THE UNIVERSITY OF WESTERN AUSTRALIA
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ECONOMICS

THE ECONOMICS OF WINE: PRICING, QUALITY AND RATE OF RETURN

PART I: INTRODUCTION

By

James Fogarty
The University of Western Australia

DISCUSSION PAPER 08.05

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PART I: INTRODUCTION*

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* This is the front matter and Chapter 1 of my PhD thesis *The Economics of Wine: Pricing, Quality and Rate of Return*, UWA, 2006. The full thesis is available as Discussion Papers 08.05 to 08.09.

LIFE CYCLE

When you cart me to the graveyard,
plant a vine upon my breast.

I shall know my alcoholic heart by its
tender roots caressed.

I shall feel mortal substance back to
wine transmogrified.

And shall thrill to taste its branches
drawing up the rising tide.

When you tread the ripened bunches,
and the festive cup goes round,

Pour a little vintage back upon the
thirsty ground.

As I pay my debt to nature, mingling
once more among men,

This shall be my consummation and
my hope to rise again.

A.D. Hope (1907- 2000)

ABSTRACT

This thesis consists of six chapters, and the main research contributions are contained in chapters two through five inclusive. The topics addressed in each chapter are distinct, but related, and the specific contributions to knowledge made by the different chapters are related to: (i) understanding more fully the nature of the demand for alcohol; (ii) explaining the relationship between reputation characteristics and consumers' willingness to pay for wine; (iii) estimating the rate of return to Australian wine; and (iv) using financial analysis to reveal the risk diversification benefits available by including wine in an investment portfolio. The details of each contribution are briefly outlined below.

Chapter 2 discusses the nature of the demand for alcohol. The demand for alcoholic beverages is an area much studied, and there are numerous studies estimating the own-price elasticity of alcoholic beverages. A review of relevant published studies indicates reported: beer own-price elasticity estimates range from -.02 to -3.00, with a mean estimate value of -.46, and standard deviation of -.41 (n = 139); wine own-price elasticity estimates range from -.05 to -3.00, with a mean estimate value of -.72, and standard deviation of .53 (n = 140); and spirits own-price elasticity estimates range from -.01 to -2.18, with a mean estimate value of -.74, and standard deviation of .47 (n = 136). Chapter 2 contributes to understanding the demand for alcohol, not by adding yet another set of elasticity estimates to an already substantial literature, but by providing a framework through which all known own-price elasticity estimates can be understood. Specifically, a meta-regression framework is employed to study previously published own-price elasticity estimates. This framework allows the effect of model design attributes to be isolated, and the underlying trend in consumer responses to price changes to be identified.

Chapter 3 is concerned with understanding the relationship between the price a consumer is willing to pay for a bottle of wine, and the underlying attributes embodied in the wine. The approach used to investigate this relationship is the hedonic price equation approach. The model developed in the chapter starts from first principles, and unlike other studies in this field considers both supply and demand issues. In the chapter particular attention is given to the possible role of reputation characteristics, and the question of whether OLS is a suitable estimation approach. Specifically, the chapter

shows: bottle age, regional reputation, varietal reputation, investment reputation, and quality reputation, all have a significant impact upon price. Subjective expert quality ratings on the other hand are shown to be not valued by consumers. These findings are at odds with those presented in other research, and possible reasons for the different results are explored.

Wine investment is a topic which has received much attention in the media, yet, in Australia, it is a topic little understood. It is perhaps so little understood because to date access to systematic and reliable price information has been limited. As such, before starting to investigate the return to wine, it was first necessary to create a database of wine prices. The database of wine prices created is unique, and is based on the price information contained in the computer system of the largest wine auction house in Australia, *Langton's*. The database created is used as the basis for the investigation into the rate of return to wine presented in Chapter 4.

The percentage return to wine *i*, at time *t* -- ignoring for a moment issues of storage costs, sales commissions, and insurance -- can be expressed as: $R_i^t = \left[\left(P_i^t - P_i^{t-1}\right)\Big/ P_i^{t-1}\right] \times 100$, where P_i^t is the price of wine i $(i = 1,...,n)$ in period *t*. The return to a portfolio of wine in any given period is some average of the *n* individual returns, and from such information, if desired, a wine price index can be constructed. Unfortunately, wine sales are infrequent, and all *n* wines are not sold in all periods. So, while there is an underlying price process for each wine, we observe prices only at infrequent and irregular intervals. The challenge is therefore, to describe the underlying but unobserved price path of wine from limited information. There are many approaches to estimating price change in such situations, and in Chapter 4 a variety of approaches are canvassed. The actual approach chosen to estimate the return to wine is the adjacent period hedonic price equation approach. In the chapter estimates of the quarterly return to wine are presented for the period 1989Q4 to 2000Q4. Following a discussion of the estimated return to wine, the chapter considers the investment performance of wines of different price, variety, and vintage.

The contributions made in Chapter 5 towards furthering understanding of the investment properties of wine are a natural extension of the analysis presented in Chapter 4. Specifically, Chapter 5 considers wine investment under two distinct sets of investment conditions. The first set of investment conditions may be thought of as

representing the conditional setting, and the second set of investment conditions may be thought of as representing the unconditional setting. In the conditional setting the question of optimal asset allocation between different wine asset is considered. In the unconditional setting the question of optimal asset allocation between wine and other financial assets is considered. The framework used to investigate the optimal asset allocation question in both the conditional and unconditional setting is the mean-variance efficient frontier framework. In the chapter, results are reported for a range of different investment approaches, and for investment decisions made using two different estimators of expected returns.

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PREFACE

The thesis consists of six chapters and a CD data appendix. To allow for the possibility of readers with an interest in only some of the topics covered in the thesis, each chapter has been written in such a way as to be more or less self contained. For such an approach to work a certain degree of repetition is required. The repetition has, however, been kept to the essential minimum, and so the cover to cover reader should not find the level of repetition a distraction. Although each chapter can be read as a stand alone document, a consistent notation and terminology is used throughout the thesis.

Each chapter contains a number of sections, and a list of references. The main chapters of the thesis -- Chapter 2 through to Chapter 5 -- also contain appendices. In some cases the appendices contain the complete estimation results for models discussed in the text. Including the complete estimation results in part explains why the thesis is relatively long. The numbering of sections and appendices occurs at two levels. Specifically, sections are denoted X.Y, where the first level of the notation refers to Chapter X and the second, the Y, to the order of occurrence of the section in the chapter. Appendices are numbered in a similar manner. So, Appendix X.Z refers to appendix Z of Chapter X. Occasionally sections or appendices include unnumbered sub-sections.

A similar approach is used with respect to the numbering of equations. For example, equation Y in Chapter X is labelled (X.Y), where the first number in the parentheses indicates the chapter, and the second the order of occurrence of the equation in the chapter. Where an equation originally introduced in Chapter X, is subsequently referred to in Chapter Z, to avoid the possibility of confusion, the original equation is restated and renumber in Chapter Z. Notation with respect to equations appearing in the appendices is similar, although an A appears before the two numbers. For example, equation Z in the appendices relating to Chapter X is denoted (AX.Z), where the A indicates the equation is in an appendix, the X indicates which chapter the appendix belongs to, and the Z indicates the order of occurrence of the equation in the appendices.

The notation for tables and figures follows the same pattern. Table X.Y and Figure X.Y indicate, respectively, the Y^{th} Table and the Y^{th} Figure of Chapter X. Where

tables or figures appear in the appendices, these tables and figures are denoted Table AX.Z and Figure AX.Z, where the A denotes that the table or figure belongs to an appendix, the X indicates which chapter the appendix belongs to, and the Z indicates the occurrence of the figure or table in the appendices.

The thesis also includes a CD data appendix. The data CD contains summary price information on the wines discussed in Chapter 4 and Chapter 5. Introductory comments regarding the data CD, and an index of the individual wine tables included in the appendix can be found in the file called *Read Me First*. The file is the first file the reader sees when they open the CD appendix, and the reader is strongly recommended to read this file before moving on to the other information contained in the data appendix. The individual wine tables are contained in four separate folders labelled: *1. Exceptional wine*, *2. Outstanding wine*, *3. Excellent wine*, and *4. Distinguished wine*. The numbering of the data tables occurs at three levels. At the first level each table is denoted with a D to indicate it is a table belonging to the data appendix. The next level of labelling indicates which folder the table belongs to, and the final level of numbering indicates the order of the table's occurrence in the folder. For example, the first table in the folder *1. Exceptional wine* is denoted D1.1.

ACKNOWLEDGEMENTS

To spend time researching an area you feel genuine passion for is all one can ever hope or want for in a PhD topic. As I find wine an intriguing and alluring subject, I can honestly say my PhD candidature has been a most wonderful time. Yet interested as I am in wine research, this is not the sole reason I have enjoyed greatly these past few years. I have enjoyed my recent years of study so much because I have benefited from the guidance of an excellent supervisor. Professor Kenneth W Clements has both inspired and amazed me, and I will forever be in his debt for the support and direction he has given me since I first knocked on his door many years ago. I have indeed gained much more than a deep understanding of the economics of wine under his supervision, I have gained research skills which will stay with me for life. The completion of this thesis has also been helped at various stages from the comments of others, and I would particularly like to acknowledge the many helpful discussion I have had with Alex Szimayer, and the support of fellow PhD students Felix Chan and John Gould. Proof reading a thesis is an unenviable undertaking, and I am extremely grateful for the assistance of Mian Er Voon and Coral Fogarty with this task. I would also like to thank the three thesis examiners: Professor D.G. Fiebig, Dr. G. Wittwer, and Professor P. Kenyon for their careful reading of the thesis and their valuable comments.

In 2002 an earlier version of Chapter 3 was presented at the PhD Conference in Economics and Business, Australian National University, and at the Australian Conference of Economists, Adelaide. I am thankful to Glyn Wittwer, the discussant at the PhD Conference in Economics and Business, for his helpful comments on this part of the research. Parts of this chapter have since been published in the Western Australian Quarterly Bulletin of Economic Trends.

An early version of Chapter 2 was presented at *Le Vin de Monde: Histoire, Management et Commerce*, University of Avignon, France, and a revised version of the paper will be appearing in a forthcoming special edition of the British Food Journal. I would like to thank the conference participants, and Gwyn Campbell in particular, for their many helpful comments and suggestions on this work.

The analysis of the rate of return to wine and role of wine in a broad investment portfolio contained in Chapters 4 and 5 would not have been possible without the

provision of wine sales data by Langton's. I would particularly like to thank the staff at Langton's for kindly providing me with wine auction sales data.

Despite passion for the subject matter, this research would not have been possible without the financial support of The University of Western Australia. In particular, the provision of a University Postgraduate Scholarship (2004-2005) was appreciated. Finally, I would like to acknowledge the support I have received from family and friends over the years, and in particular the support of my mother, to whom this thesis is dedicated.

CHAPTER 1

INTRODUCTION

'My only regret in life is that I did not drink more Champagne'

J.M. Keynes (1883-1946)
Economist

1.1 THE IMPORTANCE OF WINE TO THE AUSTRALIAN ECONOMY

Grape vines have been grown in Australia since white settlement, and records show that grapes were established in the Governor's garden by 1791. Commercial scale plantings of grapes for wine making purposes did not however occur until some time later. The founder of Australian wine making is generally reckoned to be James Busby (1801-1871) who first planted vines for wine making on a commercial scale in 1824. Busby, however, is not so much remembered for his 1824 plantings, but for publishing Journal of a Tour Through Some of the Vineyards of Spain and France in 1833, and for bringing an extensive selection of vine cuttings back to Australia following his travels in Europe. Among the varieties he was to return with included the two varieties most famous in Australia today, Shiraz and Chardonnay. The wine industry in Australia has not always been large, and the early wine styles have little resemblance to the elegant wine styles of today, but the industry has long been with us. The Australian wine industry has had many difficult periods, but in recent years the industry has grown strongly.

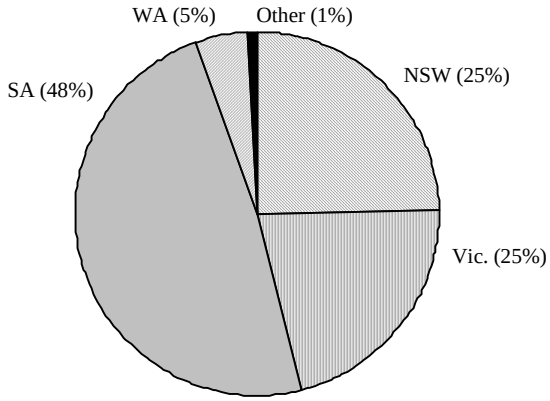
The past 20 years has seen dramatic growth in the size of the Australian wine industry, and today the wine industry is both a large employer, and a major source of export revenue. The importance of the industry as an employer is evidenced by the 2001 Census information, which identified over 30,000 people working directly in either manufacturing and blending wine or wine grape production. As Census employment figures exclude people working as seasonal grape pickers, and people working in the wine industry as a second job, they necessarily understate the importance of wine related employment. Wine tourism is also a significant and growing industry, and so a growth area of employment. All established wine producing regions in Australia -- from Margaret River in Western Australia, to the Hunter Valley in NSW -- have in recent

years devoted significant resources to attracting greater numbers of tourists, and their efforts have met with much success. The Australian wine industry is a dynamic and growing industry, and while there has been much research into aspects of wine science, there has been much less research into economic aspects of the wine industry. This thesis investigates different aspects of wine economics, however before looking at the specific questions addressed in the thesis it is worth describing the general characteristics of the Australian wine industry.

Domestic wine grape production has increased significantly in recent years. For example, between 1995 and 2004 total grape production for wine making purposes more than tripled from approximately 580 thousand tonnes, to more than 1.8 million tonnes. Interestingly, growth in the volume of production has not been matched by growth in the diversity of varieties planted, and those varieties long established in famous French wine growing regions are now dominant in Australia. Although there are small plantings of many different varieties in Australia, today just five grape varieties account for over 71 percent of total Australian grape production for wine making purposes. The varieties that dominate in Australia are: Shiraz (24.0 percent), Cabernet Sauvignon (17.6 percent), Chardonnay (17.0 percent), Merlot (6.8 percent), and Semillon (5.5 percent) (ABS, 2004, p. 21).

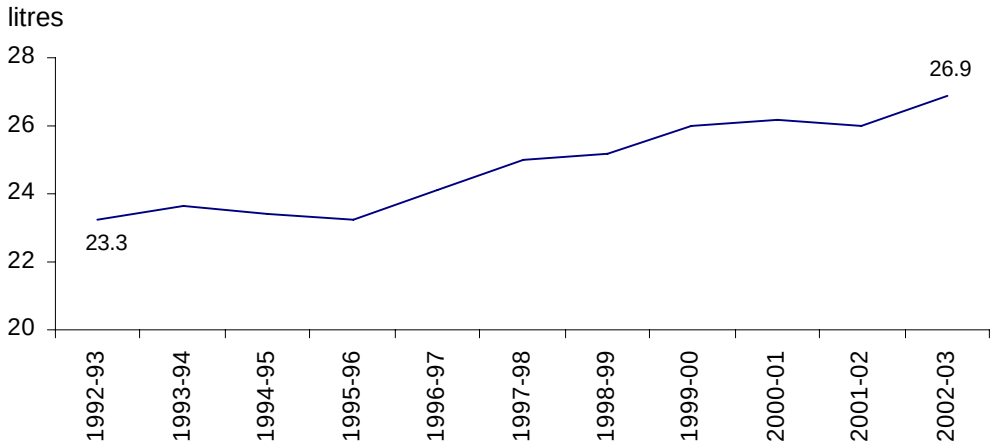
The heart of Australian wine making has always been South Australia, and in the 1930s South Australia accounted for as much as 75 percent of total Australian wine production. Australian grape production for wine making purposes remains concentrated in South Australia, and although still the dominant producer, South Australia's market share continues to gradually fall from its 1930s peak. For example, between 1995 and 2004 South Australia's share of total Australian grape production for wine making purposes fell from approximately 55 percent to 48 percent. As shown in Figure 1.1, the other main wine grape producing states are Victoria and New South Wales, with Western Australia a distant fourth. Recent production growth has not however been stimulated by a substantial increase in domestic demand. For as shown in Figure 1.2, per capita wine consumption in Australia has grown only moderately in recent years, rising from 23.3 litres per person in 1992-93 to 26.9 litres per person in 2002-03. The increase in domestic wine production is therefore directly related to an increase in Australian wine exports.

FIGURE 1.1
AUSTRALIAN WINE PRODUCTION MARKET SHARE BY STATE IN 2004



Source: ABS (2004).

FIGURE 1.2
AUSTRALIAN PER CAPITA WINE CONSUMPTION: 1992-93 – 2002-03



Source: ABS (1999, 2004).
Note: Per capita refers to the population 15 year and older.

Prior to the late 1980s both imports and exports of Australian wine were modest. For example, in 1986-87 Australia exported approximately 45 million dollars worth of wine, and imported approximately 38 million dollars worth. In nominal terms, the average value of wine exported from Australia in 1986-87 was $2.09 per litre, and the average value of wine imported to Australia was $4.90 per litre (ABS, 1999). However, wine exports have grown strongly since the late 1980s, and today the only agricultural products with a larger share of total exports are: wheat, beef, and wool. Wine imports on the other hand have grown at a much more modest rate, and so the trade surplus with respect to wine has grown dramatically. Wine exports in 2003-04 were worth approximately 2.49 billion dollars, while wine imports were worth approximately 152 million dollars. As such, the trade surplus with respect to wine in 2003-04 was 2.32

billion dollars. Although the total value of Australian wine exports has grown dramatically, Australia has been less successful in closing the import-export gap in terms of dollars per litre of wine sold. In nominal terms, in 2003-04 the average value of wine exported from Australia was $4.27 per litre, while the average value of wine imported to Australia was $8.13 per litre (ABS, 2004). The remarkable overall export performance of the Australian wine industry can be seen clearly in Table 1.1. The figures in the last row of Table 1.1 represent the arithmetic mean of the annual percentage change in the value of each column. A detailed explanation of why this measure of average change was chosen is given in Appendix 4.3. By reading across the last row of Table 1.1 to the last column, it can be seen that the average annual percentage change in the value of exports between 1986-87 and 2003-04 was 28.7 percent.

TABLE 1.1
AUSTRALIAN WINE EXPORTS BY TYPE AND VALUE

Period	Wine Type ('000) (L)				Total Wine ('000)	
	Table	Fortified	Sparkling	Other	Quantity (L)	Value ($)
1986-87	18 627	1 232	826	638	21 324	44 620
1987-88	35 022	1 411	1 603	1 088	39 124	96 157
1988-89	35 873	1 106	1 764	301	39 044	114 521
1989-90	32 095	1 936	2 074	2 015	38 120	121 248
1990-91	46 890	2 765	3 180	1 321	54 156	179 588
1991-92	71 752	2 384	3 904	639	78 679	243 526
1992-93	95 468	1 851	4 730	784	102 832	293 157
1993-94	116 655	2 873	5 042	893	125 464	366 574
1994-95	105 542	2 475	5 110	537	113 663	385 706
1995-96	121 037	2 506	5 489	639	129 671	471 576
1996-97	144 892	2 490	6 046	966	154 393	603 297
1997-98	183 024	2 505	6 110	764	192 404	873 847
1998-99	191 728	2 092	6 434	627	200 881	986 822
1999-00	272 842	2 287	9 088	717	284 935	1 372 768
2000-01	328 620	2 032	6 546	1 091	338 289	1 752 082
2001-02	406 207	2 698	8 050	1 438	418 393	2 105 139
2002-03	506 662	3 035	7 933	1 012	518 642	2 423 468
2003-04	571 324	2 512	9 806	755	584 397	2 494 089
Growth (%) p.a.	24.4	7.5	18.2	32.5	23.2	28.7

Source: ABS (1999, 2004).

Although the growth in Australia's wine exports has been remarkable, it is worth considering the size of the international wine market, and Australia's position within

this market. Considering grape production levels, or area under grape cultivation, can, in an international setting, give a misleading picture of wine production levels. For while some countries such as Turkey and Iran have vast areas under grape cultivation, they do not produce significant quantities of wine. Table 1.2 provides a snapshot of wine production, exports, and consumption in select countries for 2001. Australia is the world's seventh largest wine producing country, but accounts for less than 4 percent of total world production. Australian wine production remains a long way behind the leading wine producing nations of France, Italy, and Spain, and in fact the Bordeaux region of France produces more wine than all of Australia.

As a percentage of domestic production the level of Australian exports is relatively high, but not significantly greater than the level of exports to domestic production in the three leading wine producing nations. So, while Australia ranks fourth in terms of wine exports, the gap between third and fourth is vast, and there is little chance of Australian wine exports overtaking those of Spain in the near future. Further, even if Australia were to double production and export all the extra wine, Australia would still not replace France as the world's second largest exporter of wine.

TABLE 1.2
WORLD WINE PRODUCTION CONSUMPTION AND EXPORTS IN 2001

Country	Wine Production		Wine Exports			Consumption
	Quantity m (L)	As (%) of world production	Quantity m (L)	As (%) of country production	As (%) of world exports	Per capita (L)
France	5 338.9	20.2	1512.6	28.3	23.2	57.1
Italy	5 009.3	18.9	1537.1	30.7	23.6	53.0
Spain	3 050.0	11.5	994.6	32.6	15.3	34.6
USA	1 920.0	7.3	284.4	14.8	4.4	7.4
Argentina	1 583.5	6.0	88.2	5.6	1.4	32.1
China	1 080.0	4.1	3.0	0.3	0.0	0.9
Australia	**1 016.3**	**3.8**	**375.0**	**36.9**	**5.8**	**20.6**
Germany	889.1	3.4	242.0	27.2	3.7	24.4
Portugal	778.9	2.9	167.2	21.5	2.6	46.8
Romania	509.0	1.9	23.0	4.5	0.4	21.0
Russia	343.0	1.3	0.9	0.3	0.0	3.5
Other	4 955.0	18.7	1283.3	25.9	19.7	n.a.
World	26 473.0	100.0	6511.3	n.a.	100.0	n.a.

Source: ABS (2004).

Selvanathan and Selvanathan (2005, p. 219) provides information on the consumption patterns for alcoholic beverages in ten developed economies and reports

that spending on alcohol represents 4.75 percent of total consumer expenditure on average over the ten countries. As the corresponding figure in Australia is 5.31 percent, this is good news for Australian alcoholic beverage producers. Yet Australia remains a predominately beer drinking nation, and in 2002-03 for every litre of wine consumed 4.3 litres of beer were consumed. As shown in the final column of Table 1.2, per capita wine consumption in Australia is significantly lower than the level of per capita wine consumption in the three leading wine producing nations. Given the relatively low level of per capita wine consumption in Australia, and the relatively high level of expenditure on total alcohol, this suggests at least the possibility of increasing significantly the level of domestic wine sales. As wine export markets are becoming increasingly competitive, the potential to expand domestic wine consumption should provide some comfort to domestic wine producers.

For Australia, wine is a relatively important agricultural commodity, and by studying aspects of wine economics it is possible to gain many insights. Yet the economic importance of wine to the Australian economy is not the only reason wine is a worthy research topic. Wine has long played an important role in the cultural fabric of societies, and this importance adds a further level of interest to all wine related research. The cultural significance of wine in wider society is now briefly touched upon.

1.2 The Cultural Significance of Wine

Throughout the world wine is a topic which evokes much passion, and wine has a long and distinguished role in the cultural affairs of many nations. The exact point in time when wine was first made, deliberately or by accident, is not known with much certainty. There are however artefacts from which it is possible to date the period when it is categorically known wine was widely consumed. For example, a wine stained amphora dating back to 3500 BC was found in Iran in 1976, and it is thought by about 3000 BC Egyptian wine making skills were well developed (Clark and Rand 2001, p. 8).

It is known wine grapes grew naturally around the Black Sea, and it is thought grapes may have been cultivated in the region now occupied by Georgia and Armenia as long ago as 7000-8000 BC. When it was that *Vitis Vinifera* was first cultivated for wine, we are unlikely to ever know, but that wine has been an important part of life in many

civilisations is something we do know. For example, in ancient Egypt by 2700 BC wine was one of the essential provisions for the afterlife. Such details are known from things like the vivid paintings on the walls of the tomb of Kha'emwese at Thebes (Clark and Rand 2001, p. 8, 12).

Wine features extensively in classical literature, and examples of wine and classical literature are given in Robinson (1999). A selection of examples highlighting the role of wine in ancient culture are presented below. The consumption of wine, in an everyday sense, and the consumption of wine for special occasions, is described in both of Homer's (c. 800 BC) epic poems the Illiad and the Odyssey. While the significance of wine can be further seen in the writings of Hesiod (c. 700 BC) who wrote of the cultivation of grape vines as part of the order of nature laid down by the gods. Like so many things, what was important in ancient Greece also became important in the Roman Empire. Early Roman literature, for example the writings of Virgil (70-19 BC) and Horace (65-8 BC), include many references to wine. There are also many examples of lyric poetry from these times which include references to wine, and the following example, reproduced in Robinson (1999, p. 419), is attributed to Archilochos (c. 700 BC), and is part of a poem about a long sea voyage:

> Along the rower's benches bring your cup
> And lift the lids of the big wine jars up
> And drain the good red wine: we can't, 'tis clear
> Be sober all the time we're watching here

The importance of wine in these early civilisations can also be seen in the ancient literature on agriculture. Surviving literature containing details on viticulture can be traced as far back as the writings of Cato (234-149 BC). While advice relating to selecting clones and planting vines can be found in the works of Columella (2 BC - AD 65). Pliny (AD 23-79), also had much to say on the topic of viticulture (Robinson 1999, p. 176, p. 409).

Interestingly, ancient history also tells us the consequences of excessive drink were well known. For example, the verse of Theognis (c. 650 BC), reproduced in Robinson (1999, p. 419), warns of the dangers of drunkenness, while at the same time praises the virtue of wine:

> Stand by ready to pour for those who want to drink. We cannot have a party every night. Still because I am moderate in my use of honeyed wine, I reach my house before I think of soothing sleep, and I make clear how divine a beverage for man is wine.

Caution, with respect to over consumption of wine can also be found in Roman times. For example, the Roman God of wine was Bacchus, and festivals celebrating Bacchus were known as Bacchanalia. While originally Bacchanalia were held infrequently and attended only by women, over time men were allowed to attend, and Bacchanalia became much more frequent celebrations. Ultimately, Bacchanalia became known as wild drunken festivals, and in 186 BC the Roman Senate outlawed Bacchanalia. Although it could be argued the ban was less out of concern for the general drunkenness and sexual licence embodied by the festivals, and more out of concern for the potential of political intrigue to be planned in such environments.

Wine has long featured in English literature, and insights into the pervasiveness of wine in society can be gleaned from this literature. Although wine and general drunkenness feature in the very earliest English literature, Robinson (1999, p. 258) suggests Chaucer (1345-1400) and The Canterbury Tales, which is written in both prose and verse, along with the plays of Shakespeare (1564-1616) as amongst the first English works to refer to specific types of wine as opposed to wine in general. The English poets, and in particular the pen of Lord Byron (1788-1824) have also provided many memorable phrases on wine. Although perhaps the most loved tribute to wine in verse is the translation of The Rubaiyat of Omar Khayyam by Fitzgerald (1809-1883). The most famous stanza of the poem is the 71st, and it is reproduced below:

> And much as Wine has play'd the Infidel,
> And robb'd me of my Robe of Honour – well,
> I often wonder what the Vinters buy
> One half so precious as the Goods they sell.

Wine also had a part to play in the many outrageous Saki short stories of Munro (1870-1916) which brilliantly satirise the Edwardian period of 1901 to 1910. Many of the characters in the various Dickens (1812-70) novels were well acquainted with wine, for example in Bleak House Mr Tulkinghorn has quite a passion for aged port. Academic life and wine have also long been linked in literature, for example in

Brideshead Revisited Waugh (1903-1966) wine features heavily in the activities of Charles and Sebastian while they are at Oxford. A further modern example of wine and university life can be found in Lucky Jim by Amis (1922-1995). Although in truth, wine is far from the only beverage consumed by the young James Dixon.

Wine also features in some of the most famous iconography known, for example the Last Supper painted by da Vinci (1452-1519) on the walls of the Convent of Santa Maria delle Grazie, Milan, Italy. So, not only is wine an economically important agricultural commodity, it is a commodity with real cultural significance. Wine is therefore a subject where economic argument will not always persuade those with passionately held beliefs. Yet economic analysis can add much to understanding in this area, and this thesis presents economic insights into a range of wine and alcohol related topics. The specific contributions of the thesis are outlined in brief below.

1.3 A Preview of the Thesis

This thesis makes contributions to knowledge in a number of areas. In brief these contributions involve: (i) an analytical survey of the vast literature on the price responsiveness of the consumers of the alcoholic beverages, beer, wine, and spirits; (ii) using the hedonic price framework of Rosen (1974) to investigating the factors that effect consumers' willingness to pay for wine; (iii) estimating the rate of return to premium Australian wine, and comparing the investment performance of different vintages and varieties; and (iv) taking the mean-variance framework of Markowitz (1952) and using it to illustrate the investment properties of wine and reveal the portfolio risk diversification benefits of wine investment.

Chapter 2: The Demand for Alcohol

The body of knowledge regarding the nature of the demand for alcohol begins with the work of Stone (1945) and Prest (1949), but has evolved substantially over the past 60 years. For example, Selvanathan and Selvanathan (2005) is a recent comprehensive study, of amongst other things, the demand for alcohol in 10 countries. Perhaps unsurprisingly, given the volume of work conducted in this area, there is much conflicting published information regarding the nature of the demand for alcohol. This chapter, by presenting a meta-regression analysis of previously published work allows

some sense to be made of the conflicting results, and allows the underlying trend in the own-price elasticity of demand to be identified.

Both data quality and estimation technique have improved substantially since consumer responses to changes in the price of alcohol were first studied. In applied demand analysis single-equation estimation approaches have largely been replaced by system-wide estimation approaches, dynamic models have replaced static models, and data is now often collected on a quarterly rather than annual basis. Each new technical development in the field of applied demand analysis has been seen as an improvement on previous practice, and while this is in general true, such a view has an unfortunate side effect. There is a tendency toward seeing the most recent estimates -- estimates which rely on the latest estimation approaches -- as not only more accurate than past estimates, but as rendering past estimates obsolete. Yet this need not be the case. To ignore past estimates simply because the estimation approach used at the time has since been improved upon is to ignore potentially valuable information.

Rather than presenting own-price elasticity estimates from a model including a small extension to a previously well developed theoretical approach, the chapter analyses historical estimates, and presents a framework for interpreting the differences. Specifically, the chapter makes a contribution to knowledge by: (i) providing a framework through which all known own-price elasticity estimates can be viewed; (ii) providing estimates of the effect model design characteristics have on estimated own-price elasticity values; and (iii) identifying the underlying trend in the demand response of consumers to changes in the price of alcohol.

Chapter 3: Expert Opinion, Reputation, and the Price of Wine

Hedonic price analysis and the identification of the attributes valued by wine consumers is a relatively new area of research, and begins with the work of Oczkowski (1994). Since this work was published not only have the wines of Australia been studied, but so to have the wines of Bordeaux, Burgundy, New Zealand, Spain, and the US. For the Australian market the empirical models estimated have, over time, developed and become more sophisticated. In particular, increasing attention has been devoted to understanding the role reputation indicators play.

In estimating a revised hedonic price function for Australian wine, the chapter not only synthesises the findings of previous work, it also introduces viticulture and wine tasting theory to ensure both the selection of variables and estimation technique are theoretically appropriate. This extension to previous work provides important new insights into the way wine is priced in the Australian retail market, and the empirical findings presented suggest: (i) objective characteristics are important; (ii) subjective measures of current quality such as annual wine ratings do not influence price; and (iii) that OLS is an appropriate estimation technique.

Chapter 4: Wine and the Rewards of Patience

Although the return to wine is a topic the financial press often mention in passing, in reality little is known about the rate of return to Australian wine. As this chapter presents the first systematic study of the return to holding Australian wine, the chapter makes a substantial contribution to knowledge. Premium wine is sold at auction at irregular and infrequent intervals, and so calculating the rate of return to wine is a non-trivial matter. In the chapter an adjacent period hedonic price model is used to estimate the quarterly return to wine. As the approach is a regression based approach, both a return estimate and the standard error of each return estimate are reported each quarter.

In the chapter the return to wine in general is calculated, along with the return to a Grange only portfolio, and a portfolio of vintage 1986, 1990, and 1994 only wines. The way marginal attribute prices evolve through time is then studied to determine which grape varieties are the best performing varieties, and whether it is the most expensive wines, or the relatively less expensive wines which increase in value fastest. The return calculations presented in the chapter are based on price data provided by Langton's, the largest wine auctioneers in Australia. The data set used is unique, and details relating to the data set are provided in the CD data appendix which accompanies the thesis.

Chapter 5: A Mean-Variance Approach to Wine Investment

Given it is possible to calculate the rate of return to wine, a question of major interest to potential investors is whether techniques that have been used to analyse

financial markets can be used to study wine. In this chapter the adjacent period hedonic price framework is used to obtain quarterly return estimates for four different wine assets, and the risk-return profile of these four wine assets are compared. To answer the question of what an optimal portfolio of wine assets might look like, the quarterly return information for these four wine assets is combined with the mean-variance framework of Markowitz (1952) to find the efficient frontier. Practical wine investment strategies which use mean-variance analysis are then considered. Specifically, the investment performance of a mean-variance optimised quarterly rebalanced wine asset portfolio is compared to the investment performance of an equally weighted wine asset portfolio.

Next, the question of whether or not there are risk diversification benefits from including wine in an investment portfolio which would otherwise consist only of shares and bonds is investigated. The framework used for the shares, bonds, and wine analysis is the same mean-variance framework used to find the optimal wine portfolio. As the analysis presented in the chapter shows there are risk diversification benefits available from the inclusion of wine in an investment portfolio, the question of whether a mean-variance optimised quarterly rebalanced shares, bonds, and wine portfolio outperforms an equally weighted shares, bonds, and wine portfolio is investigated. By demonstrating wine investment can be understood using the standard techniques of financial analysis, this chapter makes a valuable and novel contribution to knowledge.

The final chapter of the thesis, Chapter 6, presents concluding remarks, a brief synopsis of the key findings of the thesis, and touches on some of the broader issues raised by the research.

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