Report prepared for the

Australian Energy Regulator

An Estimate of the Historical Equity Risk Premium for the Period 1883 to 2010

John C. Handley

University of Melbourne

Final

25 January 2011

1. INTRODUCTION

Pursuant to the National Gas Rules, the Australian Energy Regulator (AER) is currently undertaking a review of the gas access arrangements of APT Allgas and Envestra (the distributors) in Queensland and South Australia for the period 2011 to 2016. As part of this review, the AER determines the allowed revenues/tariffs that can be charged by the distributors over this period which in turn requires the AER to determine the appropriate return on capital for the period.

The AER has previously used historical excess return estimates to inform its determination of an appropriate estimate of the expected market risk premium (MRP). Previously provided estimates covered the period from 1883 to 2008.[1] There have been a number of changes in financial markets since 2008 and the AER now requires an update to include the latest available data up to 2010. In particular, the AER requires estimates of historical excess returns relative to 10-year Commonwealth Government Securities (CGS) for the following time periods: 1883 – 2009, 1937 – 2009, 1958 – 2009, 1980 – 2009, 1988 – 2009, 1883 – 2010, 1937 – 2010, 1958 – 2010, 1980 – 2010 and 1988 – 2010. The estimates are to be accompanied by standard errors and 95% confidence intervals.

In addition, separate estimates are also required assuming distributed imputation credits are valued at 20 cents, 30 cents, 40 cents, 50 cents, 65 cents, 70 cents and 80 cents in the dollar.

A copy of my resume is set out in the Appendix.

[1] Handley (2009).

2. ESTIMATION OF HISTORICAL EXCESS RETURNS OVER THE PERIOD 1883 - 2010

2.1 Data and Approach

In my earlier report,[2] I set out estimates of historical excess returns (or equivalently, estimates of the historical equity risk premium) over the period 1883 to 2008. In this section, (some of) these estimates are updated using the latest available data up to 2010. The estimates are again based on the study by Brailsford, Handley and Maheswaran (2008) who present a set of estimates of the historical equity risk premium in Australia over a number of sample periods from January 1883 to December 2005.

Annual stock return and (10 year) bond return for each calendar year from 1883 to 2005 and imputation credit yield data for each calendar year from 1988 to 2005 is sourced from BHM (2008).[3] This is supplemented with five years of additional data for the calendar years 2006 to 2010, using sources and methodologies consistent with BHM (2008). In particular:

- Stock Returns: daily closing values of the All Ordinaries Accumulation Index during 2006 to 2010 are obtained from the Australian Stock Exchange (via IRESS). The annual Historical Stock Accumulation Index Series of BHM (2008) is then extended for five years by setting the 2006, 2007, 2008, 2009 and 2010 values of the series equal to the average value of the All Ordinaries Accumulation Index in December 2006, December 2007, December 2008, December 2009 and December 2010 respectively. This leads to an annual series of (discrete) stock returns – attributable to dividends and capital gains/losses – for the 128 calendar years from 1883 to 2010.

[2] Handley (2009).
[3] See BHM (2008) for details of data sources and return series construction.

- 10 Year Bond Returns: daily yields on 10 year Commonwealth Government treasury bonds during 2006 to 2010 are obtained from the Reserve Bank of Australia (RBA) website. The annual Historical Bond Return Series of BHM (2008) is then extended for five years by setting the 2006, 2007, 2008, 2009 and 2010 values of the series equal to the yield at the end of December 2006, December 2007, December 2008, December 2009 and December 2010 respectively.

- Imputation Credit Yields: average imputation credit yields on the All Ordinaries Index during 2006 to 2010 are sourced from the Australian Taxation Office (ATO) website. The annual imputation credit yield series of BHM (2008) is then extended for five years by setting the 2006, 2007, 2008 and 2009 values of the series equal to the (weighted) average imputation credit yield for the 12 months ending December 2006, December 2007, December 2008 and December 2009 respectively and by setting the 2010 value of the series equal to the (weighted) average imputation credit yield for the 12 months ending May 2010 – which is the latest available.[4]

2.2 Results

Table 1 sets out various statistics of the historical equity risk premium in Australia over a number of sample periods from January 1883 to December 2010. The differing start dates of 1883, 1937, 1958 and 1980 correspond to periods of increasing data quality but decreasing sample size. The start date of 1988 reflects the introduction of the dividend imputation tax system in Australia. AM is the arithmetic mean, SE is the standard error, Low and High define the 95% confidence interval for the "true" but unobservable value of the mean, p-value is the (2-tail) significance level of AM and GM is the geometric mean. The equity premium is defined as the (simple) difference between the stock return and the relevant proxy for the risk free rate – in this case the yield on 10 year Commonwealth Government bonds. Calculations are based on nominal, discrete returns and the stock return takes into account cash dividends and capital gains/losses only.

[4] For consistency purposes, the (weighted) average imputation credit yield for the 12 months ending December 2010 should ideally be used. However, using the available May 2010 data (instead of the unavailable December 2010 data) is not likely to lead to any significant difference in the estimates that appear in the tables in this report.

Relative to 10 year bonds, the equity risk premium has averaged 6.1% p.a. over 1883–2010.

BHM (2008) document concerns about data quality the further back into the past one looks and in particular suggest there are sufficient question marks over the quality of data prior to 1958 to warrant any estimates based thereon to be treated with caution. Relative to 10 year bonds, the equity risk premium has averaged 6.1% p.a. over 1958–2010, which is a period of relatively good data quality.

TABLE 1

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits	0.00

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.062**	0.015	0.032	0.091	0.00	0.048
1937 - 2009	73	**0.058**	0.023	0.011	0.104	0.02	0.038
1958 - 2009	52	**0.062**	0.032	-0.001	0.126	0.05	0.036
1980 - 2009	30	0.059	0.043	-0.028	0.146	0.17	0.032
1988 - 2009	22	0.052	0.041	-0.033	0.137	0.22	0.032
1883 - 2010	128	**0.061**	0.015	0.032	0.090	0.00	0.047
1937 - 2010	74	**0.057**	0.023	0.011	0.103	0.02	0.037
1958 - 2010	53	**0.061**	0.031	-0.001	0.124	0.05	0.036
1980 - 2010	31	0.058	0.041	-0.026	0.142	0.17	0.032
1988 - 2010	23	0.050	0.039	-0.031	0.131	0.22	0.031

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

Tables 2 to 8 sets out similar statistics of the historical equity risk premium in Australia assuming distributed imputation credits are valued at 20 cents, 30 cents, 40 cents, 50 cents, 65 cents, 70 cents and 80 cents in the dollar respectively.[5]

[5] In this case, the stock return takes into account cash dividends, the value of imputation credits attached to those dividends and capital gains/losses. Any value attributable by the market to retained imputation credits would be reflected in the observed capital gain.

TABLE 2

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.20

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.062**	0.015	0.033	0.092	0.00	0.048
1937 - 2009	73	**0.059**	0.023	0.012	0.105	0.01	0.039
1958 - 2009	52	**0.064**	0.032	0.000	0.128	0.05	0.038
1980 - 2009	30	0.062	0.043	-0.025	0.149	0.15	0.035
1988 - 2009	22	0.055	0.041	-0.030	0.141	0.19	0.036
1883 - 2010	128	**0.062**	0.015	0.033	0.091	0.00	0.048
1937 - 2010	74	**0.058**	0.023	0.012	0.104	0.01	0.038
1958 - 2010	53	**0.063**	0.031	0.000	0.125	0.05	0.037
1980 - 2010	31	0.060	0.041	-0.024	0.145	0.15	0.034
1988 - 2010	23	0.053	0.039	-0.028	0.135	0.19	0.034

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 3

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.30

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.063**	0.015	0.033	0.092	0.00	0.049
1937 - 2009	73	**0.059**	0.023	0.013	0.106	0.01	0.039
1958 - 2009	52	**0.065**	0.032	0.001	0.128	0.05	0.039
1980 - 2009	30	0.063	0.043	-0.024	0.151	0.15	0.036
1988 - 2009	22	0.057	0.041	-0.028	0.143	0.18	0.037
1883 - 2010	128	**0.062**	0.015	0.033	0.091	0.00	0.048
1937 - 2010	74	**0.059**	0.023	0.013	0.105	0.01	0.039
1958 - 2010	53	**0.064**	0.031	0.001	0.126	0.05	0.038
1980 - 2010	31	0.062	0.041	-0.022	0.146	0.14	0.036
1988 - 2010	23	0.055	0.039	-0.026	0.137	0.17	0.036

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 4

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.40

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.063**	0.015	0.034	0.092	0.00	0.049
1937 - 2009	73	**0.060**	0.023	0.013	0.107	0.01	0.040
1958 - 2009	52	**0.065**	0.032	0.002	0.129	0.04	0.039
1980 - 2009	30	0.065	0.043	-0.022	0.152	0.14	0.038
1988 - 2009	22	0.059	0.041	-0.026	0.145	0.17	0.039
1883 - 2010	128	**0.063**	0.015	0.033	0.092	0.00	0.049
1937 - 2010	74	**0.059**	0.023	0.013	0.105	0.01	0.040
1958 - 2010	53	**0.064**	0.031	0.002	0.127	0.04	0.039
1980 - 2010	31	0.063	0.041	-0.021	0.147	0.14	0.037
1988 - 2010	23	0.057	0.039	-0.025	0.139	0.16	0.038

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 5

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.50

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.063**	0.015	0.034	0.093	0.00	0.049
1937 - 2009	73	**0.060**	0.023	0.014	0.107	0.01	0.040
1958 - 2009	52	**0.066**	0.032	0.002	0.130	0.04	0.040
1980 - 2009	30	0.066	0.043	-0.021	0.153	0.13	0.039
1988 - 2009	22	0.061	0.041	-0.025	0.147	0.15	0.041
1883 - 2010	128	**0.063**	0.015	0.034	0.092	0.00	0.049
1937 - 2010	74	**0.060**	0.023	0.014	0.106	0.01	0.040
1958 - 2010	53	**0.065**	0.031	0.003	0.128	0.04	0.040
1980 - 2010	31	0.064	0.041	-0.020	0.149	0.13	0.038
1988 - 2010	23	0.059	0.039	-0.023	0.141	0.15	0.040

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 6

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.65

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.064**	0.015	0.034	0.093	0.00	0.050
1937 - 2009	73	**0.061**	0.023	0.014	0.108	0.01	0.041
1958 - 2009	52	**0.067**	0.032	0.004	0.131	0.04	0.041
1980 - 2009	30	0.068	0.043	-0.019	0.155	0.12	0.041
1988 - 2009	22	0.064	0.041	-0.022	0.149	0.14	0.044
1883 - 2010	128	**0.063**	0.015	0.034	0.092	0.00	0.049
1937 - 2010	74	**0.061**	0.023	0.015	0.107	0.01	0.041
1958 - 2010	53	**0.066**	0.031	0.004	0.129	0.04	0.041
1980 - 2010	31	0.066	0.041	-0.018	0.151	0.12	0.040
1988 - 2010	23	0.062	0.039	-0.020	0.143	0.13	0.042

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 7

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.70

Relative to 10 year Bonds

				95% Confidence Interval			
Period	Years	AM	SE	Low	High	p-value	GM
1883 - 2009	127	**0.064**	0.015	0.035	0.093	0.00	0.050
1937 - 2009	73	**0.061**	0.023	0.015	0.108	0.01	0.042
1958 - 2009	52	**0.068**	0.032	0.004	0.132	0.04	0.042
1980 - 2009	30	0.069	0.043	-0.018	0.156	0.12	0.042
1988 - 2009	22	0.065	0.041	-0.021	0.150	0.13	0.045
1883 - 2010	128	**0.064**	0.015	0.034	0.093	0.00	0.050
1937 - 2010	74	**0.061**	0.023	0.015	0.107	0.01	0.041
1958 - 2010	53	**0.067**	0.031	0.004	0.129	0.04	0.041
1980 - 2010	31	0.067	0.041	-0.017	0.151	0.11	0.041
1988 - 2010	23	0.062	0.039	-0.019	0.144	0.13	0.043

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

TABLE 8

Historical Equity Risk Premium 1883 - 2010

Assumed Value of Imputation Credits 0.80

Relative to 10 year Bonds

Period	Years	AM	SE	95% Confidence Interval Low	High	p-value	GM
1883 - 2009	127	**0.064**	0.015	0.035	0.094	0.00	0.050
1937 - 2009	73	**0.062**	0.023	0.015	0.109	0.01	0.042
1958 - 2009	52	**0.069**	0.032	0.005	0.132	0.04	0.042
1980 - 2009	30	0.070	0.043	-0.017	0.157	0.11	0.043
1988 - 2009	22	0.066	0.041	-0.020	0.152	0.12	0.046
1883 - 2010	128	**0.064**	0.015	0.035	0.093	0.00	0.050
1937 - 2010	74	**0.061**	0.023	0.015	0.108	0.01	0.042
1958 - 2010	53	**0.068**	0.031	0.005	0.130	0.04	0.042
1980 - 2010	31	0.068	0.041	-0.016	0.153	0.11	0.042
1988 - 2010	23	0.064	0.040	-0.018	0.146	0.12	0.045

Note: Refer to report for data sources and variable definitions
Estimates in Bold are significant at the 5% level using a 2-tailed test.

Over the period 1883–2010 and relative to 10 year bonds, the grossed-up equity risk premium has averaged 6.2% p.a., 6.2% p.a., 6.3% p.a., 6.3% p.a., 6.3% p.a., 6.4% p.a. and 6.4% p.a. assuming distributed imputation credits are valued at 20 cents, 30 cents, 40 cents, 50 cents, 65 cents, 70 cents and 80 cents in the dollar respectively.

Over the period 1958–2010, which is a period of relatively good data quality, and relative to 10 year bonds, the grossed-up equity risk premium has averaged 6.3% p.a., 6.4% p.a., 6.4% p.a., 6.5% p.a., 6.6% p.a., 6.7% p.a. and 6.8% p.a. assuming distributed imputation credits are valued at 20 cents, 30 cents, 40 cents, 50 cents, 65 cents, 70 cents and 80 cents in the dollar respectively.

To the extent that historical data is used to inform one's view of investor's expectations of the forward looking MRP, an important issue concerns how much reliance one should place on 2010 estimates as opposed to those from any other year.

As BHM (2008) note:

> *"The sample mean is an unbiased estimator of the true population mean for any population whose mean exists. If we assume that future returns are drawn from the same population from which past returns are drawn then the reliance on the historical record can be justified."* [6]

They also suggest that if the MRP is stationary over time, then a naïve statistical approach would suggest the longer the estimation period the better (subject to the data quality consideration). [7] In other words, the estimates based on the latest available data up to 2010 are in my opinion the most relevant for this purpose.

REFERENCES

Brailsford, T.J., J.C. Handley and K. Maheswaran, 2008, Re-examination of the Historical Equity Risk Premium in Australia, Accounting and Finance, 48, 73–97.

Handley, J.C., 2009, Further Comments on the Historical Equity Risk Premium, Report prepared for the Australian Energy Regulator, 14 April.

Pindyck, R.S. and D.L. Rubinfeld, 1991, Econometric Models & Economic Forecasts, 3rd edition, McGraw-Hill International.

[6] Brailsford, Handley and Maheswaran (2008 p.95).

[7] Note that in this regard, "stationary" does not mean that the realized equity risk premium will be constant from year to year. On the contrary, the equity risk premium each year can be thought of as a random draw from the same underlying population and so will likely vary from year to year. As Pindyck and Rubinfeld (1991 p.445) state: *"If a stochastic process is stationary, the probability distribution … is the same for all time t and its shape (or at least some of its properties) can be inferred by looking at a histogram of the observations … that make up the observed series".*

APPENDIX: COPY OF RESUME

Dr John C. Handley

January 2011

---

1. QUALIFICATIONS

BCom, BMath *Newcastle*, MCom (Hons) *Melbourne*, PhD *Melbourne*

EMPLOYMENT HISTORY

Period	***Organisation***	***Position***
Jul 1993 to date	University of Melbourne Melbourne	Associate Professor of Finance (since July 2005)
Sep 2009 to Jan 2010	Stern School of Business NYU New York	Visiting Associate Professor of Finance (Fall Semester 2009)
May 2008 to Sep 2008	Stern School of Business NYU New York	Visiting Associate Professor of Finance (Summer Semester 2008)
Aug 1988 to Jul 1993	SBC Australia *(Now UBS)* Sydney and Melbourne	Corporate Finance Executive
Nov 1985 to Aug 1988	Coopers & Lybrand *(Now Pricewaterhousecoopers)* Newcastle	Audit Senior

2. RESEARCH

Research Focus: Corporate finance, derivative security pricing, corporate finance applications of derivative security pricing

Scholarly Publications (since 2000)

- Handley, J.C., 2008. "Dividend Policy: Reconciling DD with MM". Journal of Financial Economics, 87, 528-531.
- Handley, J.C. and K. Maheswaran, 2008. "A Measure of the Efficacy of the Australian Imputation Tax System". Economic Record, 84, 82-94.
- Brailsford, T.J., Handley, J.C. and K. Maheswaran, 2008. "Re-examination of the Historical Equity Risk Premium in Australia". Accounting and Finance, 48, 73-97.
- Handley, J.C., 2005. "On the Upper Bound of a Call Option". Review of Derivatives Research, 8, 85-95.
- Handley, J.C., 2003. "An Empirical Test of the Pricing of VPO Contracts". Australian Journal of Management, 28, 1, 1-22.
- Dyl, E.A., W.B. Elliott and J.C. Handley, 2002. "Do Share Prices Matter?" Accounting and Finance, 42, 225-237.
- Handley, J.C., 2002. "On the Valuation of Warrants". Journal of Futures Markets, 22, 765-782.
- Handley, J.C., 2000. "Variable Purchase Options". Review of Derivatives Research, 4, 219-230.

Case Studies

- Tufano, P. and J.C. Handley, 1999. "General Property Trust". Harvard Business School case study 299-098, HBS Publishing.

Work in Progress

- Brown, C.A., J.C. Handley and K. Palmer. "A Closer Look at Barrier Exchange Options".
- Brown, C.A., J.C. Handley and K. Palmer. "Partial Differential Equations for Asian Option Prices".
- Handley, J.C. and C. Sobfeldt-Hansen. "Floating Priced Convertibles – A Direct Test of the Faulty Contract Design and the Last Resort Financing Hypotheses"
- Brown, C.A., J.C. Handley and A. Lamba. "Share Buybacks and Information Asymmetry – Winners and Losers"

3. TEACHING

Teaching Focus: Financial Management, Corporate Finance, Derivatives, Investments

Awards

- 2009 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2008 Dean's Certificate for Excellence in Graduate Teaching.
- 2007 Dean's Certificate for Excellence in Undergraduate and Postgraduate Teaching.
- 2006 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2005 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2004 Dean's Certificate of Excellent Undergraduate Teaching.
- 2003 Dean's Individual Award for Excellence in Teaching in the Faculty of Economics and Commerce.

4. ADMINISTRATION AND LEADERSHIP

- Deputy Head, Department of Finance, 2009—.
- Coordinator, PhD Program in Finance, 2009.
- Academic Director, Master of Applied Finance Program, 2006—2008.
- Coordinator, Honours Program in Finance, 2001—2003.
- Chair, 2003 Review Committee of the Honours Program in Finance at the University of Melbourne
- Chair, 2002 Review Committee of the Undergraduate Program in Finance at the University of Melbourne

5. ENGAGEMENT AND CONTRIBUTION TO THE PROFESSION

I have provided expert advice on various financial matters to the Australian Accounting Standards Board, Australian Competition and Consumer Commission, Australian Energy Regulator, KPMG Corporate Finance and the New Zealand Commerce Commission, including the following recent engagements:

- 2010, Consultant to the Australian Energy Regulator on matters dealing with the AER Electricity Distribution Determinations for Queensland and South Australia for 2010-2015, Victoria for 2011-2015 and Gas Distribution Decisions for New South Wales and the Australian Capital territory for 2010-2015, March–May, September-October

- 2009, Consultant to the Australian Energy Regulator on matters dealing with the AER Electricity Distribution Determinations for Queensland and South Australia for 2010-2015, October.

- 2009, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of Proposed Debt and Equity Raising Costs and the Weighted Average Cost of Capital for the 2009–14 Regulatory Control Period, April.

- 2009, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of the Weighted Average Cost of Capital for Electricity Distribution and Transmission, March/April.

- 2009, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the years ending 30 June 2005 and 2006, June.

- 2008, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of the Weighted Average Cost of Capital for Electricity Distribution and Transmission, November.

- 2008, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the years ending 30 June 2004 and 2005, April.

- 2008, Presentation to the ACCC / AER on the Weighted Average Cost of Capital of Regulated Firms, February.

- 2007, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2004, March.

- 2006, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2004, May.

- 2005, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2003, February.

- 2003, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the period ending 30 June 2002, June.

6. CONTACT DETAILS

Department of Finance
University of Melbourne VIC 3010
AUSTRALIA
Tel: x 613 8344 7663 (direct)
Email: handleyj@unimelb.edu.au