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Modelling the World Wine Market to 2005: Impacts of Structural and Policy Changes

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Adelaide University
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ABSTRACT

Modelling the World Wine Market to 2005: Impacts of Structural and Policy Changes

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This paper addresses the question: What will the global wine market look like by 2005, when premium wine from Australian and other New World plantings will be ready to market? It does so using a newly developed World Multisectoral Wine Model which distinguishes premium from non-premium grapes and wine. After describing the model, we present results of projecting it from 1999 to 2005 to estimate the impact of known winegrape plantings of the late 1990s on producer and consumer prices in different regions, without and then with additional effective market promotion by Australia. Using the latter 2005 scenario as the base, we then examine in turn the effects on the global market of a strengthening of the US dollar, of a spread of Pierce's Disease in California, of a European trade policy response to the growth in premium wine exports from the New World, and of a reduction in wholesale and retail margins on beverage wines (thanks to expanding supermarket and internet sales). Production, trade and welfare results are provided for ten regions spanning the world.

Key words: wine, grapes, global wine modelling

JEL codes: C53, F11, F17, Q13

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Modelling the World Wine Market to 2005: Impacts of Structural and Policy Changes

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The world wine market is the subject of increasing interest to Australian and other New World wine producers as their national outputs and export orientation increase. Some fear that, with world wine consumption declining slightly while output is rising, the industry is vulnerable to a decline in export prices. However, despite per capita consumption declining in a number of significant wine-consuming nations in the decade to the mid-1990s, total consumption is still increasing in many other countries, including Australia; and the demand for premium wine has been outstripping supply growth, as reflected in rising unit values of bottled wine exports. It is only demand for non-premium wine that is falling globally, and that has been matched by steady falls in the production of non-premium wine. Hence any assessment of future prospects needs to distinguish between premium and non-premium segments of the world's wine markets.

New World producers account for most of the global growth in premium wine exports in the 1990s. Australia is the leader in terms of export volumes among these producers, but Argentina, Chile, New Zealand, South Africa and the United States also are experiencing rapid export growth (Anderson and Berger 1999). Winegrape plantings in these nations in the latter 1990s will translate into a substantial increase in the premium wine supply of New World producers in first few years of the new millennium.

The present paper addresses the question: what will the global wine market look like by 2005, when premium wine from the new plantings will be ready to market? To address that question, use is made of a new World Multisectoral Wine Model (WMWM). Within the model there are two types of grapes (premium winegrapes and multipurpose grapes) and three types of wine: premium, non-premium and non-beverage (i.e., for distillation or industrial use). This disaggregation within the model is the minimum necessary to deal with the issue of wine quality in different markets. Any further disaggregation awaits better data.

After presenting brief details of the model in the next section, results of five model simulations are discussed. In the first simulation, we project the model from 1999 to 2005 to estimate the impact of known winegrape plantings of the late 1990s on producer and consumer prices in different regions assuming no other shocks. Second, we repeat the first simulation but assume there has been additional effective market promotion by Australia, as called for in the industry's wine marketing strategy released in November 2000 (WFA and AWBC 2000). Using that revised 2005 scenario as the base year, we then examine in turn the effects on the global market of a strengthening of the US dollar, a spread of Pierce's Disease in California, European trade policy responses to the growth in premium wine exports from the New World, and reduced trading margins (with the growth of supermarket and internet-based sales). The final section summarizes the conclusions drawn from those structural and policy simulations and suggests areas for further simulation research and for improving the model's database (detailed in Appendices B and C).

Description of the WMWM model

WMWM is based on perfectly competitive microeconomic theory. As detailed in Appendix A, in each regional market supplies and demands reflect utility- and profit-maximising behaviour, with supplies equalling demands globally for each grape and wine product. Competitive prices are set equal to unit costs. While the model is multicommodity it is partial equilibrium in the sense that the prices of intermediate inputs, other than grapes used in production of wine, are taken as given.

On the demand side, households consume “other” products in addition to grapes and wine, where “other” is a composite of all non-wine expenditures. WMWM includes the theory of household demand based on the Stone-Geary utility function. A consumption function allows the user to tie changes in household expenditure to changes in income. The comparative static welfare calculation in the model, assuming constant preferences, is based on that utility function.

Importantly, each region’s supply is differentiated from the wine of each other region, so no region’s domestically produced wine product is a perfect substitute for wine imported from other regions.

On the supply side, the model assumes that most factors used in grape and wine production are fixed. This is reasonable for the medium term, given the large fixed costs and partly irreversible nature of vineyard and winery investments. Labour is a mobile factor within each region but human capital is fixed, and all factors are assumed to be immobile internationally.[1]

Each industry within the model uses intermediate goods that, together with a primary factor composite, are proportional to total output for a given production technology. The degree of mobility in the version of the model used here implies that in response to external shocks, most comparative static adjustments are through price (including changes in factor rewards) rather than output changes.

Product and regional disaggregation in the WMWM model

The database of WMWM in its present form includes six intermediate input commodities (chemicals, water, premium grapes, multipurpose grapes, non-premium wine, and other) and five endogenous outputs (premium winegrapes, multipurpose grapes, premium wine, non-premium wine and non-beverage wine).

The model divides the world into ten regions:[2] Western European wine Exporters (WEE), United Kingdom (UK), Germany (GER), Rest of Western Europe (OWE), Central & Eastern Europe (CEE), United States & Canada (USC), Australia (AUS), New Zealand

[1] In specific scenarios, we could alter the assumptions concerning international factor mobility, for example, by allowing wine industry human capital to be partly mobile between regions.
[2] The Berger et al. data compilations provide details for 39 regions for wine as a whole. As better data become available to make the premium/non-premium split easier, so further regional disaggregation will be possible.

(NZ), Other Southern Hemisphere wine Exporters (OSE), and the Rest of the World (ROW). The present choice of aggregation requires further comment. Western European Exporters (France, Italy, Portugal and Spain) are the largest wine producers in the world and, together with other Western European nations, also the largest consumers, accounting for roughly half the global wine market. The United Kingdom is treated separately because of its importance as a destination for New World wine, and Germany because it is the world's largest wine-importing country. Four of the regions, Australia, New Zealand, United States & Canada, and Other Southern Hemisphere Exporters (Argentina, Brazil, Chile, Uruguay and South Africa) experienced rapid export growth in the 1990s and now account for more than one-quarter of world production and exports. North America is an exception among New World regions, in that most sales growth is likely to be domestic rather than exports. The Rest of the World accounted for over 20 per cent of global grape production in the late 1990s but made only 4 per cent of the world's wine (FAO 2000). This group includes a number of nations with sizeable Moslem populations who consume little alcohol.

Given the importance we attach to distinguishing between the expanding premium and shrinking non-premium segments of the world wine market, a crucial part of database preparation was to estimate this split. Appendix B discusses this and other issues associated with putting together the 1999 data, which is the base from which the model projects forward the world wine market to 2005 (see below). Both the 1999 and the 2005 databases are summarized in the Tables of Appendix C.

Elasticities in the WMWM model

We impose Armington (1969) elasticities of substitution in comsumption between domestic and imported wine of 8.0, higher than for beverages within the GTAP database because of greater possibilities for substitution the more disaggregated a product category. For substitution between different sources of wine imports, we chose 16.0.

The expenditure elasticities in the initial database are 1.2 for premium wine and 0.6 for non-premium, based on estimates for Australia (CIE 1995). The Frisch parameter is initially –1.82 in Australia, the European nations and USC, and a slightly larger (absolute) value elsewhere, reflecting the latter's lower per capita incomes.

On the supply side, in which industry-specific factors are exogenous, the elasticity of substitution between primary factors is set at 0.5. Were we to allow for endogeneity of primary factors other than labour, supply within the model would be more price-responsive.

As better parameter estimates for the wine market become available, we can readily fit them into the model or (on the supply side) alter the theory of the model. For the time being, the GEMPACK software allows us to undertake systematic sensitivity analysis to track the influence of parameter choice (and policy uncertainty) on modelled outcomes (Arndt and Pearson 1996).

Projecting the WMWM database to 2005

Australia's grape growers planted unprecedented areas to premium winegrapes in the late 1990s. Other New World producers also accelerated plantings then, although to a lesser extent. These will translate into substantially increased winegrape supplies by the early years of the new millennium and, after allowing for lags associated with wine stockholding, a much larger volume of sales by 2005. This section analyses the projected effects of these expected supply increases, and of assumed trends in demand, on the global wine market by 2005.

Aggregate consumption growth, population growth and total factor productivity growth for wine manufacturing in each region have been adapted from that assumed for manufacturing as a whole by Anderson and Strutt (1999) and Hertel, Anderson, Francois and Martin (2001). For the primary activity of winegrape production, we assume a small decrease in total factor productivity as measured for Australia, because growers are seeking to decrease yields and chemical and water application in order to increase winegrape quality -- for which growers will be rewarded in the form of effective demand growth, since we also assume a continuation of the movement in consumer preferences away from non-premium and towards premium wines.[3] We also assume that there is a preference swing in Germany towards imported wines, due to growing domestic preferences for premium red wine (not produced in Germany) over premium white wine. Growth in primary factor use is based on available plantings data. We assume that the wine industry attracts an accommodating increase in other factor supplies to match the new plantings, and that there are no changes in consumer or import taxes on wine (to be relaxed later for Europe).

In addition to this first base case, an alternative base scenario is presented in which we assume that, between 1999 and 2005, consumers show an increasing preference for Australian wines over those from other regions in response to the major marketing strategy launched by the Australian industry in November 2000 (WFA and AEC 2000).

That alternative scenario is then taken as the base to examine the effects of: (i) a sustained appreciation of the U.S. dollar against other currencies relative to its 1999 value (as occurred in 2000); (ii) a prolonged outbreak of Pierce's disease in California's vineyards that reduces the USC crush of premium winegrapes by 10 per cent; and (iii) a raising in Europe of its barriers to premium wine imports from the New World.

Table 1 shows the key growth assumptions in projecting the model from 1999 to 2005. Plantings data (fixed capital in grape production) are speculative to a degree, being based on actual data only for Australia, the United States and New Zealand, with the assumption of an intermediate growth rate for other Southern Hemisphere producers and a slower rate for Europe (ABS 1999; WINZ 2000; WIC 2000).

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[3] In the late 1990s, growers in Australia and elsewhere received very high prices for winegrapes, with origin often mattering less than variety (Wittwer 2000; PISA 1996; PGIBSA 2000). Rapid plantings will eventually cause the premiums paid in response to winegrape shortages to be replaced by higher premiums for quality. With the increase in winegrape supply, growers will find it more difficult to market low quality, high yielding grapes.

Tables 2 and 3 show the effects on producer prices and output volumes of the projected changes from 1999 to 2005 first without Australia's marketing drive (top half), and then with that marketing drive to boost "Brand Australia" (bottom half). In terms of producer prices and, by implication, returns earned by industry-specific capital, the expected fall in premium grape and wine prices in the New World is evident in the upper part of Table 2. It is largest for Australia where output growth is expected to be largest (123 per cent for premium wine over the six years to 2005 – Table 3). Recall, however, that even though returns in the New World fall, they are doing so from a relatively high base in 1999 and so need not imply a crisis for the Australian industry, as the massive increase in plantings in the late 1990s was a consequence of unprecedented returns in this period. Such declines may indicate no more than a movement back towards rates of return earned in other industries.[4]

The 12-15 per cent drops in grape and wine prices for Australian producers (in constant US dollars) all but disappear in the alternative base scenario in which Australia is assumed to effectively promote "Brand Australia" over the next few years, as proposed by the Winemakers' Federation of Australia and the Australian Wine and Brandy Corporation (WFA and AWBC 2000). To our knowledge, no other country is planning to match this aggressive marketing effort.[5] In this alternative version of the 2005 base projection, we assume that additional promotion causes a further taste swing towards Australian premium wine and away from that of other foreign suppliers of 10 per cent in the UK, German, OWE and USC markets. Notice from the lower part of Table 2 that in addition to virtually eliminating the price drop in Scenario 1 for Australian producers, that marketing strategy reduces slightly the price fall for other Southern hemisphere exporters but exacerbates it for US producers whose products are substitutes for Australian premium wine in North American markets.

Assuming a continuing global swing towards premium wines, coupled with a limited increase in European supply, the price results in Table 2 imply better times may be ahead for European producers. However, two caveats accompany this modelled outcome. It is possible that the European Community will remove CAP subsidies on wine distilled for industrial purposes, thereby lowering returns to non-premium producers. This in turn would induce a movement of specific factors into premium production, thereby increasing premium supply and lowering rates of return in the premium segment globally. A second caveat is that the scenario assumes there is no further taste swing away from European premium wines globally, yet this could happen if the reputation of New World regions for producing high quality wines continues to grow as in the 1990s – in which case returns to New World producers would be higher and to European producers lower than those modelled.

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[4] The fall in prices is larger for premium wine than winegrapes, reflecting our assumption that the wine processing capacity will track the increase in winegrape supply. Were the increase in productive factors in the wine industry smaller than modelled, the producer price of wine would be higher while that of winegrapes would be lower relative to the modelled outcome.

[5] We assume that additional "Brand Australia" promotion by the wine industry is undertaken in this scenario to the extent of $US50 million per year. Since our model also assumes perfect competition in all markets, this added cost to wine producers reduces the amount they can afford to pay for grapes. If that promotion campaign were instead to be financed by a government grant, our model suggests wine prices would be much the same but the producer price of premium grapes in Australia would be 4.4 percentage points higher (i.e, 2.7 per cent above instead of 1.7 per cent below the 1999 level).

For each of the two projection scenarios, output growth for premium wine is decomposed into component parts (Table 3). An increase in Australia's production of wine, for example, considered from the perspective of sales, may arise from any of three causes. The first is the local market effect on both domestically produced and imported wine, brought about by changes in prices, incomes, population and tastes within Australia. The second is the import substitution effect, which is positive if the share of locally sourced sales in total domestic sales increases. Finally, there is the export effect, due to an increase in export sales of wine. As Australia's imports account for less than 5 per cent of the domestic volume of wine consumed, there is almost no scope for import replacement despite the massive increase in output expected between 1999 and 2005 (see rows 2 and 6 of Table 3). The domestic market remains an important component of total sales in the projection period, although less so when "Brand Australia" promotion is expanded (contributing 21 out of total growth of 123 percentage points without that marketing strategy but only 16 out of 127 percentage points with it). But the vast bulk of the growth in output goes to exports (100 out of total growth of 123 percentage points without and 110 out of total growth of 125 percentage points with "Brand Australia" promotion).

Among the ten regions of the model, export growth makes the largest contribution to premium output growth in Australia. Compare this with the remaining New World producers. Much of the premium growth in USC production is sold domestically (accounting for 39 out of 53 percentage points of output growth), reflecting the large and growing domestic market. Other Southern Hemisphere Exporters (OSE) have an even smaller import replacement effect on output growth than Australia. In the base projection to 2005, their local market effect accounts for 23 and the export effect 71 of their total growth of 94 percentage points, similar to the outcome for New Zealand (Table 3).

As can be seen from Table 4, as a consequence of a successful "Brand Australia" campaign New Zealand's export growth is reduced slightly but USC exports rise substantially faster (albeit from a relatively low base). The latter is because increased consumption of Australian wine within USC increases the amount of USC wine available for export. The growth in trade values is a little lower than in volume in most cases because of the (on average 6 per cent) decline in premium wine prices over the projection period.

Table 5 shows the decomposition of premium wine consumption growth in each region. There is little difference in this variable between the two projection scenarios, reflecting Australia's relatively small share of world wine production (2 per cent), so only the comparison with "Brand Australia" is reported. Population growth, rising incomes per capita, and shifts in preferences all make positive contributions to growth in consumption in all regions. The price effect is smaller but also positive in most regions, reflecting generally falling consumer prices for premium wine.[6]

In WMWM, changes in the incomes earned by fixed factors are tied to aggregate consumption. The distribution of income changes between wine consumers, grape growers

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[6] In each region, growth in production and consumption of non-premium and non-beverage wines is relatively small. Indeed, consumption of such wines declined globally in the 1990s (Berger, Spahni and Anderson 1999). These wine types therefore are of less interest, at least to Australia, where output and export growth has been entirely in the premium end of the beverage wine market. Hence the focus of reported results is on the premium segment.

and winemakers is obtained from the dollar change in aggregate consumption. The outcome for consumers in each region is equal to the real change in aggregate consumption minus the additional income earned by fixed factors in the grape and wine industries.[7] In the "Brand Australia" scenario, there are net gains to Australia. These are mostly to the wineries ($US209 million relative to the 2005 scenario without the campaign), with a smaller gain to grape growers ($US56 million). While there is a net aggregate expenditure gain to Australia of $US92 million, Australian wine consumers lose $173 million through higher-than-otherwise wine prices. In USC, producers lose through increased international competition while the region's consumers pay higher prices for wine, so that the sign of the outcome is negative for each of the three USC groups in Table 6. However, a major caveat is in order: the consumer loss is based on the assumption that Australia's expanded "Brand Australia" marketing effort in Europe and North America has not yielded utility to consumers exposed to it, which is unrealistic (see Alston and Chalfant 1999). Hence the negative numbers in the consumer row of Table 6 should be interpreted merely as indicating higher prices for premium wine consumers. This contrasts with the UK and Germany: they import large quantities of premium wine from Australia's competitors, whose prices fall. For them, this outweighs the effect of rising Australian prices.

Having established a base projection for the world wine market in 2005 with the effects of "Brand Australia" promotion included, three questions are now addressed in turn: what would be the effects of (i) a real appreciation of the US dollar above its 1999 level, (ii) an outbreak of Pierce's disease in the Napa and Sonoma counties of California, (iii) a raising of barriers by Western Europe against New World premium wine imports and (iv) a global reduction in wholesale and retail trade margins on wine of one-fifth?

A real appreciation of the US dollar

Since the WMWM is a model of real activity, we cannot model a financial shock directly. The best we can do is to model exogenously some consequences of such a shock. To capture the effect of a real appreciation of the US currency, a negative shock is imposed on real expenditure in regions other than USC, with a positive shock to USC. The rationale for this treatment of a real appreciation is that we expect it to result in a larger US trade deficit than otherwise. This in turn implies that for a given level of output in the United States, aggregate US consumption increases with its dollar's appreciation (4 per cent) while consumption elsewhere decreases (–2 per cent). In this scenario, we assume a short- to medium-term time horizon in which primary factor endowments in each industry are fixed.

A real appreciation raises non-traded prices relative to traded prices. One might expect this to penalise US wine producers through a loss of competitiveness relative to importers. And indeed our results suggest US exports of premium wine decrease and imports replace some domestic-sourced wine. But there is also an expenditure effect, which increases real consumption of all normal goods and services in the USC region for a given level of activity. This has a positive effect on the US demand for wine. More than that, the positive domestic expenditure effect on domestic production is large enough to outweigh the loss of

[7] We assume within the model that the "Brand Australia" campaign costs the Australian wine industry an additional $US50 million per year in promotion. Necessarily the actual magnitudes of both the additional costs and the returns from additional demand affect the distributional outcomes.

international competitiveness according to our scenario 3 results.

In US dollar terms, producer prices in USC rise, while those elsewhere fall (Table 7). But given that in each region many inputs are locally sourced and therefore denominated in local currency units, a sustained US appreciation could benefit producers in other regions too. That is, their returns could rise in local currency units even if they fall in US dollar units.

The bilateral trade matrix reveals that USC imports of wine increase (by 16 per cent), while USC exports decrease (by 22 per cent). For other wine exporters, their export volumes rise slightly but there is a diversion in their exports of premium wine from Western Europe to North America (Table 8).

In the export-oriented regions of Australia and other Southern Hemisphere wine producers, the increase in exports of premium wine to the United States is sufficient to offset the negative effect on domestic wine sales of their devaluation against the US dollar. In the European regions, with their lesser degree of export orientation, there are only slight wine output losses as a consequence of the appreciation of the dollar (Table 9).

If exporters take advantage of the strong US currency to promote sales in USC, this could have a greater effect on wine sales than indicated in the small changes recorded in Tables 8 and 9. As shown in the previous "Brand Australia" scenario, shifting preferences arising from successful promotion can have a significant effect on returns to producers. To the extent promotion resulting in an established presence in a particular market is irreversible, consumers in USC may continue to purchase imported wine following a reversal of the US dollar appreciation. For this reason, the benefits from exporting more to the USC market following a US dollar appreciation may be somewhat greater than we have modeled; but the opposite effects from a subsequent devaluation may be more muted.

Diminished US wine output due to a spread of Pierce's disease

The Californian wine industry has coped with Pierce's disease for over a century, with severe losses in the Los Angeles basin in the 1880s, the 1930s and the 1940s (WIC 2000). The latest outbreak, confined so far to Southern California, is more ominous however, because it is spread by a new vector (the glassy winged sharpshooter) which is far more mobile than its predecessor (see, for example, Smart 2000). Hence the US Government and industry have allocated over $20 million in funding for disease management research in response to the current outbreak, but that may be too little too late to halt its spread to the Napa and Sonoma counties where most of the premium grapes are grown in the US.

To simulate such an outbreak, Scenario 4 projects the impact of an illustrative 10 per cent reduction in USC premium grape output and a loss of 10 per cent in premium wine processing total factor productivity, as compared with the 2005 base. The effect is to raise producer prices for grapes in the USC region by about one sixth. Because of the large share of USC in global wine output (about one-eighth), prices for premium wine rise elsewhere too, but by much lesser percentages than in the US (Table 7). Notice that even though winegrapes are non-tradable between regions, there is sufficient substitution of imported wine for domestically produced wine in USC for producer prices for grapes elsewhere in the world to rise as well. Exports from all non-USC regions expand, while USC's wine exports fall and imports rise (Table 8). The outbreak of Pierce's disease has a negative effect on wine consumers globally, through rising wine prices. Consequently, the local market contribution to output is negative in each region, and the export contribution is positive in regions other than USC (Table 9).

The loss to consumers from Pierce's Disease is also evident in Table 10. One surprising result is that grape producers in USC experience an overall income gain despite the output loss, through sharp price increases. This outcome depends partly on choice of Armington parameters within WMWM, on the local contribution to total USC sales, and on the assumption that processing capacity in the wine industry does not change. If, for example, we were to assume that fixed factors in the wine industry decline by the same proportion as winegrape output, projected returns to fixed factors in grape production in USC would be lower while returns to wineries would be higher. The aggregate global loss from such a shock is estimated to exceed $200 million and the US loss alone is almost $200 million (Table 10), which is many times the recently announced increase in investment in research on the disease. The estimated net gain to Southern Hemisphere wine-exporting countries (where producer welfare increases more than consumer welfare decreases) could of course quickly turn to a net loss if Pierce's Disease were to spread from the US to their vineyards.

Effects of Western Europe raising barriers to imports of premium wine from the New World

There is a growing concern in Europe that New World producers are poaching their traditional wine markets. In this final scenario, we assume that Europe responds to increased international competition in the wine market by raising its trade barriers, rather than through enhanced R&D or marketing efforts. Historically, this has been the case, with the European Community responding to threats from international competition through a combination of production and export subsidies, plus non-tariff barriers to imports such as imposing tougher technical standards. There is also a (so far unsuccessful) push currently from Europe to label wines produced with mechanical assistance (e.g., for grape harvesting and pruning) as "industrial", regardless of their quality, while labeling the rest as " agricultural".

The scenario reported here assumes Western Europe imposes a 30 per cent import tariff on New World wines. This is a proxy for any import-restrictive measure that raises the price of imports relative to locally-produced wine in Western Europe. This of course reduces the returns to New World producers while raising returns to European producers, although USC producers suffer less than those elsewhere in the New World because their domestic market accounts for a larger proportion of total sales of USC wines (Table 7). There is also a substantial diversion in global trade, with Australian exports to the United Kingdom and elsewhere in Europe declining sharply while those to USC increase. Conversely, Western European Exporters increase their sales to other European nations while decreasing exports to USC (Table 8). Consumers in New World regions gain slightly through falling prices, as shown by the positive local market effect in Table 9. Both exports and output decrease for New World producers, while output increases in Europe either through increased sales to other European nations (as is the case for Germany) or through import replacement (as in Western Europe Exporters and Other Western European nations).

For Australia, the UK market would account for most of its losses in export sales. Policies within Europe to discourage imports would force Australian producers to increase their marketing efforts in USC and in the Asian region, where sales remain low.

The distributional consequences of imposing the tariff are that grape and wine producers gain and consumers lose in the European regions, with overall welfare losses. Conversely, in the New World, wine consumers gain and producers lose and, except in USC, the benefits to consumers are outweighed by the losses suffered by producers. Global economic welfare would be reduced by just over $1 billion per year (Table 10).

A reduction in wine wholesale and retail marketing margins

The role of supermarkets chains in retail wine sales has been growing steadily in the United Kingdom following changes in liquor licencing laws in the 1970s. That phenomenon is gradually spreading to continental Europe, and similar trends have been advancing inexorably in Australasia and North America for some time (Geene et al. 1999). As Moulton (1984, p. 400) noted early in that development, supermarkets and discount liquor stores typically work on retail margins of 15-25 per cent rather than the conventional margin of 35-50 per cent. To that is now being added the potentially even cheaper on-line marketing of wine via email and the internet. These cost-reducing technologies are lowering the spread between producer and final consumer prices, to the benefit of all parties. But how will that saving be apportioned?

To get a sense of that, in this final scenario we assume that, as a consequence of an increasing proportion of total sales being sold in supermarkets and on-line, the trade margins cost in wholesaling and retailing wine transactions falls by one-fifth.[8] If we assumed fixed physical and human capital stocks there would be only a limited supply response and so consumers would gain little and the benefits would be shared between the innovative marketers and grape and wine producers. So it is more appropriate in this scenario, which is a more gradual long-run change, to alter the assumptions of the model such that physical and human capital in the various segments of the wine industry are no longer exogenous. Hence we assume that the price of each factor is fixed and its quantity employed grows to drive profits back towards normal. As a consequence of that more elastic supply, global premium wine output and exports increases by 4 to 5 per cent (Tables 8 and 9), producer prices of both grapes and wine rise by around 1 per cent (Table 7), and consumer prices fall by around 6 per cent. Consumers' gains (net of tax changes) are $US10 billion globally, returns to grape growers increase by $US0.5 billion and returns to wineries increase by $US0.9 billion per year in 1999 US dollars. Since we assume that reduced margins are due to technology changes, we do not net out reductions in traders' incomes (Table 10). Thus the global increase in economic welfare from such an efficiency improvement is estimated to be $11.5 billion per year, split roughly one-eighth to producers and seven-eighths to consumers under the assumptions used in this scenario – and the wine industry would be nearly 5 per cent larger in all major regions.

[8] Note that this implies a larger fall in sales for off-premise consumption than one-fifth, as around one-third of sales are on-premise where the margin is much higher. In the model's database the wholesale and retail margins, not counting taxes and international transport costs, account for 27 per cent of the retail tax-inclusive price of wine in aggregate.

Conclusions

In developing WMWM and projecting it to 2005, we have attempted to incorporate key features of the global wine market. These include rapid growth in premium production among New World producers and a global taste swing by consumers from non-premium to premium (especially red) wine. Data on the shares of each market attributable to the premium segment are, however, patchy. It may be that we have under-estimated the swing towards premium production in Europe, for example. If so, given Europe's huge share of the global wine market, we have underestimated the likely decline in premium grape and wine prices in the New World. Our hope is that this paper might stimulate the provision of better disaggregated data and thereby allow more realistic modelling analyses.

Such modelling is worthwhile not least because it can throw up non-intuitive results. Several have emerged in the above scenarios, including the following. From scenario 1, a global glut of wine does not seem imminent because production is changing in response to consumer trends: non-premium grapes and wine are being replaced by higher-quality products. Premium wine prices are projected to fall nonetheless, but only by 6 per cent between 1999 and 2005 on average across the world -- from exceptionally high levels.

From Scenario 3, if as assumed a real appreciation of the US dollar against other currencies increases aggregate consumption in USC and reduces it elsewhere, this is not unequivocally good news for wine producers in other regions and bad news for those in USC. On the contrary, US producers may gain through a positive expenditure effect in the US. Whether the impact on producers elsewhere is positive depends on their degree of export orientation: the higher it is, the more likely sales growth to USC will outweigh the negative expenditure impact on local sales of domestic wine.

From Scenario 4, the harm to US producers from a Pierce's disease outbreak in California would be offset somewhat by a larger rise in producer prices in USC than elsewhere (because of the Armington assumption of imperfect substitution in consumption between domestic and foreign wine). Wine imports do dampen the increase in USC prices while raising those elsewhere, to the detriment of consumers globally, but only to a modest extent.

From Scenario 5, the impact of imposing import barriers in Europe on New World wines is to encourage a diversion of New World wine sales from Europe to elsewhere. Returns to producers in the New World will decrease by less than they would have a few years ago, thanks to the growth in wine markets elsewhere and especially in North America.

And finally from Scenario 6, consumers appropriate most of the gains from reduced marketing margins, even in the short- to medium-term but especially in the longer term. With most factors fixed in the short term, the various segments of the wine industry gain from reduced selling costs. Certainly those producer gains diminish per tonne or litre as factors adjust in the longer term, but that is because the industry's capital stocks and hence output and exports grow. The global welfare gains from increasing the efficiency of wholesaling and retailing are thus shared between producers, consumers and traders.

Needless to say there are many other scenarios that might be run with this model.[9] One obvious one, with the recent launch of the next round of agricultural trade negotiations under the WTO, is to examine the impact of cuts in import tariffs. Again, non-intuitive results can emerge, as was shown in a trial run (not reported here for space reasons): a cut in Western Europe’s wine tariff – which is volumetric rather than ad valorem – encourages the consumption and importation of non-premium relative to premium wines and so leads to less rather than more sales from premium wine exporters such as Australia and New Zealand. Clearly ANZ trade negotiators would need to keep such things in mind as they fine-tune their requests for trade policy reforms abroad.

Other relevant scenarios that the WMWM can be used to address include the impact on wine markets of a faster transformation of Europe’s vineyards from non-premium to premium quality, of Central and Eastern Europe joining the European Union (see Berger 2000), of the European Union adopting common (higher or lower) consumer taxes on wine, of East Asia lowering its tariffs on wine (which effectively tax consumption of wine much more than domestically produced beverage substitutes such as beer and spirits – see Berger and Anderson 1999), and of Australia reducing or eliminating its consumer tax on wine (the so-called Wine Equalization Tax, the removal of which the industry is lobbying for during the 2001 federal election campaign). But all that is for another day.

[9] See Anderson (2001) for a review of issues currently facing the wine industry.

Table 1: Key assumptions in projecting from 1999 to 2005
(percentage change over the 6 years)

	AUS	WEE	OWE	UK	GER	CEE	USC	OSE	NZ	ROW	World
Aggregate consumption	19.4	14.6	14.6	14.6	14.6	17.3	18.0	19.4	18.7	18.7	17.1
Population	6.0	0.6	0.6	0.6	0.6	1.6	6.8	8.7	5.0	4.9	4.7
Taste swing to premium	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Fixed capital, premium grapes	130.0	10.0	10.0	10.0	10.0	10.0	50.0	80.0	100.0	15.0	23.6
Human capital, premium grapes	100.0	5.0	5.0	5.0	5.0	5.0	40.0	70.0	80.0	10.0	20.0
Fixed & human cap., multigrapes	10.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-4.9
Fixed capital, premium wine	80.0	5.0	5.0	5.0	5.0	5.0	40.0	60.0	70.0	10.0	23.8
Human capital, premium wine	80.0	5.0	5.0	5.0	5.0	5.0	40.0	60.0	70.0	10.0	16.2
Fixed capital, non-premium wine	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
Human cap., non-premium wine	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0
Variable capital, grape & wine	90.0	10.0	10.0	10.0	10.0	10.0	30.0	60.0	70.0	15.0	22.0
Total factor productivity, wines[a]	15.0	12.6	12.6	12.6	12.6	1.8	10.0	12.6	12.6	1.8	11.0

Sources: Anderson and Strutt (1999); Hertel et al. (2001); ABS (2000); and authors' own assumptions.

[a] In addition, for premium grapes we have assumed that TFP declines by 1.4 per cent in Australia between 1999 and 2005 due to quality improvements that require reduced yields per hectare. Elsewhere, we assume no change in grape TFP.

Table 2: Producer price change
(% change from 1999 to 2005 in 1999 constant US dollars)

1. 2005 base	*AUS*	*WEE*	*GER*	*OWE*	*CEE*	*USC*	*OSE*	*NZ*	*ROW*	*World*
Premium grape	-11.7	30.7	7.4	21.4	9.3	-3.0	-7.3	-6.9	-13.2	14.2
Multipurpose grapes	1.5	6.9	-1.4	6.1	3.4	16.9	29.6	-10.4	19.1	15.3
Premium wine	-15.2	-2.2	-13.2	-3.2	7.2	-11.6	-13.0	-13.5	-2.9	-6.5
Nonpremium wine	3.2	8.3	7.1	7.7	13.5	10.3	3.5	4.5	12.6	8.5
2. 2005, "Brand Australia"										
Premium grape	-1.7	31.2	7.2	12.6	9.2	-6.6	-6.6	-5.4	-12.4	13.9
Multipurpose grapes	-0.2	6.8	-1.5	6.4	3.5	17.0	29.3	-9.7	19.1	15.3
Premium wine	-1.3	-2.0	-13.2	-7.4	7.1	-14.2	-12.6	-12.1	-2.4	-6.3
Nonpremium wine	5.6	8.2	7.0	7.3	13.4	9.6	3.5	6.2	12.5	8.4

Source: Authors' WMWM model results.

Table 3: Decomposition of growth in volume of premium wine output
(% change from 1999 to 2005)

1. 2005 base	***AUS***	***WEE***	***GER***	***OWE***	***CEE***	***USC***	***OSE***	***NZ***	***ROW***	***World***
Local Market	21	17	25	24	26	39	23	19	29	28
Import Substitution	2	-1	-33	-5	-3	7	0	2	-16	1
Export	100	2	21	0	-3	6	71	76	-1	9
Total	123	18	13	20	21	53	94	97	11	**38**
2. 2005, "Brand Australia"										
Local Market	16	17	25	23	26	40	23	20	29	27
Import Substitution	-1	-1	-33	-13	-3	2	0	9	-17	-3
Export	110	2	21	7	-3	9	71	68	-1	14
Total	125	18	13	18	21	52	94	97	12	**38**

Source: Authors' WMWM model results.

Table 4: Growth in bilateral premium wine trade between major exporters and importers
(% change from 1999 to 2005)

(a) Volume

	1. 2005 base					*2. 2005, "Brand Australia"*				
Sales to:	**UK**	**GER**	**WEN**	**USC**	**Total exports**	**UK**	**GER**	**WEN**	**USC**	**Total exports**
From:										
AUS	163	540	285	159	**178**	172	683	350	280	**203**
WEE	-32	78	-2	-26	**4**	-40	72	-1	-17	**4**
GER	122	-9	202	113	**143**	102	-9	212	146	**144**
USC	83	345	158	48	**140**	119	470	247	43	**218**
OSE	122	413	204	108	**146**	92	386	199	129	**148**
NZ	117	438	214	119	**131**	69	362	179	119	**118**
WORLD	**30**	**87**	**30**	**10**	**53**	**27**	**87**	**35**	**33**	**58**

(b) Value (in 1999 constant US dollars)

	1. 2005 base					*2. 2005, "Brand Australia"*				
Sales to:	**UK**	**GER**	**WEN**	**USC**	**Total exports**	**UK**	**GER**	**WEN**	**USC**	**Total exports**
From:										
AUS	148	525	270	144	**163**	171	682	349	279	**202**
WEE	-34	76	-4	-28	**2**	-42	70	-3	-19	**2**
GER	109	-22	189	100	**130**	89	-22	199	133	**131**
USC	71	333	146	36	**128**	105	456	233	29	**204**
OSE	109	400	191	95	**133**	79	373	186	116	**135**
NZ	104	425	201	106	**118**	57	350	167	107	**106**
WORLD	**24**	**81**	**24**	**4**	**34**	**21**	**81**	**29**	**27**	**41**

Source: Authors' WMWM model results.

Table 5: Decomposition of growth in volume of premium wine consumption
(% change from 1999 to 2005 "Brand Australia")

	AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW	World
Income	16	18	18	17	18	19	14	14	17	17	**17**
Price	1	1	5	-2	2	-2	3	6	4	3	**2**
Taste	11	11	11	11	11	11	11	11	11	11	**11**
Other	7	1	1	1	1	2	8	10	6	6	**8**
Total	35	30	34	26	31	29	36	41	38	37	**38**

Source: Authors' WMWM model results.

Table 6: Distribution of returns from the additional "Brand Australia" promotion campaign
(change between 2005 base and 2005 "Brand Australia", constant 1999 US million dollars)

	AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW
Grape growers	56	17	0	-1	-29	3	-72	-6	1	-8
Winemakers	209	8	0	-1	-22	-1	-193	7	3	2
Consumers	-173	-20	102	15	-21	4	-353	-2	-7	-8
Total	92	5	102	13	-72	6	-618	-1	-3	-14

Source: Authors' WMWM model results.

Table 7: Producer price change from shocks
(% change from base year 2005, "Brand Australia", in 1999 constant US dollars)

	AUS	WEE	GER	OWE	CEE	USC	OSE	NZ	ROW	World
3. Real $US appreciation										
Premium grape	-0.5	-1.8	-1.9	-1.7	-2.4	1.1	-0.6	-0.9	0.3	-1.0
Multipurpose grapes	-2.6	-2.7	-1.8	-3.0	-1.9	0.8	-3.5	-2.3	-3.5	-2.6
Premium wine	-0.6	-1.1	-1.1	-1.1	-1.8	1.0	-0.8	-0.9	-1.2	-0.3
Nonpremium wine	-1.6	-1.6	-1.5	-1.7	-1.8	0.1	-1.6	-1.8	-1.9	-1.3
4. Pierce's disease in the US										
Premium grape	4.0	6.1	6.0	5.6	1.8	15.8	5.4	4.1	4.8	7.6
Multipurpose grapes	5.4	2.1	2.2	1.9	1.1	18.3	1.9	0.5	2.3	4.3
Premium wine	4.1	3.5	3.4	3.4	1.2	8.4	3.9	4.0	3.5	4.6
Nonpremium wine	3.3	3.0	3.1	2.9	2.3	6.5	3.0	3.3	2.7	3.5
5. Higher EU15 tariffs on New World imports										
Premium grape	-9.5	9.4	12.0	9.8	2.6	-5.9	-11.8	-8.7	-1.9	3.3
Multipurpose grapes	-1.1	0.3	0.4	1.0	0.6	-0.6	-3.6	0.7	0.1	-0.2
Premium wine	-9.7	5.2	6.8	5.8	1.7	-5.0	-8.8	-8.5	-1.2	0.3
Nonpremium wine	-7.6	2.4	4.0	3.0	2.3	-3.4	-6.1	-6.3	1.1	0.2
6. Reduction in marketing margins										
Premium grape	1.5	1.2	1.6	1.2	0.6	1.3	1.4	1.4	1.1	1.3
Multipurpose grapes	0.7	0.6	0.4	0.6	0.2	0.5	0.6	0.9	0.1	0.3
Premium wine	1.5	0.9	1.2	0.9	0.4	1.5	1.3	1.5	0.4	1.1
Nonpremium wine	1.9	1.2	1.6	1.1	0.6	1.6	1.4	1.9	0.3	1.2

Source: Authors' WMWM model results.

Table 8: Change in bilateral premium wine trade volumes between major exporters and importers from shocks

(% change from base year 2005, “Brand Australia”)

	3. Real $US appreciation					*4. Pierce’s disease in US*				
Sales to:	**UK**	**GER**	**WEN**	**USC**	**Total exports**	**UK**	**GER**	**WEN**	**USC**	**Total exports**
From:										
AUS	-4	-7	-6	12	**1**	-2	-6	-4	10	**2**
WEE	3	-1	1	19	**4**	4	0	3	16	**5**
GER	3	-2	1	19	**4**	5	-1	4	17	**6**
USC	-22	-23	-23	3	**-22**	-33	-33	-33	-8	**-32**
OSE	-1	-5	-3	15	**2**	-1	-3	-1	13	**4**
NZ	0	-4	-2	16	**1**	1	-3	-1	12	**2**
WORLD	**-2**	**-2**	**-3**	**16**	**-1**	**-1**	**-2**	**-2**	**14**	**0**

	5. Higher EU15 tariffs on New World imports					*6. Reduction in marketing margins*				
Sales to:	**UK**	**GER**	**WEN**	**USC**	**Total exports**	**UK**	**GER**	**WEN**	**USC**	**Total exports**
From:										
AUS	-43	-64	-59	67	**-5**	5	5	6	5	**5**
WEE	81	8	29	-57	**5**	3	4	4	5	**4**
GER	55	-5	14	-62	**17**	7	5	7	7	**7**
USC	-65	-77	-74	3	**-49**	3	4	4	4	**3**
OSE	-48	-66	-61	49	**-10**	6	6	6	6	**6**
NZ	-46	-67	-62	46	**-7**	4	4	5	4	**4**
WORLD	**1**	**-1**	**-1**	**-2**	**-5**	**5**	**4**	**5**	**5**	**4**

Source: Authors’ WMWM model results.

Table 9: Decomposition of change in volume of premium wine output from shocks
(% change from base year 2005, "Brand Australia")

3. Real $US appreciation	***AUS***	***WEE***	***GER***	***OWE***	***CEE***	***USC***	***OSE***	***NZ***	***ROW***	***World***
Local Market Growth	-0.6	-1.2	-1.3	-1.5	-1.6	3.7	-0.8	-0.7	-1.8	-1.8
Import Substitution	0.0	0.0	0.3	0.9	0.2	-1.9	0.0	0.0	2.1	2.1
Export	0.6	0.9	0.7	0.3	0.1	-1.5	0.8	0.5	0.1	0.1
Total	-0.1	-0.2	-0.3	-0.3	-1.3	0.3	-0.1	-0.2	0.5	0.5
4. Pierce's disease in the US										
Local Market Growth	-0.5	-0.9	-0.9	-1.1	-0.3	-2.7	-0.6	-0.6	-1.3	-1.3
Import Substitution	-0.1	0.0	0.2	1.1	0.6	-4.6	0.0	-0.1	3.0	-1.0
Export	1.2	1.7	1.7	1.0	0.4	-2.7	2.1	1.4	0.2	0.5
Total	0.6	0.8	1.0	1.1	0.7	-10.0	1.5	0.7	1.8	-1.8
5. Higher EU15 tariffs on New World imports										
Local Market Growth	1.3	-1.2	-1.4	0.4	-0.5	1.7	1.5	1.4	-0.4	-0.1
Import Substitution	1.0	0.6	-1.7	4.8	0.5	1.2	0.2	1.1	-7.7	0.7
Export	-4.2	2.0	5.1	-3.1	1.2	-4.5	-6.3	-4.4	6.9	-0.6
Total	-1.9	1.4	2.0	2.1	1.2	-1.6	-4.6	-2.0	-1.3	0.0
6. Reduction in marketing margins										
Local Market Growth	1.4	2.7	3.0	3.9	3.3	4.0	1.7	1.3	4.0	3.0
Import Substitution	0.0	0.0	0.5	0.1	0.0	-0.1	0.0	0.0	1.4	0.0
Export	3.2	1.4	2.1	0.6	0.1	0.2	3.3	2.6	0.5	1.3
Total	4.6	4.1	5.6	4.6	3.4	4.1	5.0	3.9	5.8	4.4

Source: Authors' WMWM model results.

Table 10: Distribution of returns arising from shocks

(change from 2005 "Brand Australia", constant 1999 US million dollars)

3. Real $US appreciation	***AUS***	***WEE***	***UK***	***GER***	***OWE***	***CEE***	***USC***	***OSE***	***NZ***	***ROW***	***World***
Grape growers	-9	-226	-1	-12	-24	-107	79	-149	0	-1035	**-1484**
Winemakers	-17	-125	-1	-14	-19	-29	56	-26	-2	-7	**-184**
Consumers	-4030	-27126	-9201	-10471	-13366	-9796	131470	-8847	-668	-46311	**1654**
Total	**-4056**	**-27477**	**-9203**	**-10497**	**-13409**	**-9932**	**131605**	**-9022**	**-670**	**-47353**	**-14**
4. Pierce's disease in the US											
Grape growers	37	428	2	36	33	64	1063	114	2	674	**2453**
Winemakers	95	333	1	39	44	32	-54	99	6	19	**614**
Consumers	-82	-695	-182	-219	-324	-113	-1198	-143	-7	-326	**-3289**
Total	**50**	**66**	**-179**	**-144**	**-247**	**-17**	**-189**	**70**	**1**	**367**	**-222**
5. Higher EU15 tariffs on New World imports											
Grape growers	-60	515	3	72	44	39	-158	-224	-4	27	**254**
Winemakers	-226	413	3	71	57	37	-362	-217	-13	-1	**-238**
Consumers	183	-942	-411	-348	-547	-122	729	305	15	54	**-1084**
Total	**-103**	**-14**	**-405**	**-205**	**-446**	**-46**	**209**	**-136**	**-2**	**80**	**-1068**
6. Reduction in marketing margins											
Grape growers	18	216	1	24	20	30	100	56	1	52	**518**
Winemakers	73	342	1	48	42	30	264	87	5	15	**907**
Consumers	228	2337	889	913	1575	1079	1904	464	26	708	**10123**
Total	**319**	**2895**	**891**	**985**	**1637**	**1139**	**2268**	**607**	**32**	**775**	**11548**

Source: Authors' WMWM model results.

Appendix A: The Theoretical Structure of WMWM

The model used here is an extension of that developed by Berger (2000). Berger's partial equilibrium model of the global wine market consists of non-linear equations for a single commodity (wine). We have altered these to linearised expressions so as to be able to use GEMPACK software (Harrison and Pearson 1994). In addition, the supply side of the model has been extended to include two types of grapes plus intermediate and primary input usage. We have disaggregated Berger's regions further so that the UK, Germany and New Zealand appear as separate entities. Premium, non-premium and non-beverage wines are now separately identified too. A consumption function appears linking income in each region to aggregate consumption of household goods. And we have updated the model's database to 2005.

On the supply-side of the model, the multi-input product specification follows the separability assumptions of typical computable general equilibrium (CGE) models. For example, consider the production function for a single-product industry:

$$\text{F(inputs, output)} = 0 \tag{1}$$

We write this as:

$$\text{G(inputs)} = \text{Output} \tag{2}$$

The inputs in turn are derived from nested demands for intermediate inputs and primary factors. In the model, there are two grape industries plus three wine industries whose prices and outputs are endogenous. Intermediate inputs to these industries include grapes that are therefore both inputs and outputs in this model. In percentage change terms, the demand for intermediate inputs *i* from source *s* by endogenous industry *j* in region *n* (x_{is}^{jn}) is related to the nested input demand (x_i^{jn}) in (3):

$$x_{is}^{jn} - a_{is}^{jn} = x_i^{jn} - \sigma_i^n (p_{is}^{jn} + a_{is}^{jn} - p_i^{jn}) \tag{3}$$

In (3), p_{is}^{jn} is the source-specific input price and (p_i^{jn}) the effective input price. The Armington elasticity for intermediate inputs is σ_i^n (see Armington 1969). The source-specific preference shifter is a_{is}^{jn}. Next, we calculate the effective or nested price of the source-composite input, where S_{is}^{jn} refers to the sales share:

$$p_i^{jn} = \sum_s S_{is}^{jn} (p_{is}^{jn} + a_{is}^{jn}) \tag{4}$$

The percentage change in the price of each intermediate input by regional source is set equal to the percentage change in the basic price (p_{is}^{o}) of each input, assuming that there are no input taxes or margins:

$$p_{is}^{jn} = p_{is}^{o} \tag{5}$$

The percentage change in effective inputs demanded is related to output (x^{0jn}) in (6):

$$x_i^{jn} - (a_i^{jn} + a^{jn}) = x^{0jn} \tag{6}$$

The variables a_i^{jn} and a^{jn} refer to percentage changes in effective intermediate and all-inputs unit requirements.

The next set of equations deals with primary factor demands. Within WMWM, there are four substitutable primary factors *f*, human capital, fixed capital, variable capital and "harvest". The latter factor is a composite of mechanical and manual labour inputs into grape harvesting, determined in a separate substitutable equation. The percentage change in primary factors demanded (x_f^{jn}) is given by:

$$x_f^{jn} - a_f^{jn} = x_1^{jn} - \sigma_1^{jn}(p_f^{jn} + a_f^{jn} - p_1^{jn}) \tag{7}$$

Percentage changes in the productivity of individual factors are given by a_{is}^{jn}, and the primary factor CES parameter by σ_1^{jn}. The subscript *P* refers to the primary factor composite, with composite quantities demanded being calculated in (8):

$$x_P^{jn} - (a_P^{jn} + a^{jn}) = x^{0jn} \tag{8}$$

Equation (9) computes the price term for effective factor demands:

$$p_P^{jn} = \sum_f S_f^{jn}(p_f^{jn} + a_f^{jn}) \tag{9}$$

One of primary factors, variable capital, is treated as perfectly mobile between grape and wine industries, so as to equalise the factor price:

$$p_K^{jn} = p_K^{n} \tag{10}$$

The market clearing expression for variable capital is:

$$x_K^{n} = \sum_j S_K^{jn} x_K^{jn} \tag{11}$$

Allocation of mechanical and manual inputs into grape harvesting in industry *g* (a subset of *j*) is determined by CES substitution in (12), while (13) computes the effective price:

$$x_h^{gn} - a_h^{gn} = x_H^{gn} - \sigma_H^{gn}(p_h^{gn} + a_h^{gn} - p_H^{gn}) \tag{12}$$

$$p_H^{gn} = \sum_h S_h^{gn}(p_h^{gn} + a_h^{gn}) \tag{13}$$

Equation (14) ensures zero pure profits in computing the producer price (p_1^{jn}), calculated using the cost shares for intermediate (S_i^{jn}) and primary inputs (S_P^{jn}):

$$p_1^{jn} - a_1^{jn} = \sum_i (S_i^{jn}(p_i^{jn} + a_i^{jn})) + S_P^{jn}(p_P^{jn} + a_P^{jn}) \tag{14}$$

The relationship between producer and consumer prices (p_{cs}^{wn}) is:

$$V_s^{wn} p_{cs}^{wn} = [B_s^{wn} + \sum_g T_s^{wng}](p_{0s}^{w} + \sum_g t_s^{wng}) + \sum_u (M_s^{wnu} p^{nu}) \tag{15}$$

in which the upper-case terms refer to levels. The total consumption value of a transaction (V_s^{wn}), for sales from source *s* to region *n*, is equal to the basic value B_s^{wn} (i.e., at producer prices), plus all tariff and consumer taxes on wine ($\sum_g T_s^{wng}$, where *g* is type of tax) plus margins ($\sum_u M_s^{wnu}$, where *u* is the type of margin). The variable t_s^{wng} denotes percentage changes in the power of a tax and p^{nu} is the percentage change in the margin price. Margins are used in the ORANI school of CGE models (Horridge, Parmenter and Pearson 1996) to distinguish between prices by type of sale. Here they are important, because retail mark-ups are a large proportion of the total value of a wine, particularly in the case of on-premise consumption. Another type of margin within the *u* set is transport costs. In the present version of the model, margins are not added to the cost of intermediate inputs.

Consumer demands (x_c^{jn}) are based on the Klein-Rubin utility function:

$$x_c^{jn} = \varepsilon^{jn} / F^n (v_c^n + a_{cl}^{jn} - p_c^{jn}) + (1 - \varepsilon^{jn} / F^n)(q^n + a_{cS}^{jn}) \tag{16}$$

in which *j* refers to household commodities, and endogenous grape and wine types *w* are a subset of *j*. In applications of this model, non-grape and non-wine commodities comprise a single composite with an exogenously determined price. The percentage change terms include population (q^n), aggregate supernumerary consumption (v_c^n), composite consumer prices (p_c^{jn}), and shifts in supernumerary (a_{cl}^{jn}) and subsistence preferences (a_{cS}^{jn}). The parameters include expenditure elasticities (ε^{jn}) and the Frisch parameter (F^n). The first part of (16) calculates supernumerary expenditure (i.e. $x_{cl}^{jn} = \varepsilon^{jn} / F^n (v_c^n + a_{cl}^{jn} - p_c^{jn})$) and the second part subsistence expenditure. The percentage change in utility (u^n) is derived from the Klein-Rubin utility function:

$$u^n - q^n = \sum_j S_{cl}^{jn} \; x_{cl}^{jn} \tag{17}$$

in which S_{cl}^{jn} denotes marginal budget shares. The supernumerary (a_{cl}^{jn}) and subsistence shifts (a_{cS}^{jn}) in preferences are related to the exogenous consumer preference shifter (a_c^{jn}):

$$a_{cS}^{jn} = a_c^{jn} - \sum_j S_c^{jn} \, a_c^{jn} \tag{18}$$

and

$$a_{cl}^{jn} = a_{cS}^{jn} - \sum_j S_{cl}^{jn} \, a_{cS}^{jn} \tag{19}$$

where the expenditure shares of aggregate consumption are given by S_c^{jn}.

In the model, we differentiate wine through disaggregation into wine types *w*, plus the Armington assumption of imperfect substitution by source *d* (1 = domestic, 2 = import composite) used to determine the domestic-import demands (x_d^{wn}):

$$x_d^{wn} - a_d^{wn} = x^{wn} - \sigma^{wn} (p_d^{wn} + a_d^{wn} - p^{wn}) \tag{20}$$

In (20), σ^{wn} is the Armington elasticity and a_{cd}^{wn} the domestic-import preference shifter. Demands for imports from specific sources are determined in (21):

$$x_s^{wn} - a_s^{wn} = x_m^{wn} - \sigma_s^{wn} (p_s^{wn} + a_s^{wn} - p_m^{wn}) \tag{21}$$

The parameter σ_s^{wn} is the elasticity of substitution between import sources. Subscript *m* refers to the import composite, and subscript s to the source of purchase. Hence, the demand for purchases by source entails a two-stage nesting process, between domestic purchases and a composite of imported purchases, and between different imports.

Next, we calculate the effective price of the source-composite wine commodity (p_c^{wn}), where S_d^{wn} refers to share of the sales of *d* in total sales to region *n*.

$$p^{wn} = \;_{d} \; S_d^{wn}(p_d^{wn} + a_d^{wn}) \tag{22}$$

The import composite price equation is:

$$p_m^{wn} = S_m^{wn} (p_m^{wn} + a_m^{wn}) \tag{23}$$

The percentage change in the quantity of margin services (x_s^{wnu}) demanded is set equal to that of the wine type:

$$x_s^{wnu} = x_s^{wn} \tag{24}$$

The market-clearing equation sets the supplies by source equal to the sum of demands (intermediate plus household) by region:

$$x^{0ws} = \sum_n (S_s^{wn} x_s^{wn}) + \sum_n \sum_i (S_{ws}^{in} x_{ws}^{in}) \tag{25}$$

In (25), S_s^{wn} and S_{ws}^{in} are the share of each sale in total sales of *w*, calculated at producer prices. In the present version of the model, only multipurpose grapes have sales as both intermediate inputs and household commodities.

Before calculating changes in income, we need to calculate the change in indirect taxes. Equation (26) does this, where t^n is the percentage change in tax and tariff revenue, and T^n the level of tax plus tariff revenue:

$$T^n t^n = \sum_w \sum_s [(B_{cs}^{wn} + \sum_g T_{cs}^{wng}) \sum_g t_{cs}^{wng} + \sum_g T_{cs}^{wng} (p_{0s}^{w} + x_{cs}^{wn}) \tag{26}$$

In comparative static runs (i.e., in which we assume that national endowments are unchanged), the change in income ($Y^n y^n$) is calculated as the percentage change in income earned by non-mobile factors multiplied by the income level (F_h^{jn} , where subscript *h* is the non-mobile subset of all factors) in the grape and wine sectors, plus the percentage change in wine tax and tariff revenue.

$$Y^n y^n = \sum_h F_h^{jn} (p_h^{jn} + x_h^{jn}) + T^n t^n \tag{27}$$

The percentage change in income calculated in (27) appears in the consumption function, to determine aggregate consumption (x_c^n), where (f_c^n) denotes shifts in the average propensity to consume:

$$x_c^n = y^n + f_c^n \tag{28}$$

If changes in household expenditure are tied directly to changes in income (i.e., f_c^n is exogenous), we can use (17) to calculate changes in welfare. But we are also concerned with the distribution of income between grape growers, wineries and the rest of the economy in each region ("consumers" in Tables 6 and 10). In only Scenarios 4 to 6 is the change in aggregate consumption determined by changes in real income in the grape and wine industry. So that our calculation is valid with either x_c^n or f_c^n exogenous, we divide the change in aggregate consumption ($C_c^n x_c^n$) (i.e., excluding aggregate income that is saved) between the industry and rest of the economy ($C_{c*}^n x_{c*}^n$), where p^n is CPI:

$$C_c^n x_c^n = \sum_h F_h^{jn} \left(p_h^{jn} + x_h^{jn} - p^n \right) + C_{c*}^n x_{c*}^n \tag{29}$$

Appendix B: Constructing the 1999 database for WMWM

Production, consumption and trade data

The starting points for constructing a global database are the historical statistics compiled by Berger, Anderson and Stringer (1998) and Berger, Spahni and Anderson (1999) that are based on FAO, OIV and (for trade data) UN sources. These relate to wine as a single commodity for years up to 1997. The challenge was to disaggregate those available data into premium and non-premium segments and to update them to 1999. Necessarily this task involves not only official statistics but also judgments by informed industry participants and observers. The resulting database for 1999 is considered to be representative of markets in that year, but is still subject to revision as new information comes to light. It has 23 per cent of the value and 60 per cent of the volume of world wine production in the non-premium category in 1999, similar to the Rabobank estimates (Geene et al. 1999).

Disaggregated data for the Australian region were drawn from two official agencies (ABS 1999, 2000 and AWEC 2000) and from a recent thesis by Wittwer (2000). ABS data for Australia distinguish between premium and non-premium wines by container, with premium wines referring to those distributed in bottles of 1.5 litres of less. We have amended this slightly so that two-litre casks also are categorised as premium wine. Among the other Southern Hemisphere exporters, there are sufficient New Zealand industry data to estimate disaggregated production and sales, with non-premium production now being a small proportion of the total (WINZ 2000). South African data indicate that a larger proportion of production is of non-premium quality than in other New World regions (SAWIS 2000). Estimates of the split between premium and non-premium production for the remaining Southern Hemisphere exporters are based on Jenster, Jenster and Watchurst (1993), but updated to reflect an increasing proportion of premium in total production in the New World.

The industry in a number of European nations is classified by quality, but such classifications vary from country to country. The publication by Onivins (1998) provides some indicators of the quality split of consumption and production in France. Geene et al. (1999, Figure 2.10) provides a split between premium and other table wine for EU-12 consumption based on European Commission data. The premium proportion has been adjusted downwards in our database because, according to Geene et al., this category may include some wine inappropriately classified as premium.

Aggregate per capita wine consumption is much lower in North America than in Western Europe, but the premium proportion of the total is higher. Data in WIC (2000) indicate that until 1999, the volume of North American exports exceeded that of Australia. But the unit value and total value were substantially lower. US producers, particularly premium suppliers, have been able to rely mostly on an ever-growing domestic market for increased sales, in contrast to Southern Hemisphere producers.

In Central and Eastern Europe, the collapse of communism has severely disrupted the industry in these nations. This in turn has hindered any trend towards increased production of premium wine. The transition has made the region more responsive to market signals, but decaying infrastructure and social upheaval have set back the wine industry in this region. The 1999 data used for this region, as for the Rest of the World, are based on the authors' best guesses of trends in the latter 1990s based on available OIV and FAO statistics.

Price data

Some indicative winegrape price data are readily available for Australia (PISA 1996; PGIBSA 2000), South Africa (SAWIS 2000), the United States (WIC 2000) and New Zealand (WINZ 2000). We assume that winegrapes account for approximately 25 per cent of the costs of wine production (based on discussions with Winemakers' Federation of Australia). Otherwise, prices are based to a considerable extent on UN unit value trade data, as in Berger (2000). Onivins (1998) and Geene et al. (1999) also provide some guidance in estimating producer prices for winegrapes and wine.

Tax data

A careful compilation of wine consumer and import tax rates in all the key wine countries has been prepared by Berger and Anderson (1999). Our task was simply to update that set of tables using the same sources. An important feature of the tax data base is that ad valorem and volumetric tax rates are separately included, since changes in the latter (and hence a switch from one form to the other) affect the premium and non-premium markets to different extents.

Transport and related margins

We assume that transport costs for domestic wine sales are equal to 15 per cent of the producer price for premium wine and (reflecting its lower unit value) 20 per cent for non-premium wine. The corresponding transport costs assumed for imported wine are 25 per cent for premium and 30 per cent for non-premium wine. Based on discussions with the Winemakers' Federation of Australia, retail margins at liquor stores are assumed to be 33 per cent of the tax-inclusive wholesale price for premium wine and 25 per cent for non-premium wine. But since approximately one-fifth of wine consumption is on licensed premises with mark ups typically exceeding 100 per cent, the overall retail margins are assumed to be 46 per cent for premium and 40 per cent for non-premium wine.

Key data for both 1999 and 2005 are summarized in the tables of Appendix C.

Appendix C: the WMWM database, 1999 and 2005

Table C.1: Premium wine summary, 1999

Consumption	AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW	World
Total volume (Ml)	151	3673	673	1001	748	921	1273	569	29	345	9383
Share of region's: vol. (%)	42	42	77	56	32	30	48	24	59	30	**40**
value (%)	76	81	92	80	70	59	84	48	83	54	**77**
Per capita	8.1	23.5	11.4	12.2	8.2	2.4	4.1	2.2	7.6	0.1	**1.5**
Share of global: volume (%)	1.6	39.1	7.2	10.7	8.0	9.8	13.6	6.1	0.3	3.7	**100**
value (%)	2.2	29.6	6.4	11.3	11.1	3.8	28.9	3.0	0.3	3.4	**100**
Production											
Total volume (Ml)	353	5035	56	643	234	966	965	896	31	205	**9,384**
Share of region's: vol. (%)	60	44	78	79	20	30	42	32	92	30	**40**
value (%)	85	80	94	92	50	55	81	61	92	60	**77**
Share of global: volume (%)	3.8	53.7	0.6	6.9	2.5	10.3	10.3	9.5	0.3	2.2	**100**
value (%)	4.3	50.3	0.3	7.3	3.6	3.9	23.1	5.5	0.4	1.4	**99**

Table C.2: Non-premium wine summary, 1999 (excluding sales for industrial purposes)

Consumption	AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW	World
Total volume (Ml)	209	4981	199	788	1558	2196	1380	1758	21	792	13882
Share of region's: vol. (%)	58	58	23	44	68	70	52	76	41	70	**60**
value (%)	24	19	8	20	30	41	16	52	17	46	**23**
Per capita	11.1	31.9	3.3	9.6	17	5.6	4.5	6.7	5.3	0.2	**2.3**
Share of global: volume (%)	1.5	35.9	1.4	5.7	11.2	15.8	9.9	12.7	0.1	5.7	**100**
value (%)	2.3	23.4	1.9	9.0	15.6	8.8	18.7	10.5	0.2	9.7	**100**
Production											
Total volume (Ml)	240	6433	16	168	953	2294	1361	1938	3	473	**13,878**
Share of region's: vol. (%)	40	56	22	21	80	70	58	68	8	70	**60**
value (%)	15	20	6	8	50	45	19	39	8	40	**23**
Share of global: volume (%)	1.7	46.4	0.1	1.2	6.9	16.5	9.8	14.0	0.0	3.4	**100**
value (%)	2.6	41.0	0.1	2.0	12.0	10.2	17.7	11.4	0.1	3.0	**100**

Table C.3: Volume of sales by source and region of beverage wine, millions of litres, 1999

Premium Sales to:	**AUS**	**WEE**	**UK**	**GER**	**OWE**	**CEE**	**USC**	**OSE**	**NZ**	**ROW**	**Total**
Source:											
AUS	140	1	128	5	12	0	48	0	9	10	**353**
WEE	9	3582	287	387	400	19	300	0	5	47	**5036**
UK	0	13	3	38	3	0	0	0	0	0	**57**
GER	0	21	34	552	21	0	14	0	0	0	**642**
OWE	0	2	18	6	190	0	6	2	0	8	**232**
CEE	0	1	55	6	0	902	1	0	0	1	**966**
USC	0	2	41	6	30	0	860	0	0	26	**965**
OSE	0	47	95	1	87	0	41	567	1	58	**897**
NZ	2	0	9	0	1	0	2	0	14	2	**30**
ROW	0	4	3	0	4	0	1	0	0	193	**205**
Total	**151**	**3673**	**673**	**1001**	**748**	**921**	**1273**	**569**	**29**	**345**	**9383**
Non-premium											
Source:											
AUS	205	2	7	2	5	0	3	0	12	5	**241**
WEE	0	4872	76	548	560	76	100	14	0	188	**6434**
UK	0	2	0	13	2	0	0	0	0	0	**17**
GER	0	9	42	61	49	0	2	5	0	0	**168**
OWE	0	13	4	26	843	15	10	0	5	39	**955**
CEE	0	12	20	108	30	2105	9	0	0	10	**2294**
USC	0	4	29	0	62	0	1205	0	0	61	**1361**
OSE	4	57	19	20	7	0	50	1739	1	39	**1936**
NZ	0	0	0	0	0	0	0	0	3	0	**3**
ROW	0	10	2	10	0	0	1	0	0	450	**473**
Total	**209**	**4981**	**199**	**788**	**1558**	**2196**	**1380**	**1758**	**21**	**792**	**13882**

Table C.4: Behavioural parameters

Expenditure elasticities	AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW
Premium wine	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Non-premium wine	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Frisch parameter	-1.82	-1.82	-1.82	-1.82	-1.82	-2.5	-1.82	-2.0	-2.0	-2.0
Armington (dom.-imp.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Import sub'n elasticity (imp.-imp.)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Primary factor CES	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Intermediate input elas. of substitution	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Table C.5: Premium wine summary, 2005 "Brand Australia"

Consumption		AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW	World
Total volume (Ml)		206	4,760	911	1,341	1,102	1,173	1,801	806	38	512	12,648
Share of region's:	vol. (%)	49	50	83	65	43	36	57	31	66	41	**48**
	value (%)	80	84	93	84	74	64	86	54	86	59	**80**
Per capita		10.3	30.3	15.3	16.2	12	2.9	5.4	2.8	9.5	0.1	**2.0**
Share of global:	volume (%)	1.6	37.6	7.2	10.6	8.7	9.3	14.2	6.4	0.3	4.0	**100**
	value (%)	2.3	29.5	6.2	11.2	10.7	4.0	29.3	3.0	0.3	3.5	**100**
Production												
Total volume (Ml)		833	6151	86	724	276	1149	1539	1601	59	230	**12,648**
Share of region's:	vol. (%)	80	84	93	84	74	64	86	54	86	59	**48**
	value (%)	92	82	95	92	51	62	85	72	95	65	**80**
Share of global:	volume (%)	6.6	48.6	0.7	5.7	2.2	9.1	12.2	12.7	0.5	1.8	**100**
	value (%)	7.5	45.5	0.2	5.9	3.1	3.8	24.6	7.6	0.5	1.2	**100**

Table C.6: Non-premium wine summary, 2005 "Brand Australia"

Consumption		AUS	WEE	UK	GER	OWE	CEE	USC	OSE	NZ	ROW	World
Total volume (Ml)		210	4,776	191	731	1,494	2,094	1377	1,809	20	750	13,452
Share of region's:	vol. (%)	51	50	17	35	58	64	43	69	35	59	**52**
	value (%)	20	16	7	16	26	36	14	46	14	41	**20**
Per capita		10.5	30.4	3.2	8.8	16.2	5.3	4.2	6.3	5	0.2	**2.1**
Share of global:	volume (%)	1.6	35.5	1.4	5.4	11.1	15.6	10.2	13.4	0.1	5.6	**100**
	value (%)	2.3	22.9	1.9	8.8	15.3	9	19.2	10.7	0.2	9.8	**100**
Production												
Total volume (Ml)		242	6180	16	174	948	2093	1311	2091	3	394	**13,457**
Share of region's:	vol. (%)	20	16	7	16	26	36	14	46	14	41	**52**
	value (%)	8	18	5	8	49	38	15	28	5	35	**20**
Share of global:	volume (%)	1.8	45.9	0.1	1.3	7	15.6	9.7	15.5	0	2.9	**100**
	value (%)	2.7	40.8	0.1	2.2	12.2	9.4	17.7	12.3	0.1	2.6	**100**

Table C.7: Volume of sales by source and region of beverage wine, millions of litres, 2005

Premium Sales to**:**	**AUS**	**WEE**	**UK**	**GER**	**OWE**	**CEE**	**USC**	**OSE**	**NZ**	**ROW**	**Total**
Source:											
AUS	186	0	351	41	55	0	184	0	8	8	**833**
WEE	11	4,579	170	666	395	35	250	0	5	39	**6,151**
UK	0	11	2	70	3	0	0	0	0	0	**86**
GER	1	50	69	502	65	3	33	1	0	0	**724**
OWE	0	3	18	18	212	1	9	2	0	11	**276**
CEE	0	0	13	4	0	1,131	0	0	0	0	**1,149**
USC	0	4	90	35	104	0	1,226	0	0	80	**1,539**
OSE	0	108	181	4	261	2	94	802	1	149	**1,601**
NZ	7	0	15	1	3	0	4	0	23	5	**59**
ROW	1	4	2	0	4	0	1	0	0	219	**230**
Total	**206**	**4,760**	**911**	**1,341**	**1,102**	**1,173**	**1,801**	**806**	**38**	**512**	**12,648**
Non-premium											
Source:											
AUS	205	2	8	2	6	0	3	0	11	5	**242**
WEE	0	4,652	71	530	526	93	101	12	0	196	**6,180**
UK	0	2	0	12	2	0	0	0	0	0	**16**
GER	0	9	44	61	53	0	2	5	0	0	**174**
OWE	0	13	4	27	825	20	11	0	4	44	**948**
CEE	0	7	11	64	19	1,981	6	0	0	6	**2093**
USC	0	3	24	0	52	0	1,176	0	0	56	**1311**
OSE	5	81	28	29	11	1	77	1,792	2	64	**2091**
NZ	0	0	0	0	0	0	0	0	3	0	**3**
ROW	0	7	1	7	0	0	1	0	0	379	**394**
Total	**210**	**4,776**	**191**	**731**	**1,494**	**2,094**	**1377**	**1,809**	**20**	**750**	**13,452**

References

ABS (Australian Bureau of Statistics) (1999), *Sales of Australian Wine and Brandy by Winemakers*, Catalogue no. 8504.0, ABS, Canberra.

ABS (Australian Bureau of Statistics) (2000), *Australian Wine and Grape Industry*, Catalogue no. 1329.0, ABS, Canberra.

Alston, J.M. and Chalfant, J.A. (1999), "Advertising and Consumer Welfare", CIES Discussion Paper 99/09, University of Adelaide, June.

Anderson, K. (2001), "Where in the World is the Wine Market Going?" Plenary Paper to be presented at the Australian Agricultural and Resource Economics Annual Conference, Adelaide, 23-25 January.

Anderson, K. and Berger, N. (1999), "Australia's Re-emergence as a Wine Exporter: The First Decade in International Perspective," *Australian and New Zealand Wine Industry Journal* 14 (6): 26-37, November/December.

Anderson, K. and Strutt, A. (1999), "Impact of East Asia's Growth Interruption and Policy Responses: the Case of Indonesia", *Asian Economic Journal* 13(2): 205-18, June.

Armington, P.A. (1969), "A Theory of Demand for Products Distinguished by Place of Production", *IMF Staff Papers* 16: 159-78.

Arndt, C. and Pearson, K. (1996), "How to Carry Out Systematic Sensitivity Analysis via Gaussian Quadrature and GEMPACK", GTAP Technical Paper No. 3, Preliminary version, Purdue University, West Lafayette, May.

AWEC (Australian Wine Export Council) (2000), Wine Export Approval Report, monthly, www.awbc.com.au/awec/export_statistics.html.

Berger, N. (2000), Modelling Structural and Policy Changes in the World Wine Market into the 21st Century, unpublished Masters' dissertation submitted to Adelaide University, November.

Berger, N. and K. Anderson, (1999), "Consumer and Import Taxes in the World Wine Market: Australia in International Perspective", Australian Agribusiness Review 7(3), June.

Berger, N., Spahni, P. and K Anderson (1999), *Bilateral Trade Patterns in the World Wine Market, 1988 to 1997, A Statistical Compendium*, Centre for International Economic Studies, University of Adelaide.

CIE (Centre for International Economics) (1995), "Generation of Demand Parameters for an Economy-wide Model of the Grape and Wine Industry", Prepared for the

Commonwealth Government Inquiry into the Wine Grape and Wine Industry, Canberra, February.

FAO (Food and Agricultural Organisation of the United Nations) (2000), Online database, apps.fao.org.

Geene, A., Heijbroek, A., Lagerwerf,. A. and Wazir, R. (1999), *The World Wine Business*, Rabobank International, Utrecht, Netherlands.

Harrison, J. and Pearson, K. (1994), "Computing Solutions for Large Scale General Equilibrium Models Using GEMPACK", *Computational Economics* 9(2): 83-127.

Hertel, T., Anderson, K., Francois, J. and Martin, W. (2001), "Agriculture and Non-Agricultural Liberalisation in the Millennium Round", Ch. in *Agriculture and the New Trade Agenda From a Development Perspective*, edited by M.D. Ingco and L.A. Winters, Cambridge and New York: Cambridge University Press (forthcoming).

Horridge J., Parmenter, B. and Pearson, K. (1998), *ORANI-G: A General Equilibrium Model of the Australian Economy*, Centre of Policy Studies and Impact Project, prepared for an ORANI-G course at Monash University, 29 June–3 July, *www.monash.edu.au/policy/ftp/oranig/oranidoc.pdf*.

Jenster, P., Jenster, L. and Watchurst, N. (1993), *The Business of Wine: An Analysis of the Global Wine Industry*, SMC Publishing, Lausanne, Switzerland.

Moulton, K. (1984), "The Economics of Wine in California", pp. 380-405 in *The Book of Californian Wine*, edited by D. Muscatine, M.A. Amerine and B. Thompson, Berkeley: University of California Press.

Onivins (Office national inteprofessionnel des vins) (1998), *Statisiques sur la filiere viti-vinicole*,

PGIBSA (Phylloxera and Grape Industry Board of South Australia) (2000), *South Australian Winegrape Utilisation and Pricing Survey – 2000*, Adelaide, South Australia.

PISA (Primary Industries South Australia) (1996), *South Australian Winegrape Utilisation and Pricing Survey – 1996*, South Australian Grape Advisory Committee and Phylloxera and Grape Industry Board of South Australia.

SAWIS (SA Wine Industry Information & Systems) (2000), *South African Wine Industry Statistics NR 24*, SAWIS, May.

Smart, R. (2000), "Pierce's Disease a Threat to California, and Maybe Australia", *Australian and New Zealand Wine Industry Journal* 15(5): 62-65, September/October.

WFA (Winemakers' Federation of Australia) and AWBC (Australian Wine and Brandy Corporation) (2000), The Marketing Decade: Setting the Australian Wine Marketing Agenda 2000 to 2010, WFA, Adelaide.

WINZ (Wine Institute of New Zealand) (2000), Online statistics, www.nzwine.com/statistics.

WIC (Wine Institute of California) (2000), Online statistics, www.wineinstitute.org/communications/statistics

Wittwer, G. (2000), The Australian Wine Industry During a Period of Boom and Tax Changes, Unpublished Ph.D. dissertation, Adelaide University.

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