Accounting for Growth in Australia's Grape and Wine Industries, 1986 to 2003

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ABSTRACT

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This paper seeks first to quantify the relative importance of the different factors contributing to growth in Australia's wine industry over the ten years to 1996. This growth accounting exercise uses an economy-wide model for Australia that separately distinguishes non-premium from premium red and premium white grapes and wine. Around half the premium wine output growth in that period is attributed to export demand growth. Other important contributors to growth include upgrading of domestic preferences, increases in national income, input-saving technological changes and (negatively) increases in domestic consumer taxes on wine. Looking forward, recent and intended vine plantings ensure wine output in 2003 will be about twice that of the mid-1990s. Our model is used to examine how that vineyard expansion might affect the market, especially grape and wine prices and wine exports early next century.

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NON-TECHNICAL SUMMARY

This paper examines the contribution of different factors to the substantial changes in the Australian grape and wine industries over the decade to 1996, and uses those insights to project developments in these industries to 2003. To ensure consistency, an economy-wide CGE model that includes three separate grape and wine industries is used both to backcast and forecast from 1996.

Despite Australia's considerable income and population growth over the decade to 1996, the volume of wine consumed domestically fell by 2 per cent. However, there has been a marked switch in consumption from non-premium to (especially red) premium wine in Australia, as in numerous European countries. An important consequence has been the hike in real prices of premium red over the decade: by 43 per cent for wine and 116 per cent for winegrapes. Producers responded to the hike in premium grape and wine prices with an almost 80 per cent increase in plantings of premium wine grapes in the decade to 1996 (or 150 per cent when the period is extended to 1998).

Around half the industry's premium output growth in the 1986-96 period is attributable to export demand growth. Australia's exports of premium wine have grown more than ten-fold since the mid-1980s, raising the share of production exported from less than 5 per cent to more than 30 per cent.

Income growth accounts for about one-fifth of the increase in premium red wine output and two fifths of premium white output. For non-premium wine, income growth offset the negative taste swing by domestic consumers. Technological changes appear to have made positive contributions too. In winegrape production, mechanical harvesting and pruning were used far more widely at the end of the decade than the beginning.

Consumer tax changes were the other main factor considered. The largest impact of increased wholesale and franchise taxes over the decade has been on consumer prices. For premium red wine, for example, taxes were responsible for almost half of the real increase in price, while for premium white wine, real consumer prices on average would not have risen at all had there been no tax increases. Through diverting sales from the domestic market to overseas, increased taxes have had a positive but only small effect on exports, according to our model.

Turning to the future, recent and intended vine plantings ensure wine output in 2003 will be about twice that of 1996. The model is used to examine how that vineyard expansion

might affect grape and wine prices over the next few years. Results suggest that even with continued strong export demand growth for premium wine, winegrape prices, and to a lesser extent wine prices, will fall substantially in real terms from their current very high levels, particularly for the premium segments of the industry. The price of winegrapes and the consumer price of wine are projected to fall as early as 2000. Premium red grape prices are projected to fall by $500 per tonne (31 per cent) and premium white grape prices by $160 per tonne (16 per cent) between 1998 and 2003. The corresponding projected falls in premium wine prices are around 9 per cent for both red and white by 2003.

Domestic consumption of premium red wine is projected to increase from 53 Ml (megalitres) in 1998 to 95 Ml in 2003. Over the same period, premium white wine consumption is projected to increase from 65 Ml to 90 Ml. Non-premium wine consumption, by contrast, is projected to increase only slightly, from 249 Ml to 267 Ml.

With domestic demand growing so much slower than domestic supply, exports of premium wine are projected to continue to accelerate over the next few years. Premium red wine exports are projected to increase from 77 Ml in 1998 to 328 Ml in 2003, and premium white wine exports from 74 Ml to 130 Ml.

The inevitable drop in premium grape prices, particularly red, is being anticipated by established grape growers, and most are likely to remain profitable at prices much lower than those of the late 1990s. They are well aware that the Australian industry has experienced four previous major booms in the past 150 years, all of which have ended in 'busts'. More vulnerable are growers who entered the industry in the late 1990s budgeting on high prices continuing into the future. While some of the features of the present boom are different from past booms, an eventual 'bust' is possible unless there is a concerted marketing effort to accommodate the forthcoming increase in supply of premium grapes over the first few years of the next millennium.

Finally, other small rural industries can learn a great deal from the wine industry's experience about how to both generate and then accommodate to rapid supply growth. In particular, the projected acceleration in supply and consequent projected fall in prices is a sobering reminder of the need for high-quality and timely information on actual and intended plantings at home and abroad as an industry begins to expand in response to demand growth.

Accounting for Growth in Australia's Grape and Wine Industries, 1986 to 2003

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The Australian wine industry has expanded dramatically over the past dozen years. During the decade to 1996, wine production increased by 45 per cent. The composition of output also altered substantially, with premium output more than doubling (red more that white) while non-premium output declined slightly. Numerous factors have contributed to that dramatic growth and structural change. The first part of this paper seeks to quantify the relative importance of those various factors, both to help us project what might happen in the industry during the next few years (the second part of the present paper) and to help other industries identify potential sources of growth that they might exploit.

For both the historical (1986 to 1996) and the prospective (to 2003) growth accounting exercises, we use an economy-wide computable general equilibrium (CGE) model for Australia. This model, FEDSA-WINE, is described in Section 1. It separately distinguishes non-premium from premium red and premium white grapes and wine. The historical and prospective results are then reported in Sections 2 and 3, respectively. To keep the task manageable, we focus on the contributions of four factors in particular: export demand growth, domestic consumer taste changes, domestic consumer tax changes, and technological changes in the grape and wine industries. In doing so, macroeconomic changes such as in incomes and real exchange rates, as well as growth in other sectors of the economy, are taken into account in the CGE modeling of 1986 and 2003.

According to our results, around half the industry's premium output growth in the 1986-96 period is attributable to export demand growth. Domestic taste changes explain much of the rest for premium red wine, more than offsetting the dampening effect on domestic demand of

increased taxes on wine consumption. Income growth accounts for about one quarter of the increase in premium output, while input-saving technological changes have made positive contributions too. Looking forward, recent and intended vine plantings ensure wine output in 2003 will be about twice that of 1996. Drawing on the historical growth accounting exercise, our CGE model is used to examine how that vineyard expansion might affect grape and wine prices by 2003. Results suggest that even with continued strong export demand growth for premium wine, winegrape prices, and to a lesser extent wine prices, will fall substantially in real terms from their current very high levels, particularly for the premium segments of the industry. The paper concludes with suggestions of what is required to slow the decline in prices for premium grapes and wine, and mentions the potential for drawing lessons from the wine industry's growth experience for other small rural industries seeking to export their way to prosperity.

1. The FEDSA-WINE simulation model

To undertake these growth accounting exercises, use is made of a modified computable general equilibrium (CGE) model of the Australian economy. That model, known as FEDSA-WINE, is based on a two-region model developed by the South Australian Centre for Economic Studies and is a disaggregated form of the national ORANI model (an early version of which is fully documented in Dixon et al. (1982)). The FEDSA-WINE model thus has all the attributes and limitations of the ORANI comparative static CGE model, with the additional feature that three grape and three wine industries/product groups are disaggregated from other horticulture and other beverages, respectively (and South Australia is separated from the rest of Australia, although for brevity results in this paper are shown only for Australia as a whole). A description of the model can be found in Wittwer and Anderson (1998, Appendix A). The data base in FEDSA-WINE has been set at 1995-96, from which a backcast to 1985-86 and a forecast to 2002-03 are made (see below).

There are several reasons for analysing the grape and wine industries with a CGE model despite these industries currently accounting for less than 0.2 per cent of GDP. First, a CGE model was available for use.[1] Second, since~~Even though the export orientation of Australian~~

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[1] It was developed~~indeed,~~ for examining ~~GST~~tax reform options in an earlier study, where it was necessary to consider the effect on the whole economy of ~~tax reform~~the proposed move to a goods-and-services tax ~~on the~~

~~wine is increasing,~~ the domestic ~~consumption still~~ market ~~accounts~~ for ~~a large proportion~~the majority of sales, ~~(about 50 per cent in 1998, Table 6). This implies that~~ it is important to ~~estimate and forecast~~project domestic consumption formally, ~~considering~~taking into account changes in after-tax prices and~~,~~ income, in population, and ~~taste changes~~in preferences. ~~Similar~~Thirdly, the CGE model provide~~s~~d an appropriate framework for estimating export demand effects when there are ~~ile modeling observed~~ changes in the real exchange rate. And finally, by modeling growth in the rest of the economy, we are able to distinguish between factors specific to the grape and wine industries and more general factors that contribute to 'background' economic growth.

2. Accounting for growth historically

This section uses the FEDSA-WINE modeling framework to estimate the impacts of different effects on the wine industry in the decade of vintages to 1996. The estimates come from decomposing the effects of a historical simulation of the period. This is an alternative to comparative static analysis, in that it allows the modeller to account for influences outside the wine industry, including technological change in other industries, changes in the real exchange rate, and observed changes in total real household consumption in the period. In addition, the method captures the direct influences on industry growth usually undertaken with comparative static analysis, including growth in export demand for wine and changes in taxes on wine consumption. Given the lack of econometric estimates for the ever-changing grape and wine industries, the need simply to assume certain parameter values cannot be avoided. Notwithstanding this limitation, the economy-wide modeling approach ensures that all the behavioural reactions to changes in variables are taken into account. In this sense, the model is more than a sophisticated adding-up machine, because it demands internal consistency and market clearing as the various actors in the economy adjust to imposed shocks.

The historical data

~~whole economy, an~~as well as the~~d~~ feedback to wine production and consumption, rather than ~~model~~examine just grapes and wine in isolation (Wittwer and Anderson~~,~~ 1998).

Table 1 shows pertinent data for Australia in the two 3-year periods surrounding the 1986 and 1996 vintages, including total and annual average rates of growth in those variables over the decade between those two periods. At the macroeconomic level, income growth allowed Australia's aggregate real consumption of goods and services to rise 38 per cent over that decade. But consumption of wine fell by 2 per cent, despite the income growth and an adult population increase of 19 per cent. This is not unlike the trend in Western Europe, where consumption of both beer and wine have fallen substantially, partly for health reasons (PVGD 1997; Berger, Anderson and Stringer 1998). However, within the wine category, there has been a marked switch in consumption from non-premium to (especially red) premium wine, in Australia as elsewhere. Even more dramatic has been the boom in wine exports: Australia's exports of premium wine have grown more than ten-fold since the mid-1980s, raising the share of production exported from less than 5 per cent to more than 30 per cent. To accommodate a rapid increase in export demand, producers responded with an almost 80 per cent increase in plantings of premium wine grapes in the decade to 1996 -- or 150 per cent when the period is extended to 1998. Together with increases in yields per hectare, that area expansion has allowed the quantity of premium wine production to more than double. Meanwhile, substantial increases in ad valorem taxes on domestic wine consumption have encouraged a larger share of premium wine to be exported; and tariff reductions have contributed to increased imports of wine (especially non-premium, albeit from a very low base).

Modeling growth in reverse (backcasting)

The starting point for the historical simulation is the 1996 database. Due to the very large changes in prices, export volumes and output in the focus period, the decade was split for modeling convenience into three: 1986 to 1990, 1990 to 1993 and 1993 to 1996.[2] The closure, that is, the combination of endogenous and exogenous variables within the model, was altered to allow us to shock exogenously some variables that are usually treated as endogenous. These variables include the wine consumption and export changes shown in Table 1. In addition, shocks on variables that are generally exogenous capture the impacts of consumer tax changes and increased grape plantings. Total factor productivity growth in the grape and

wine industries was endogenised by ascribing observed changes to grape and wine industry employment, land usage and estimates of changes in industry capital stocks in the three periods. Total factor productivity growth for remaining industries in the economy was extrapolated from Dixon and Rimmer (1998), assuming that it was greatest in mining, followed by agriculture and manufactures.

Observed changes in Australia's macroeconomic variables including real aggregate consumption, real investment and the value of exports were imposed after the closure swaps. Changes in public spending and in the trade balance also were shocked using variables that are typically exogenous.

Decomposing changes in the grape and wine industries

Even though we report below the changes for the whole decade rather than for each sub-period, the decade in fact divides neatly into three sub-periods, each with its own features. The first, from 1986 to 1990, started with such gloomy prospects within the grape and wine industries that the South Australian and Commonwealth governments introduced a vine-pull scheme for a short time. But with the real exchange rate falling 30 per cent over the five years to 1986, a few large firms in the industry realised there were expanding market opportunities overseas so they began increasing exports, albeit from a low base. Then between 1990 to 1993, a global recession occurred and export demand growth slowed, causing export and domestic wine prices to fall. Domestic red wine consumption also did not grow during that recessionary sub-period. Between 1993 and 1996, however, further rapid growth in demand at home and abroad, at least for premium red wine and to a lesser extent premium white wine, resulted in grape growers experiencing price hikes to record highs. This in turn induced rapid vineyard expansion. Therefore, none of these sub-periods during the decade could be thought of as being in equilibrium. Around 1986, domestic market signals encouraged an exodus of resources from the industry, with only a few firms initially recognising the potential that a devaluation of the currency in the preceding four years offered for export growth. Then the recession of the early 1990s dampened the optimism that was building in the industry by the late 1980s, slowing the supply response to expanding export market opportunities. By 1996,

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[2] Shocks were ascribed to the model to depict the observed changes in simulating back one decade in these three steps, based on three-year averages surrounding 1986, 1990, 1993 and 1996. Three year averages help to smooth

vineyard plantings were still accelerating. Thus the decade commenced with the pulling of vines out of unprofitable vineyards, and ended with the high profits that were being made in established vineyards attracting funds to expand the existing area at an unprecedented rate.

The disequilibria were as follows. In the mid-1980s, grape growers would have been constrained from exiting the industry by the high costs of switching to another form of horticulture or agriculture, so an excess of capital prevailed in the industry, driving down rates of return. Due in part to the recession of the early 1990s, there was a considerable lag before grape growers and winemakers observed a significant grape price recovery, driven substantially by the increase in premium wine export demand. For some years growers may have perceived the recovery as sufficient only to maintain profits in the industry at its then present size, because substantial price rises were observed only after the slump in the early 1990s (Figure 1). Since it takes up to five years for a vineyard to produce a commercially viable crop, by the mid-1990s the grape supply expansion was only starting to catch up with the growth in demand.

Bearing in mind that both the beginning and end of the historical period were characterised by disequilibria, what can our model results tell us about the relative importance of the various factors contributing to the wine boom over that decade? This requires us to decompose the changes in the grape and wine industries, and to changes in the rest of the economy, over the focus period. The shocked variables that are usually endogenous were swapped to become exogenous. That is, the endogenous changes of the swapped variables in the historical simulation are imposed as exogenous shocks in the decomposition simulation. Tables 2 and 3 summarise the contributions of different supply, demand and technology effects to the total change in the six segments of the grape and wine industries between 1986 and 1996. The aim of the decomposition is to explain as much of the industries' growth as possible over that decade, while distinguishing effects specific to these industries from other economy-wide effects. Columns 1 to 4 of Tables 2 and 3 capture effects relatively specific to the grape and wine industries, and column 5 captures effects that impact on the economy at large. To help interpret the numbers, we begin with domestic changes in beverage preferences and the growth in demand for Australia's wine exports, before turning to wine consumer tax changes, technology changes and factors in other parts of the economy.

short-term fluctuations due to weather.

Domestic taste changes and growth in wine export demand

There were distinct differences in the market between premium red and premium white winegrapes and wine during the decade. Premium white grapes and wine started the decade with higher average prices than those for premium red varieties. Indeed, Chardonnay grape prices reached record levels in Australia in 1989. But a slight domestic taste swing against premium white wine prevailed during the decade (column 1 of Tables 2 and 3).

For premium red output, a combination of a substantial positive domestic taste swing, growth in overseas export demand, and a depressed market at the start of the decade resulted in large overall increases in red prices during the decade. The recession of the early 1990s, by delaying the supply response, contributed to the price hike of the mid-1990s.

Changing domestic preferences towards premium wine and increased export demand (columns 1 and 2 of Table 2) account for around two-thirds of all observed growth in premium red output (82 out of 119 per cent total growth for red wine). Increased export demand accounted for two fifths of the growth in the premium white grape and wine industries, with little effect from taste changes. These factors had a strong negative effect on non-premium output, however, reducing non-premium wine production by 27 per cent.[3]

Together with associated increases in red wine stocks, we would expect the two effects to account for all the increase in red wine prices not accounted for by the historical increase in wine taxes. Within the model, these two effects are responsible for raising the real consumer price of red wine by 35 per cent (columns 1 and 2 of Table 2).

Increases in Commonwealth wine taxes and State franchise fees

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[3] Growing export demand had both output-reducing and output-increasing effects on the non-premium segment of the market. While there was an observed increase in the volume of non-premium wine exports during the decade, the increasing profitability of the premium segment of the industry induced substitution from non-premium into premium production. Some grape growers did this in the most direct and rapid manner possible, by grafting premium varieties onto non-premium vinestocks. That effect of export demand growth for premium wine was therefore output-reducing for non-premium wine. But since export demand and the volume of non-premium wine exports also grew, a substantial increase in non-premium imports was needed to meet domestic demand.

The Commonwealth Government introduced a 10 per cent wholesale sales tax on wine in August 1984, which had increased to 31 per cent by August 1993, before settling at 26 per cent in July 1995 after several adjustments. In addition, there were modest increases in State Government franchise fees on retail alcohol sales. The impact of increased taxes on domestic consumption had a marked effect on exports of all three types of wine in terms of percentage changes from 1986 levels (column 3 of Table 2). But measured in terms of levels (column 3 of Table 3), the impact on exports is quite small. This is because output is reduced by the increase in consumption taxes. While such an increase diverts some sales from the domestic market to exports, the net effect on exports is small. For premium red wine, for example, changes in taxes account for little more than one fiftieth of total export growth (29 per cent out of 1,332 per cent, Table 2).

The largest impact of taxes has been on consumer prices. For premium red wine, for example, taxes contributed 12 out of the 47 per cent real increase in price, equivalent to over $1 per litre.[4]

Primary factor-saving technological changes in the grape and wine industries

During the decade, there was a marked increase in the proportion of winegrapes harvested mechanically. This decreased the labour-intensity of winegrape production, so there was no increase in employment in the industry between 1986 and 1993. But between 1993 and 1996, employment in vineyards increased by 30 per cent, as the vine area expanded. Since the land used for winegrapes in the decade to 1996 increased by 34 per cent, this might suggest little change over the decade in the labour intensity of winegrape production. But this would be a wrong interpretation, since much of the more recent employment growth has been associated with the construction of new vineyards that had still not yielded a commercial crop by 1996.

As for the wine industry, employment over the decade grew by 77 per cent according to ABS census data, while output grew by only 45 per cent. On the surface, this implies an increase in labour intensity in winemaking. However, premium wine production is substantially more labour-intensive than non-premium production. Winemakers, for example, pay most attention to premium produce even in wineries where the volume of non-premium wine is substantially

greater than the premium volume. Therefore, employment growth per unit of output simply reflects an increase in premium wine's share of total production.

Detailed capital data are not readily available. Hence capital usage changes had to be inferred for grape growing, partly from the area of grapes harvested. For all the grape and wine industries, we assume that changes in the rate of return on capital track changes in output prices. In this way we endogenise changes in capital usage.

In addition to the lack of data on changes in capital usage and to details of labour employment by wine type, our estimates of total factor productivity changes in the grape and wine industries are approximate for a number of other reasons too. For premium red wine, growth in wine stocks at the end of the decade (not captured in the historical version of the model) would imply larger output changes than modelled, resulting in an underestimate of total factor productivity growth. The converse applies for the non-premium grape and wine industries. Furthermore, wine is a highly differentiated product. Within the three grape and wine types, it is highly probable that there have been significant quality improvements from 1986 to 1996. By not capturing those quality improvements, we may overstate to some extent the impact of export demand growth and, for red wine, domestic taste changes on the industry, and understate the role of changing technology. Even so, our results suggest total factor productivity growth within the decade had a substantially larger influence on the industry than taxation increases.

Other sources of growth

Column 5 in Tables 2 and 3 captures the effects on the industries of influences in other parts of the Australian economy in the decade to 1996. These include increases in the total labour force, population, and aggregate real domestic spending (both public and private), real exchange rate changes, and smaller effects including technological growth in industries other than grapes and wine and cuts in import tariffs. These effects, which in the absence of other information may approximate the "expected" growth of the industry, account for less than one third of the total premium wine output increase in the period. General economic growth alleviated the effect on non-premium grape and wine output of the domestic taste switch away

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[4] Since the tax is ad valorem, the total real change is also endogenous to other factors affecting price. This explains why the percentage changes in consumer prices differ between wine types.

from non-premium wine to premium wines, and the overall decrease in per capita consumption associated with this switch.

3. Projecting to 2003

We can also use the FEDSA-WINE model to project the effects of the anticipated increase in supply of winegrapes and wine into the future. This entails the use of macroeconomic projections plus projections of what is likely to happen in the grape and wine industries themselves. We chose 2003 as the end of the projection period because that can capture the grape supply effect of known actual and intended plantings in the second half of the 1990s.

The method used in this section for projecting the effects of increased grape and wine supply is to impose exogenous increases in land and capital usage in the grape industries and exogenous increases in capital usage on the wine industry. These increases match the industry's projected increase in winegrape area, shown in Table 4. In addition, we impose total factor productivity gains on all industries in the model, and assume export demand growth and domestic taste changes continue as in the historical period 1986-96 but at a slower pace (Table 6).[5] We then vary the assumed real exchange rate change between 1998 and 2003 to observe how sensitive the grape and wine industries will be to that important variable. Specifically, the base case with no change in the real exchange rate is compared with a 10 per cent real depreciation. Finally, we compare the base case to a scenario in which the domestic consumer tax on premium wine is lowered from the present rate of 48 per cent to 16 per cent (which is still double the OECD average rate).[6]

The base case projection from 1998 to 2003

The base projection has domestic premium red wine consumption increasing from 53 Ml (megalitres) in 1998 to 95 Ml in 2003 (Table 7). In the same period, premium white wine consumption is projected to increase from 65 Ml to 90 Ml, with non-premium wine

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[5] The assumed export demand shifts between 1998 and 2003 are based on estimated shifts between 1990 and 1998. Since the volume of premium wine exports grew by around seven-fold in this period, we have scaled down the proportional shifts for forecasting, bearing in mind the massive recent expansion in premium winegrape vineyards abroad. A downwards adjustment also applies to assumed domestic taste changes.

[6] The tax on non-premium wine is left unchanged since at 48 per cent it already approximates twice the OECD average of 26 per cent (Berger and Anderson 1999, Table 2).

consumption increasing only slightly from 249 Ml to 267 Ml. The producer and consumer prices are projected to fall as early as 2000. This assumes that in 1998, industry prices were well above equilibrium levels and that they will move closer to equilibrium by 2003 with the substantial supply increase. Premium red grape prices are projected to fall from $1,606 to $1,106 per tonne (-31 per cent) between 1998 and 2003 (Table 7). That projected 2003 price approximates the real prices recorded during the 1994 vintage (Figure 1). Over the same period, premium white grape prices are projected to fall from $985 to $825 per tonne (-16 per cent), still higher than the real price recorded during the 1994 vintage.

These projected falls in grape prices are similar to those forecast by ABARE, who expect the real price of Riverland Chardonnay and Cabernet Sauvignon to fall by around one third between 1998 and 2003 (Shepherd 1998, Table 1). ABARE projects less growth in wine exports over those five years (an increase of about 200kt compared with our 300kt). A possible reason for the larger excess domestic supply in our modeling is that we assumed annual TFP growth is 1.0 per cent, approximating estimates from the historical simulations (Table 5). Our forecast domestic consumption also differs from ABARE, since it is based on thea demand function that depends on prices, income, population and taste changes. Had we used the taste changes estimated between 1986 and 1996, consumption would have been slightly lower than shown in Table 6. But between 1996 and 1998, there was a marked swing towards wine, with domestic consumers increasing per capita consumption of all wine types despite real prices increasing. Given this altered pattern, in forecasting to 2003, we have assumed that there is a slight taste swing towards premium white wine, and a weaker swing against non-premium wine, than in the decade to 1996.

Price falls are projected for as early as 2000 for premium winegrapes, given the substantial increase in supply between 1998 and 2000. Consumer prices for premium wines correspondingly fall, but by smaller proportions than grape prices. It is possible that the price downturn for wine could be delayed for another season or two beyond 2000, if the stockholding ratio falls less quickly than modelled.[7] The per litre price of premium red wine

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[7] We project an increase in premium red wine stocks from 364 Ml in 1998 to 631 Ml in 2003, which represents a decline in stocks as a proportion of annual production from 1.60 to 1.23.

falls from $13.87 to $12.22 (-12 per cent) and premium white wine from $11.31 to $10.59 (-6 per cent) in the five years to 2003 (Table 7).

Due to the rapid increase in premium red grape production between 1998 and 2003, the export supply of premium wine is projected to escalate in this period. Premium red wine exports increase from 77 Ml in 1998 to 328 Ml in 2003, while premium white wine exports increase from 74 Ml to 130 Ml, with little change in non-premium exports. But a different trend than projected in wine stocks could alter the outcome: for example, if premium red stocks accumulate at a more rapid rate than in our model, a smaller increase in their export volume would result.

Another possibility is that more premium winegrapes are used in non-premium wine production than we assume in our base case. This may arise if the supply of premium grapes by 2003 exceeds the processing, storage and marketing capacity of the premium industry. We project an increase in premium red wine production of 120 per cent between 1998 and 2003, compared with an overall increase of only 50 per cent for all wine. A shortage of premium processing and storage capacity may be one of the reasons for premium red winegrapes being diverted into non-premium wine production. Such an adjustment would impact on future returns to grape producers, due to the lower price of premium grapes used in non-premium wine production. Winemakers will be reluctant to make such a switch, however, as the fall in premium wine prices from increased premium supply is likely to be considerably smaller than the fall in wine prices associated with downgrading to non-premium wine.

Projecting from 1998 to 2003 with a real depreciation of 10 per cent.

A real depreciation of the Australian dollar of 10 per cent between 1998 and 2003 reduces projected growth in the domestic consumption of premium wine (Table 7). Premium red consumption reaches 91 Ml by 2003 instead of 95 Ml as in the constant real exchange rate case, while premium white consumption is 90 instead of 86 Ml and non-premium wine consumption is 267 instead of 263 Ml. A real depreciation encourages the wine industry to be more export-oriented. For example, premium red wine exports in 2003 are 28 Ml higher in this than in the base case, the difference increase being equal to almost half the total premium red exports for 1998. The real depreciation also reduces the decline in Australian dollar grape

prices brought about by the massive increase in the supply of premium winegrapes. Premium red grapes are $44 per tonne higher in this than in the base case, premium white grapes are $35 per tonne higher, and non-premium grapes are $36 per tonne higher (Table 7). Consumer prices for wine also are higher than in the base case. Premium red wine is $12.87 per litre, $0.65 higher than the base case, removing two-fifths of the base case price fall between 1998 and 2003. While production is higher by around 4 per cent for each wine type with the devaluation, much of the increase in exports is brought about through a smaller than otherwise build-up of premium red wine stocks (Table 7).[8]

Reducing the consumer tax on premium wine

Consumers of wine in Australia are taxed at a very high ad valorem rate of 48 per cent. This compares with an average consumer tax equivalent (CTE) rate for OECD countries of 8 per cent for premium wine and 26 per cent for non-premium wine, not counting VAT (Berger and Anderson 1999). The final scenario considered here is to project forward to 2003 as before except cutting the wine CTE to about double the OECD average. This involves a cut on premium wine tax to 16 per cent while not cutting the non-premium rate so that, in volumetric terms, the latter tax is about the same as for premium wine. With such a tax reform domestic consumption of premium wine increases from 95 Ml to 107 Ml for red wine, and from 90 Ml to 102 Ml for white wine.[9]

The impact on industry output is small, with the premium segment expanding by less than 0.5 per cent relative to the base case. This small change is due to our assumption that land in the winegrape industries and capital in all the winegrape and wine industries is the same in this as in the base scenario, leaving labour as the only variable factor within these industries. Importantly for producers, however, the volume of premium exports required to maintain the same total volume of sales as in the base case reduces significantly. Consumer prices drop significantly for premium wine, by over $1.50 per litre.

4. The future of the industry

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[8] The effects of a real appreciation essentially are equal and opposite those of a real depreciation. The wine industry would become less export-oriented, with an increase in domestic consumption and a decrease in exports. Grape prices would fall by more than in the base case, as would wine prices.

The Australian wine industry has experienced dramatic growth since the mid-1980s. The impetus for this growth has come from a significant move into export markets, stimulated by a 30 per cent decline in the Australian dollar's real exchange rate in the first half of the 1980s. In the mid-1980s, virtually all segments of the industry were domestically focussed but, by 1998, exports accounted for almost 30 per cent of all wine production. As modelled using FEDSA-WINE, an increase in export demand explains much of the industry's growth. This reflects an increasing emphasis on quality in the industry, sustained generic and brand marketing efforts that have greatly boosted Australia's image as a producer of good value-for-money wines overseas, and an autonomous switch by consumers both in Australia and elsewhere towards premium wine (driven in part by health considerations, especially for reds).

The recession of the early 1990s slowed the supply response of the Australian wine industry to growing export opportunities. Premium grape prices dropped in 1990 and 1991, and remained at a lower level for two more vintages before a steady increase in premium white grape prices and a rapid increase in premium red grape prices came with sustained export demand growth. Therefore, 1994 was the first vintage that was unambiguously encouraging for grape growers.

Annual plantings of premium winegrape varieties have accelerated dramatically since the mid-1990s, encouraged in part by new accelerated depreciation provisions in the income tax legislation. So large is the increase that as we move into the next millennium, a new challenge is confronting the industry: a potentially faster growth of supply than of demand for premium winegrapes. In that case premium grape prices on average, particularly red, will drop from the record-high levels of 1998, despite continuing growth in demand both in Australia and overseas. This is being anticipated by established grape growers, and most are likely to remain profitable at prices much lower than those of the late 1990s. The vulnerable growers are likely to be those who entered the industry in the late 1990s budgeting on high prices continuing into the future.

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[9] In per capita terms, in the 2003 base case, premium consumption is 4.8 litres for red wine and 4.5 litres for white wine. These levels increase to 5.4 litres and 5.2 litres, respectively, in the tax reform scenario.

A further concern is that the premium wine processing, storage and marketing capacity may not grow quickly enough to accommodate the increased premium winegrape supply projected for 2003. If this is so, the industry may not be able to process such grapes at an optimal time or in an optimal manner. A consequent diversion of premium red winegrapes into bulk wine production and sales would reduce the price paid for such grapes, and threaten the financial viability of individual growers. Recent entrants to the premium grapegrowing industry may be the most vulnerable, as established growers with long-term contracts are likely to receive priority in having their grapes processed into premium wine if the expected shortage of capacity in fact materializes.

For Australian consumers, the increasing supply of premium wine is ostensibly good news, with average retail prices likely to fall. But consumers of ultra-premium wine may find that the supply changes little or indeed that the prices of some products will rise to close the still-large gap between Australian producers' prices and their competitors' prices abroad. That is, relatively rare products may not decrease in price, even if continuing quality improvements ensure many lower and mid-range premium products become even better value for money than at present.

Two obvious ways to alleviate falls in premium grape prices present themselves. The first is an expansion in investments in the winery processing and storage capacity, beyond those already planned. The second, which is supplementary rather than a substitute for the first, is an expansion in investments in promotion of Australian premium wines, especially overseas. The changes in labelling and the new regional boundaries being formed in response to the European Union-Australian Wine Agreement provide scope for adding more precision to the targeting of such marketing efforts. Other reasons for a boost to these efforts are to offset the demand-dampening effects of the Asian financial crisis and the recent massive supply response of other premium wine-producing nations.

Two final points. Firstly, the Australian industry has experienced four previous major booms in the past 150 years, all of which have ended in 'busts' (Osmond and Anderson, 1998). While some of the features of the present boom are different from past booms (Osmond and Anderson 1998), an eventual 'bust' is inevitable unless there is a concerted marketing effort

to accommodate the forthcoming increase in supply of premium grapes over the first few years of the next millennium.

Secondly, other small rural industries can learn a great deal from the wine industry's experience about how to both generate and then accommodate to rapid supply growth. This is not the place to elaborate on those lessons, but the projected acceleration in supply and consequent projected fall in prices is a sobering reminder of the need for high-quality and timely information on actual and intended plantings at home and abroad as an industry begins to expand in response to demand growth.

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Table 1: Growth in the Australian grape and wine industries, vintages 1986 to 1996

Variable	1985-87[g]	1995-97[g]	Cumulative % change Over the decade	annual average % change (compound growth)
Population (>18 yrs, millions)	11.5	13.6	19	1.7
Population (total, millions)	16.3	18.3	12	1.2
Real aggregate consumption ($bn)[f]	220.7	303.9	38	3.3
Domestic wine consumption (Ml)[a,b]				
Premium red wine	22.1	38.5	74	5.7
Premium white wine	45.5	55.4	22	2.0
Non-premium wine	268.0	236.0	-12	-1.3
Wine, total	**335.6**	**329.9**	**-2**	**-0.2**
Wine production (Ml)[a]				
Premium red wine	69.7	158.7	128	8.6
Premium white wine	97.7	197.6	102	7.3
Non-premium wine	240.4	236.8	-2	-0.2
Wine, total	**407.9**	**593.1**	**45**	**3.8**
Wine exports (Ml)[a]				
Premium red wine	3.3	47.0	1324	30.4
Premium white wine	4.0	54.3	1258	29.8
Non-premium wine	8.8	31.3	256	13.5
Wine, total	**16.1**	**132.6**	**724**	**23.5**
Table grape exports (kt)	71.2	38.8	-46	-5.9
Wine imports (Ml)[a]	11.2	16.0	43	3.6
Producer prices($/tonne)[c,f]				
Premium red winegrapes	645	1,394	116	8.0
Premium white winegrapes	874	899	3	0.3
Non-premium winegrapes	289	392	36	3.1
Consumer prices($/litre)[c,f]				
Premium red wine	8.98	12.85	43	3.6
Premium white wine	8.83	10.71	21	1.9
Non-premium wine	3.54	3.53	0	0.0
Wine, total	**4.61**	**5.82**	**26**	**2.4**
Land bearing winegrapes ('000 ha)[a]				
Premium red grapes	10.1	18.0	78	5.9
Premium white grapes	10.7	18.9	77	5.9
Non-premium grapes	18.4	15.7	-15	-1.6
Winegrapes, total	**39.2**	**52.6**	**34**	**3.0**
Commonwealth consumer taxes [b,d]	10%	26%	..	..
State wine consumer taxes [d]	9%	15%	..	..
Import tariff [e]	22%	5%	..	..
Employment				
Grape growing	5,760	7,420	29	2.6
Wine production	4,688	8,328	78	5.9

Sources and notes for Table 1:

a Osmond and Anderson (1998, Table 10)

b Unpublished data from the Winemakers' Federation of Australia (WFA)

c Authors' calculations based on unpublished WFA data and PISA (1997) for grape prices

d Estimated using Commonwealth Grants Commission data, expressed as an ad valorem equivalent at the wholesale level

e unpublished data from the Industry Commission

f All values are real, in 1995-96 dollars

g Three-year annual averages around the 1986 and 1996 vintages

Table 2: Decomposition of changes in the grape and wine industries (cumulative % change from 1985-87 to 1995-97)

	(1) Domestic taste changes, alcohol	(2) Growth in export demand for wine	(3) Increases in taxes on wine consm.	(4) Primary factor-saving tech. change, grapes and wine	(5) Remaining growth	Total (sum of cols. 1 to 5)
Output volume						
Premium red grapes	10	60	-3	14	22	103
Premium white grapes	-2	22	-3	14	22	53
Non-premium grapes	-8	-21	-1	37	13	19
Premium red wine	14	68	-4	17	23	119
Premium white wine	-2	23	-3	14	22	55
Non-premium wine	-24	-3	-4	3	20	-8
Export volume						
Premium red wine	-51	1,270	29	92	-6	1,334
Premium white wine	124	916	33	161	-7	1,226
Non-premium wine	69	176	22	30	-38	259
Real producer price						
Premium red grapes	37	128	-3	-24	-3	136
Premium white grapes	-4	26	-2	-6	-10	3
Non-premium grapes	-3	70	-5	-20	-7	36
Real consumer price						
Premium red wine	6	29	20	-7	0	47
Premium white wine	-3	10	11	-5	-2	11
Non-premium wine	-21	11	17	-7	1	2
Consumption volume						
Premium red wine	54	-26	-10	8	48	74
Premium white wine	-15	-8	-11	5	50	22
Non-premium wine	-31	-3	-4	2	17	-18

a Changes in aggregate household consumption, population, the real exchange rate, import tariffs and technology in other industries.
Source: Authors' FEDSA-WINE model results.

Table 3: Decomposition of changes in the grape and wine industries (unit change from 1985-87 to 1995-97)

	Unit	(1) Domestic taste changes, alcohol	(2) Growth in export demand for wine	(3) Increases in taxes on wine consm.	(4) Primary factor-saving tech. change, grapes and wine	(5) Remaining growth	Total (sum of cols. 1 to 5)
Output volume							
Premium red grapes	kt	9	55	-3	13	20	95
Premium white grapes	kt	-3	29	-4	18	29	69
Non-premium grapes	kt	-27	-69	-2	120	40	62
Premium red wine	Ml	10	48	-3	12	16	83
Premium white wine	Ml	-2	22	-3	14	22	53
Non-premium wine	Ml	-58	-7	-9	8	48	-18
Export volume							
Premium red wine	Ml	-2	42	1	3	0	44
Premium white wine	Ml	5	40	1	7	0	54
Non-premium wine	Ml	6	15	2	3	-3	23
Real producer price							
Premium red grapes	$/t	241	823	-16	-152	-17	878
Premium white grapes	$/t	-37	224	-21	-53	-89	25
Non-premium grapes	$/t	-10	203	-13	-58	-19	103
Real consumer price							
Premium red wine	$/l	0.54	2.61	1.75	-0.67	-0.02	4.21
Premium white wine	$/l	-0.26	0.94	1.04	-0.51	-0.17	1.04
Non-premium wine	$/l	-0.58	0.31	0.48	-0.19	0.04	0.06
Consumption volume							
Premium red wine	Ml	12	-6	-2	2	11	16
Premium white wine	Ml	-7	-4	-5	2	23	10
Non-premium wine	Ml	-82	-8	-12	6	47	-50

a Changes in aggregate household consumption, population, real exchange rate, import tariffs and technology in other industries.

Source: Authors' FEDSA-WINE model results.

Table 4: Growth assumptions for projections, Australia, 1998 to 2003

Exogenous Variables	Actual 1998	Projected for 2000	Projected for 2003	% change, 1998 to 2003
Population (total)	18.7	19.2	19.8	8.2
Real agg. consumption (billions, 1996 dollars)	316.6	332.4	349.1	10.3
Land bearing winegrapes (hectares)				
Red premium	26,500	39,200	57,800	118.1
White premium	24,800	29,500	32,000	29.0
Non-premium	15,300	15,000	14,500	-5.2
Total	**66,600**	**83,700**	**104,300**	**56.6**

Sources: Australian Wine and Brandy Corporation (unpublished estimates);
ABS gopher://trent.abs.gov.au

Table 5: Changes to total factor productivity (TFP), wine export demand and domestic wine preferences, 1986-96, 1996-98 and 1998-2003 (% per annum)

	1986-96	1996-98	1998-2003
TFP growth			
Red premium winegrapes	*2.4*	1.0	1.0
White premium winegrapes	*1.5*	1.0	1.0
Non-premium winegrapes	*0.6*	1.0	1.0
Red premium wine	*1.8*	1.0	1.0
White premium wine	*0.9*	1.0	1.0
Non-premium wine	*0.7*	1.0	1.0
Other agriculture (average)	2.0	2.0	2.0
Mining (average)	3.0	2.5	2.5
Manufacturing (average)	0.7	1.0	1.0
Services (average)	0.4	0.5	0.5
Export demand growth			
Red premium wine	*14.5*	*8.0*	4.2
White premium wine	*6.3*	*6.0*	3.4
Non-premium wine	*8.1*	*2.7*	2.1
Domestic taste change			
Red premium wine	*7.2*	*17.5*	7.9
White premium wine	*-1.2*	*6.0*	2.3
Non-premium wine	*-3.9*	*0.7*	-0.7

Source: Italicised numbers are estimated using the historical simulations of the FEDSA-WINE model; other numbers are exogenously imposed as described in the text, except for extrapolations from Dixon and Rimmer (1998) for mining, manufacturing and services and from Knopke, Strappazzon and Mullen (1995) for other agriculture.

Table 6: Projected growth in the Australian grape and wine industries, vintages 1996 to 2003[a]

Endogenous Variables	1996 actual	1998 actual	% 1996-1998	Base 2000	% 1998-2000	Base 2003	% 2000-2003
Domestic consumption (Ml)							
Red premium wine	38.5	53.4	*38.7*	67.4	*26.3*	95.1	*41.0*
White premium wine	55.4	65.0	*17.3*	73.2	*12.6*	89.9	*22.8*
Non-premium wine	236.0	248.6	*5.3*	253.2	*1.9*	266.6	*5.3*
Wine, total	**329.9**	**367.0**	***11.2***	**393.9**	***7.3***	**451.6**	***14.6***
Production (Ml)							
Red premium wine	158.7	227.0	*43.0*	331.3	*46.0*	512.5	*54.7*
White premium wine	197.6	240.0	*21.5*	295.5	*23.1*	336.0	*13.7*
Non-premium wine	236.8	210.0	*-11.3*	215.4	*2.6*	219.3	*1.8*
Wine, total	**593.1**	**677.0**	***14.1***	**842.3**	***24.4***	**1067.8**	***26.8***
Wine exports (Ml)							
Red premium wine	47.0	77.4	*64.7*	171.2	*121.2*	328.2	*91.7*
White premium wine	54.3	74.1	*36.5*	108.9	*47.0*	130.3	*19.6*
Non-premium wine	31.3	40.9	*30.7*	47.6	*16.5*	40.8	*-14.4*
Wine, total	**132.6**	**192.4**	***45.1***	**327.8**	***70.4***	**499.3**	***52.3***
Table grape exports(kt)	38.8	39.5	*1.8*	46.3	*17.2*	54.2	*17.2*
Wine imports (Ml)							
Red premium wine	8.1	9.1	*12.3*	10.8	*18.7*	12.9	*19.2*
White premium wine	3.1	4.7	*51.6*	5.1	*8.6*	6.0	*16.7*
Non-premium wine	4.5	11.2	*148.9*	11.7	*4.4*	12.7	*8.3*
Winegrape prices ($/tonne)							
Red premium grapes	1,394	1,606	*15.2*	1,359	*-15.4*	1,106	*-18.6*
White premium grapes	899	985	*9.6*	890	*-9.7*	825	*-7.2*
Non-premium grapes	392	381	*-2.8*	385	*0.9*	387	*0.7*
Wine consumer prices ($/litre)							
Red premium wine	12.85	13.87	*8.0*	13.62	*-1.8*	12.22	*-10.3*
White premium wine	10.71	11.31	*5.6*	11.19	*-1.0*	10.59	*-5.4*
Non-premium wine	3.53	3.68	*4.3*	3.71	*1.0*	3.62	*-2.6*
Wine stocks (Ml)							
Red premium wine	266.0	364.0	*36.8*	457.1	*25.6*	604.8	*32.3*
White premium wine	365.0	386.0	*5.8*	393.2	*1.9*	391.8	*-0.4*
Non-premium wine	152.0	150.0	*-1.3*	135.5	*-9.7*	113.6	*-16.2*

a Assuming no change in the real exchange rate between 1998 and 2003. 1996 refers to the average of the three vintages, 1995 to 1997.

Source: Authors' FEDSA-WINE projections; ABS catalogue no. 8504.0.

Table 7: Projected scenarios for 2003 with differing exchange rate and tax assumptions

| Endogenous Variables	1998 actual	Base 2003 (1)[a]	2003 (2)[a]	(2)-(1)	2003 (3)[a]	(3)-(1)
Domestic consumption Ml						
Red premium wine	53.4	95.1	91.1	-3.9	107.1	12.0
White premium wine	65.0	89.9	86.1	-3.8	102.1	12.2
Non-premium wine	248.6	266.6	262.6	-4.0	266.5	-0.1
Wine, total	**367.0**	**451.6**	**439.9**	**-11.7**	**475.7**	**24.1**
Production (Ml)						
Red premium wine	227.0	512.5	531.4	18.8	514.6	2.1
White premium wine	240.0	336.0	348.7	12.7	337.0	1.0
Non-premium wine	210.0	219.3	222.9	3.6	219.2	-0.1
Wine, total	**677.0**	**1067.8**	**1102.9**	**35.1**	**1070.9**	**3.1**
Wine exports (Ml)						
Red premium wine	77.4	328.2	356.6	28.4	310.7	-17.5
White premium wine	74.1	130.3	144.1	13.9	122.9	-7.4
Non-premium wine	40.9	40.8	54.8	14.0	40.8	0.0
Wine, total	**192.4**	**499.3**	**555.5**	**56.3**	**474.3**	**-25.0**
Table grape exports (kt)	39.5	54.2	65.8	11.6	54.3	0.1
Wine imports (Ml)						
Red premium wine	9.1	12.9	12.2	-0.7	14.6	1.7
White premium wine	4.7	6.0	5.7	-0.3	6.8	0.8
Non-premium wine	11.2	12.7	11.9	-0.8	12.6	-0.1
Winegrape prices($/tonne)						
Red premium grapes	1,606	1,106	1,150	44	1114	8
White premium grapes	985	825	860	35	830	5
Non-premium grapes	381	387	423	36	388	1
Wine consumer prices($/l)						
Red premium wine	13.87	12.22	12.87	0.65	10.46	-1.76
White premium wine	11.31	10.59	11.19	0.60	9.03	-1.56
Non-premium wine	3.68	3.62	3.75	0.13	3.62	0.00
Wine stocks (Ml)						
Red premium wine	364.0	604.8	560.0	-40.8	601.1	-3.7
White premium wine	386.0	391.8	457.2	-34.6	388.0	-3.8
Non-premium wine	150.0	113.6	109.7	-3.9	116.4	2.8

a (1) Base case (including no change in the real exchange rate, 1998 to 2003), as in Table 6.
  (2) Real depreciation of 10 per cent between 1998 and 2003.
  (3) The consumer tax rate for premium wine is reduced from the current 48% to 16% (the average for OECD countries), while the non-premium wine remains unchanged at 48% (which also approximates the OECD average for non-premium wine, and is about the same tax rate in volumetric terms as is the 16% tax on premium wine).
Source: Authors' FEDSA-WINE projections; ABS catalogue no. 8504.0.

Figure 1: Real wine grape prices, 1989 to 1998 (expressed in 1996 Australian dollars)

$ per tonne

Premium red grapes

Premium white grapes

Non-premium wine grapes
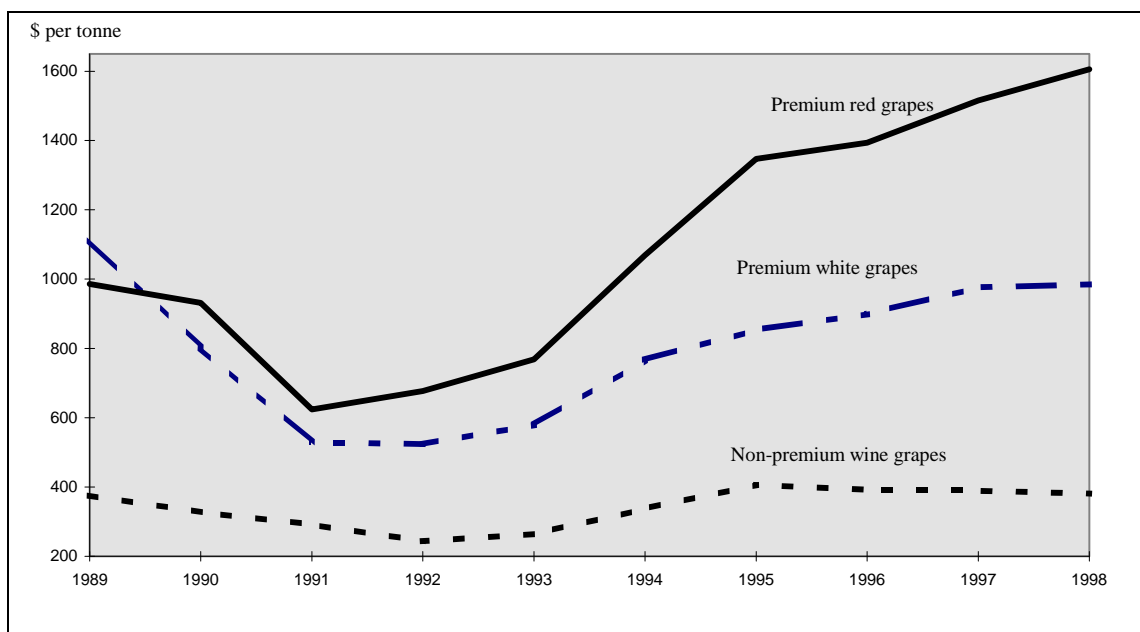
Source: Based on Australian Wine and Brandy Corporation data.

Appendix A: Details of the FEDSA-WINE model

The FEDSA-WINE model, a version of the FEDERAL-SA model housed at the South Australian Centre for Economic Studies, is based on the ORANI model of the Australian economy but has been modified in four important ways.[10] First, it disaggregates 'other agriculture' into premium red wine grapes, premium white wine grapes, non-premium grapes, and other agriculture, and also disaggregates beverages into premium red wine, premium white wine, non-premium wine, beer, spirits, and soft drinks. Second, in the forward projections version of the model, a wine stocks module has been added to the model. Third, it separates South Australia from the rest of Australia, based on the methodology developed by Madden (1990). That potentially is helpful in examining the wine industry because half that industry is located in South Australia where the proportions of grapes and wine that are premium quality are well above that for the rest of Australia (an advantage not exploited in the present paper). Fourth, in order to project the initial database to other years, modifications have been made to the macroeconomic equations within the model. This allows observed changes in real aggregate consumption, investment and trade in an historical simulation, or the forecasts of other agencies in a forward projection, to be imposed on the model. The model's data base, is derived from 1995-96 national accounts, manufacturing and other census data, and trade data from the ABS, and tax data from ABS and other various sources.

The theory incorporated in the model has microeconomic foundations similar to that of the ORANI model, described in Dixon et al. (1982) and Madden (1990). We have modified the model to include tax shifters in production, investment and consumption.[11] and to capture the elements of GDP on the income side

FEDSA-WINE contains 293 industries producing 293 commodities, including premium red wine grapes, premium white wine grapes and non-premium grapes among the agricultural industries, and premium red wine, premium white wine, non-premium wine, beer and spirits among the manufacturing industries. The grape and wine industries

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[10] See Dixon et al. (1982) for an early description of ORANI. FEDSA-WINE uses GEMPACK software (Harrison and Pearson 1994a). The method of generating model solutions is described in Harrison and Pearson (1994b).

[11] These tax shifters are expressed as percentage change in power of the tax. If the initial tax rate is 20 per cent, the power of the tax is 1.2. If the tax rate is increased to 32 per cent, the tax shift is $100*(1.32-1.20)/1.20 = 10$. The power of the tax form allows to tax rate to pass through zero.

~~are multiproduct in the model, with scope in long run simulations for transformation among these industries from one product to another in response to changing relative prices.~~ We treat each of the three wine industries as export oriented. The absence of econometric estimates of demand elasticities means assumed values must be used. In the present version export demand elasticities of -8~~5~~.0 have been imposed on each of the wine commodities~~and 10.0 respectively, reflecting a higher degree of product differentiation for red wine~~. This reflects the small market assumption, coupled with a degree of product differentiation (although for practical purposes this differs little from -20, the usual elasticity within the model for commodities with a small share of world trade).

Any split between premium and non-premium grape varieties and wines is bound to be somewhat arbitrary. We define premium white winegrape varieties <u>to</u> include Chardonnay, Riesling, Sauvignon Blanc, Semillon and Chenin Blanc (but not Colombard). Premium red winegrape varieties are defined to include Cabernet Sauvignon, Cabernet Franc, Pinot Noir and Ruby Cabernet in all regions. In regions of South Australia other than the Riverland, all Shiraz production is included. Riverland Shiraz was split half and half between the premium and non-premium categories. This was necessary, given the wide dispersion of Shiraz prices, from $220 to $1,275 per tonne in the Riverland, which was near both the high and low prices for all grape varieties produced in the region in 1995-96. Premium wine is distinguished from non-premium by its container: premium is defined to include only wines sold in bottles of no more than one litre. Since their volumes are small, for simplicity we have put all fortified wines in the non-premium category, and all sparkling wines in the premium white category.

Within the database of FEDSA-WINE, premium red and premium white winegrapes are sold to the respective premium wine industries in Australia. Premium red wine is produced exclusively from premium red grapes. A small proportion of premium white wine is produced using premium red grapes, while non-premium wine is produced mostly but not exclusively from non-premium grapes. Non-premium grapes, in addition to being an input to the non-premium wine industry, are sold to consumers or exported as either table grapes or dried grapes.

Wine has various sale modes. Most wine is sold either to domestic consumers or exported. The remainder is sold as either own-inputs or inputs to the spirit part of the

industry. Spirit in turn is sold as an input to the non-premium wine industry for the production of fortified wines, classified here as part of the non-premium wine segment.

Land allocation to each agricultural industry is exogenous within FEDSA-WINE. Capital and labour are both mobile between industries in the long run, although labour is constrained at the national level. The mobility of all primary factors will approximate the effects of allowing transformation of outputs in the grape industries.

The household demand function of the model follows the Stone-Geary form. The restrictions of this demand system result in generally low and negative cross-price elasticities across commodities. While Meagher, Parmenter, Rimmer and Clements (1985) describe a method of imposing estimates of a subset of own-price and cross-price elasticities of demand on a larger demand system in ORANI-type models, we know of no cross-price estimates which include wine disaggregated into three types. Furthermore, exogenous taste changes appear to exert a much larger influence on consumption than cross-price effects.[12]

The elasticities adopted, which are drawn from a range of econometric studies including Clements and Selvanathan (1991) but constrained somewhat by the symmetry requirements of the demand system chosen, are reported in Table A13. We assume that existing estimates of wine elasticities apply to non-premium wine, which in the historical period of estimation would have accounted for most wine consumption. We assume that premium wine is more income elastic than non-premium wine, and consequently impose higher income and own-price elasticities on premium wine in the absence of estimates.

Constant returns to scale are assumed in FEDSA-WINE. We recognise that industry growth and welfare benefits in some scenarios would be larger were we to assume increasing returns to scale, some of which may be captured in the historical simulation in estimating technological change.

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[12] Per capita consumption of red wine more than doubled between 1986 and 1998 despite prices surging as domestic and foreign demand grew while, with little change in the real retail price, corresponding non-premium wine consumption declined by 20 per cent.

Table A1: Beverage expenditure and price elasticities in FEDSA-WINE, Australia

	Income	Beer price	White wine price	Red wine price	Non-premium wine price	Spirits price
			Elasticity with respect to change in:			
Beer	0.782	-0.439	-0.001	0.000	-0.002	..
White wine	1.352	-0.017	-0.744	-0.001	-0.003	..
Red wine	1.407	-0.018	-0.001	-0.774	-0.003	..
Bulk wine	0.666	-0.008	..	0.000	-0.368	..
Spirits	1.723	-0.022	-0.001	-0.001	-0.004	-0.947

.. Between -0.001 and 0