants (Williams 1995; Smart 1999) – continuing a long-established tendency for Australians to be willing to travel and even live abroad for years to learn more. Another is via foreign investment by Australia's biggest wine companies in grape production, wine making, and/or wine marketing and distribution in other countries. And a third way is via scientific co-publication resulting from multi-country research and development projects (Cassi et al. 2010). Such international technology transfers are not peculiar to the wine industry of course - it is part of the general contribution by multinational corporations to globalization. That in turn has been aided by reforms to restrictions on foreign investment and by the fall in air transport costs, and thanks to the digital/information revolution in communication costs. Smaller grapegrower/winemaker firms might be affected adversely in so far as the spreading abroad of Australian expertise in viticulture, winemaking and wine marketing eventually reduces the distinctiveness of 'Australian' wine in the global marketplace. It can also lead to the exploitation of knowledge of the Australian market by those large Australian-based companies operating abroad – as with the recent flood of imports of Sauvignon Blanc from New Zealand. However, there is the offsetting prospect that internationally engaged Australians will bring back new ideas that can be exploited to good effect in Australia.

Innovation's role in the years ahead

The Australian wine industry, having expanded dramatically and become (along with Chile and New Zealand) the most export-focused in the world, is now facing a second generation of

challenges. In addition to having to deal, like all other suppliers, with the current global recession-driven decline in demand, the supermarket revolution and climate change impacts on production, those challenges include a strong Australian dollar because of a mining boom driven by China's rapid industrialization, a concern with the carbon imprint of shipping (especially bottled wine) long distances, and a fashion swing away from Australian wine abroad and at home (including the sudden growth in imports from New Zealand as that country too moves into a situation of excess supplies of wine).

To weather the industry's present depressed economic conditions and return to prosperity, its producers and leaders have to place even more emphasis on innovation. The *Directions to 2025* strategy is one example of possible fresh approaches to generic promotion. That national initiative is being supplemented by regional promotion campaigns (funded entirely by regional producer levies), and by the creation of a new grouping of "Australia's First Families of Wine". The latter is made up of a dozen of the oldest family companies not listed on the stock exchange and hence not subject to the same financial 'short-termism' of listed companies. Emphasis needs to be given to the quality and originality of Australia's various fine wine regions and single-site labels. The need to diversify markets for Australian wine exports so as to reduce the reliance on four English-speaking countries is now evident, and generic promotion initially at least in markets such as China's is likely to have a high payoff alongside the marketing (and possibly direct foreign investment) efforts of individual firms. Even earlier rewards are likely to be reaped from marketing into the now duty-free market of Hong Kong.

Such efforts on the demand side of the market need to be matched by equally strong initiatives on the supply side. The best producers will continue their tradition of innovating on the job, but an expansion of formal R&D investments also is needed. Australia's R&D investments only very recently have reached the point of taking full advantage of the federal government's dollar-for-dollar matching of national grower levies up to 0.5 percent of the gross value of production. Benefit-cost analyses suggest the level of investment could be expanded much more and still provide an attractive marginal rate of return to the industry, provided those funds are spent on research projects with the highest expected payoffs. The return in the next decade or so may be even higher than in the past, bearing in mind marketplace changes and long-term uncertainties such as climate change, water and other

environmental policy reforms, and alcohol tax changes. That prospect has led the main producer organization to work with the industry's R&D funding body to develop a new strategy for administering research and extension activities (GWRDC and WFA 2009).

Transgenic biotechnology offers much promise for accelerating the research discovery process, but consumer resistance to genetic engineering is limiting the exploitation of that opportunity (Pretorius and Hoj 2005). The scope for collaboration across scientific disciplines could be exploited more, as could the scope for collaboration between scientists at the basic and applied ends of the spectrum, and between scientists in various countries. As one step toward that end, the University of Adelaide recently established its *Wine 2030* research program (see www.adelaide.edu.au/wine2030), but many more such steps will be needed. Meanwhile, if producers remain attuned to the market and flexible enough to respond to exogenous shocks such as currency re-alignments, macroeconomic downturns, changes in consumer fashions, or disease outbreaks, as well as to try promising new technologies as soon as they become available, their long-term prospects for a return to prosperity look good. But, as anybody who has studied the history of the wine industry knows, the only thing that is really certain is that this is an industry characterized by great uncertainty, ever-fluctuating fortunes, and in particular long periods of low profits following each boom in acreage.

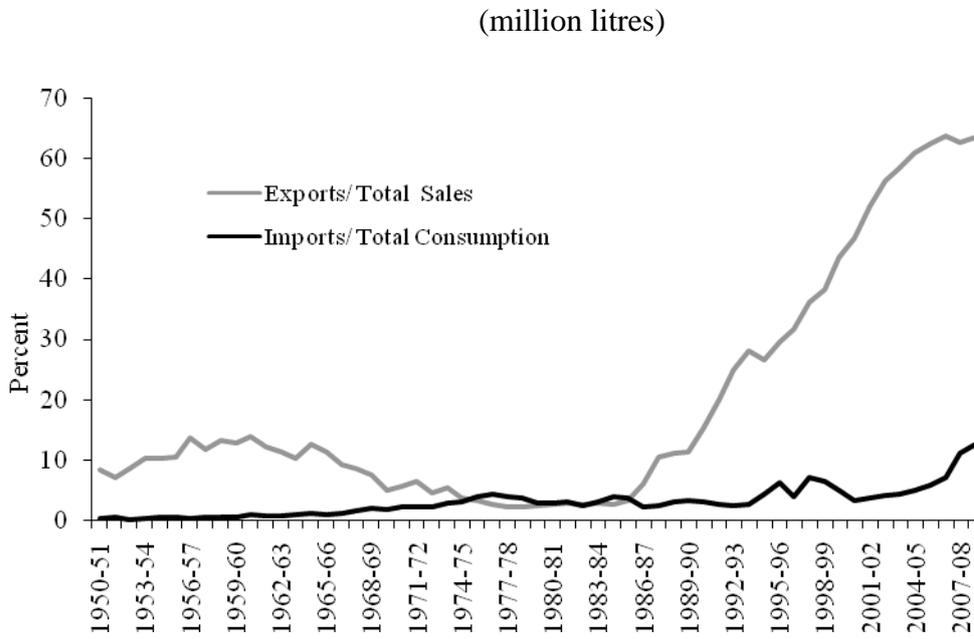
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Figure 1: Export share of total sales of Australian wine and import share of total consumption of wine in Australia, by volume, 1950-51 to 2008-09



Source: Updated from Osmond and Anderson (1998), using data from www.awbc.com.au.

Figure 2: Volume and average price of export sales of Australian wine, 1980-81 to 2008-09

(million litres and Australian cents per litre)

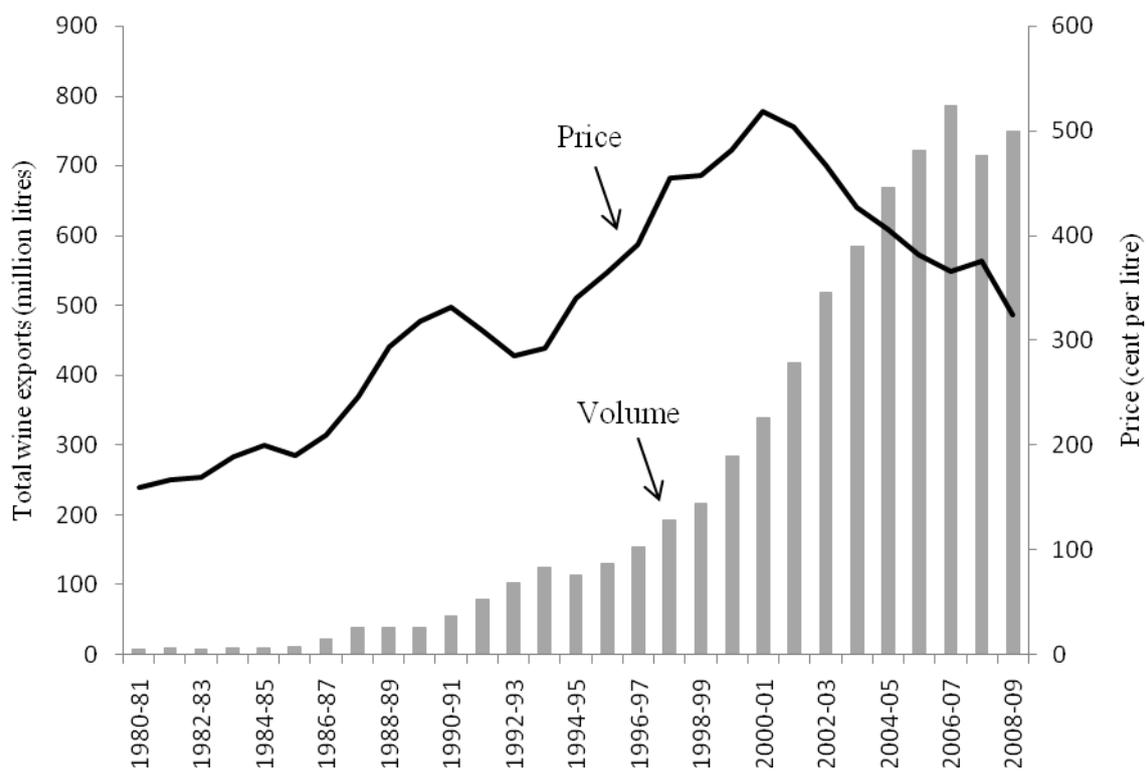
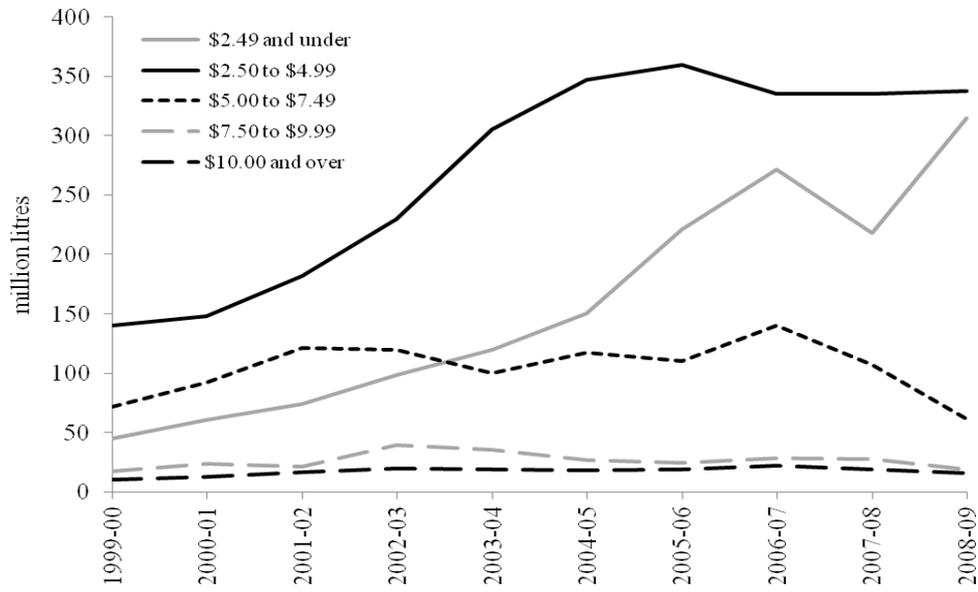
Source: Authors' derivation from data at www.awbc.com.au

Figure 3: Volumes of wine exports by price segment, Australia, 1999-00 to 2008-09
(A\$ per litre, fob prices)



Source: Authors' derivation from data at www.awbc.com.au

Table 1: Booms and plateaus in the development of Australia's wine industry, vintages 1854 to 2010

Vintages:	Boom/ plateau/ cycle no.	No. of years	Increase in vine area (% pa)	Increase in wine production (% pa)	Increase in wine export volume (% pa)	Av. share (%) of exports in Australian wine sales(%)	Av. domestic per capita consumption (litres p.a.)
1854 to 1871	1st boom	17	15.5	18.4 ^a	14.1	1.8	na
1871 to 1881	1st plateau	10	-1.1	-0.6	-5.2	1.6	na
1854 to 1881	1st cycle	27	8.4	10.7	8.2	1.7	na
1881 to 1896	2 nd boom	15	9.7	7.5	23.0	9.8	na
1896 to 1915	2 nd plateau	19	-0.1	-0.4	0.4	16.5	5.1
1881 to 1915	2nd cycle	34	3.9	3.3	8.7	14.4	na
1915 to 1925	3 rd boom	10	7.0	12.7	4.5	8.5	5.8
1925 to 1945	3 rd plateau	20	0.9	0.1	-1.2	16.4	4.0
1915 to 1945	3rd cycle	30	2.4	3.6	4.9	14.9	4.7
1945 to 1968	slow growth	23	0.2	2.1	0.2	5.4	6.2
1968 to 1975	4 th boom	7	3.3	6.2	-1.4	2.7	10.9
1975 to 1987	4 th plateau	12	-1.7	1.0	8.4	2.2	19.1
1968 to 1987	4th cycle	19	0.2	3.1	2.5	2.4	16.0
1987 to 2004	5 th boom	17	18	11	22	32	20
2004- present	5 th plateau	?					

Source: Updated from Anderson (2004), using data from www.awbc.com.au.

Table 2: Wine research publications^a and national shares of global wine production volume and global GDP, 1992 to 2006

	1992-1996					1997-2001					2002-2006				
	Wine prodn, %	GDP, %	Publicns, %	<i>Publicns</i> <i>/Prodn</i>	<i>Publicns</i> <i>/GDP</i>	Wine prodn, %	GDP, %	Publicns, %	<i>Publicns</i> <i>/Prodn</i>	<i>Publicns</i> <i>/GDP</i>	Wine prodn, %	GDP, %	Publicn %	<i>Publicns</i> <i>/Prodn</i>	<i>Publicn</i> <i>s/GDP</i>
France	21.7	5.3	15.5	0.71	2.94	20.9	4.6	14.0	0.67	3.07	18.9	4.7	11.7	0.62	2.42
Italy	23.3	4.2	10.5	0.45	2.49	19.6	3.8	10.9	0.57	2.87	17.3	3.9	11.6	0.67	2.94
Spain	10.1	2.1	14.2	1.41	6.72	12.7	1.9	15.2	1.20	7.88	13.6	2.4	16.6	1.22	6.93
United States	6.7	25.8	25.9	3.87	1.00	8.1	29.7	21.5	2.65	0.72	8.4	28.8	18.1	2.15	0.63
Argentina	5.8	0.9	1.1	0.19	1.14	5.2	0.9	0.8	0.15	0.83	5.2	0.4	1.1	0.21	2.84
Australia	2.0	1.3	5.6	2.80	4.19	3.0	1.3	4.9	1.63	3.73	4.7	1.5	6.8	1.45	4.45
Germany	3.9	8.2	5.1	1.31	0.62	3.8	6.7	5.7	1.50	0.86	3.3	6.3	4.6	1.39	0.73
South Africa	3.2	0.5	1.3	0.41	2.47	3.6	0.4	1.2	0.33	2.75	3.3	0.5	1.7	0.52	3.48
Chile	1.3	0.2	0.4	0.27	1.63	2.0	0.2	0.7	0.36	2.97	2.6	0.2	1.3	0.50	5.42
Portugal	2.7	0.4	2.7	1.00	7.16	2.3	0.4	3.7	1.61	9.92	2.5	0.4	4.4	1.76	10.65
Others	19.3	51.0	17.7	0.92	0.35	18.8	50.1	21.4	1.14	0.43	20.2	50.9	22.1	1.09	0.44
WORLD	100.0	100.0	100.0	1.00	1.00	100.0	100.0	100.0	1.00	1.00	100.0	100.0	100.0	1.00	1.00

^a No adjustment is made for the quality or relevance of publications (as measured by, for example, citations). The source includes predominantly English-language journals and so understates the contributions of continental European and South American countries.

Source: Author's compilation drawn from OIV wine production data, World bank GDP data, and wine publication data compiled from the Web of Science data of the Institute for Scientific Information by Cassi, Morrison and Rabellotti (2010).