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Reconstructing the Beggs and Skeels Dataset

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Report for

The Victorian Electricity Distributors

25 October 2010

Summary

The Victorian electricity distribution businesses are in the midst of a five-yearly price review process. As part of that review, the Australian Energy Regulator (AER) must determine an appropriate compensation for corporate income tax, which is a function of the valuation of dividend imputation credits, also referred to as gamma. Strictly speaking, gamma is defined as the product of the 'imputation credit payout ratio' (F-payout ratio) and the 'utilisation rate (θ-theta), as acknowledged by the AER (page 528 of the draft decision). However, this report concentrates only on theta, the utilisation rate. No consideration has been given to the value of the payout ratio.

The AER has taken account of a limited number of dividend drop-off studies to estimate theta, including Beggs and Skeels (2006) and a number of studies by SFG Consulting. It has been difficult to reproduce the Beggs and Skeels study, because of the unavailability of the dataset, and also because it was not clear which observations have been filtered.

The broader ComSec database, on which the Beggs and Skeels study was based, has recently become available. However, it is not clear which of the observations were filtered. In this report we outline our attempts to replicate the Beggs and Skeels results.

Declaration

We confirm that, in preparing this report, we have made all inquiries that we believe are desirable and appropriate and that no matters of significance that we regard as relevant have, to our knowledge, been witheld. We have been provided with a copy of the Federal Court's "Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia" and this report has been prepared in accordance with those Guidelines.

Contents

1 Introduction

In the Victorian draft decision, the AER has most relied on the dividend drop-off study conducted by Beggs and Skeels (2006), who fit the model:

$$P_{c,j} - P_{x,j} = \gamma_0 + \sum_{j=1}^{7} \gamma_{1,j} d_{i,j} D_i + \sum_{j=1}^{7} \gamma_{2,j} d_{i,j} F_i + \varepsilon_i, i = 1, \ldots, n \qquad (1)$$

where

$$
\begin{aligned}
P_{c,i} &= \text{Cum-dividend share price of } i\text{th share} \\
P_{x,i} &= \text{Ex-dividend share price for } i\text{th share,} \\
&\quad \text{(adjusted for aggregate return on the market)} \\
\gamma_{1,j} &= \text{Cash drop-off ratio for period } j \\
\gamma_{2,j} &= \text{Franking Credit drop off ratio for period } j \\
d_{i,j} &= \text{Dummy variable for } i\text{th share in period } j \\
D_i &= \text{Dividend for } i\text{th share} \\
F_i &= \text{Franking Credit for } i\text{th share} \\
\varepsilon_i &= \text{error}
\end{aligned}
$$

with an auxiliary equation involving company size, gross dividend, and the cum-dividend share price as predictor variables to account for the heteroscedasticity in the data. In this model $\gamma_{2,j}$ refers to the value of theta rather than gamma directly. Beggs and Skeels analysed data over seven tax regimes, but of major interest are the results for the last three periods. Table 1 gives dates of the seven tax regimes, adapted from Table 1 of Beggs and Skeels (2004).

Period No.	Period	Effect of tax change relative to previous regime
1	–30 Jun 88	
2	1 Jul 88–30 Jun 90	Superannuation funds can use franking credits
3	1 Jul 90–30 Jun 91	Provisions to stop dividend streaming
4	1 Jul 91–30 Jun 97	Limits to life assurance funds use of franking credits
5	1 Jul 97–30 Jun 99	Provisions limiting related payments, holding period and delta hedge
6	1 Jul 99–30 Jun 00	Capital gains tax reduced
7	1 Jul 00–30 Jun 04	Tax rebate for unused franking credits

Table 1: Summary of Tax Regime Changes, adapted from Table 1 of Beggs and Skeels (2006)

Period	Parameter	Estimate	Std. Error
1 Apr 86 - 30 Jun 89	$\gamma_{1,1}$	0.465	0.040
1 Jul 89 - 30 Jun 90	$\gamma_{1,2}$	0.646	0.064
1 Jul 90 - 30 Jun 91	$\gamma_{1,3}$	0.765	0.115
1 Jul 91 - 30 Jun 97	$\gamma_{1,4}$	0.861	0.059
1 Jul 97 - 30 Jun 99	$\gamma_{1,5}$	0.795	0.099
1 Jul 99 - 30 Jun 00	$\gamma_{1,6}$	1.168	0.099
1 Jul 00 - 30 Jun 04	$\gamma_{1,7}$	0.800	0.052
1 Apr 86 - 30 Jun 89	$\gamma_{2,1}$	0.752	0.157
1 Jul 89 - 30 Jun 90	$\gamma_{2,2}$	0.450	0.119
1 Jul 90 - 30 Jun 91	$\gamma_{2,3}$	0.376	0.206
1 Jul 91 - 30 Jun 97	$\gamma_{2,4}$	0.201	0.103
1 Jul 97 - 30 Jun 99	$\gamma_{2,5}$	0.418	0.186
1 Jul 99 - 30 Jun 00	$\gamma_{2,6}$	0.128	0.204
1 Jul 00 - 10 May 04	$\gamma_{2,7}$	0.572	0.121

Table 2: Beggs and Skeels results

Table 2 gives the results of Beggs and Skeels for all seven periods. The AER has used the $\hat{\gamma}_{2,7}$ figure of 0.572 in their determination of the appropriate value of theta and therefore gamma.

The data set used by Beggs and Skeels has only recently become available. However, some observations were filtered by Beggs and Skeels prior to their analysis. The question addressed in this report is whether the Beggs and Skeels results can be replicated.

We were supplied with the ComSec database for the same period as analysed by Beggs and Skeels (2006). After deleting observations with missing values and applying the market capitalization filter, a comparison of the number of dividends for each financial year reported by Beggs and Skeels (2006) and in the ComSec database is reported in Table 1. A comparision of the figures in Table 1 shows that, in almost every year, there are a greater number of franked and unfranked dividend events in the ComSec database than there are in the Beggs and Skeels (2006) filtered dataset. However, there are two exceptions to be taken into consideration:

1. Beggs and Skeels report 336 unfranked dividends in the financial year ending 1986, but there are only 108 dividends over the same period in the ComSec database.

2. Beggs and Skeels report 318 franked dividends in the financial year ending 2003, but there are only 301 franked dividends over the same period in the ComSec database.

Note that the discrepancies are recorded at the start of the sample period (in 1986) and towards the end of the period (in 2003). The principal focus of our analysis is on the time period from 1st

Financial Year	Beggs and Skeels		ComSec	
Ending	Unfranked	Franked	Unfranked	Franked
1986	336	0	108?	0
1987	310	4	430	5
1988	100	160	148	209
1989	101	199	161	259
1990	69	177	101	232
1991	50	186	79	235
1992	43	182	78	219
1993	64	199	88	255
1994	64	208	114	274
1995	76	216	138	287
1996	85	218	155	271
1997	85	229	169	280
1998	72	230	165	271
1999	79	192	161	241
2000	78	189	144	229
2001	68	219	120	280
2002	70	229	107	294
2003	100	318	125	301?
2004	74	232	97	300

Table 3: Comparison of number of franked and unfranked dividends for each year, reported by Beggs and Skeels, and for the ComSec database. Missing values for any variables have been removed and the Market Capitalisation filter has also been applied. The market capitisation filter means eliminating all observations where the market capitisation of a company was not reported, or where the weight of market capitalisation in the All Ordinaries index was less than 0.03 per cent (as per Beggs and Skeels, 2006, page 252).

July 2000 to 30th June 2004. Hence, the shortfall in the number of observations in the ComSec database in 1986 has a very muted impact on the results obtained from simulations conducted over the 2000 to 2004 period. The limited impact that there is is exerted through the error equation (first unnumbered equation on page 243 of Beggs and Skeels, 2006).

2 Attempting to reconstruct the Beggs and Skeels Dataset

2.1 Measuring Deviation from the Beggs and Skeels results

To measure the deviation from the Beggs and Skeels results the correlation between the estimates for the γ_1 and γ_2 parameters are required. These are not given explicitly in Beggs and Skeels (2006). The correlation for the SFG (2009, 2010a, 2010b) analysis for period 7 is -0.729, and the correlations for the parameters for periods 5 and 6 are -0.790 and -0.826, respectively. We decided to use $\rho = -0.8$. In addition, based on the SFG analysis, we have assumed that

parameter estimates from different periods are approximately independent. We do not believe these assumptions will affect our analysis in any substantial way.

Our objective was to try to reproduce the Beggs and Skeels results by filtering observations from the ComSec database. To measure how close our results were to those obtained by Beggs and Skeels for each trial filtered dataset we used the Beggs and Skeels methodology to obtain parameter estimates, and compared those estimates to those obtained from Beggs and Skeels by calculating the density of a multivariate normal distribution with a mean equal to the Beggs and Skeels estimates, standard deviations also given by Beggs and Skeels, with correlation between γ_1 and γ_2 parameters in the same period equal to -0.8, and other correlations between parameters equal to 0. Higher values indicate stronger agreement.

In addition, we also took into account the standard errors by examining the total percentage error squared given by

$$SPE = \left(\frac{\text{se}(\hat{\gamma}_{1,1}) - 0.040}{0.040}\right)^2 + \left(\frac{\text{se}(\hat{\gamma}_{1,2}) - 0.064}{0.064}\right)^2 + \ldots + \left(\frac{\text{se}(\hat{\gamma}_{2,7}) - 0.121}{0.121}\right)^2$$

where the standard errors are given in Table 2.

The criterion we used was a compromise between maximising the density and minimising the value of SPE. After some experimentation we used

$$C = \log(\text{multivariate density}) - 5 \times (SPE).$$

Higher values of C indicate stronger agreement.

2.2 Method

We first randomly sampled from the ComSec database according to the numbers of observations used by Beggs and Skeels. For example, in 1987 there were 430 unfranked dividends and 5 franked dividends in the ComSec database, but Beggs and Skeels (2006) only used 310 unfranked dividends and 4 franked dividends. We selected 310 unfranked dividends from the 430 unfranked dividends at random, and also selected 4 franked dividends from the 5 franked dividends. We did this for each year.[1] We then applied the Beggs and Skeels results to get an initial estimate.

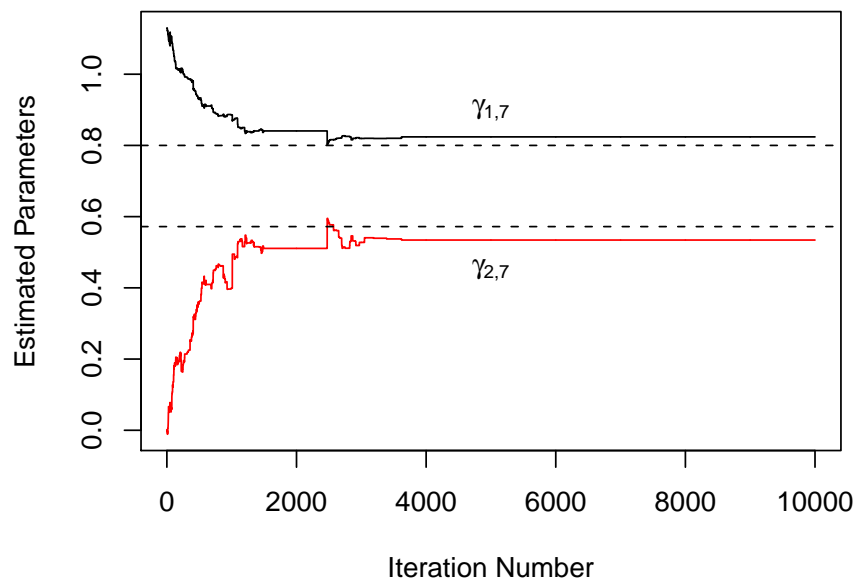[1] We used all 108 ComSec observations for 1986, and all 301 franked observations for 2003.

Figure 1: Estimated values of $\gamma_{1,7}$ and $\gamma_{2,7}$ for 10,000 iterations. The dotted lines correspond to the Beggs and Skeels estimates.

For each iteration ($N = 10,000$) we then tried to improve the solution. At each iteration, we randomly included one observation for each year that was not used in the previous iteration and randomly excluded one observation for the same year that was used at the previous iteration. If the parameter estimates were better (i.e. closer to the Beggs and Skeels estimates) based on a higher value of C, then we retained that solution for subsequent iterations, otherwise we discarded the solution and went back to the best previous solution.

The results are shown in Figure 1 for the period 7 parameters against the iteration number. Although the parameters for period 7 do not match those of Beggs and Skeels (2006), they are quite close.

Figure 2 gives the estimated standard errors. Here the match is not as close as for the parameters. The estimated standard errors are higher than those given by Beggs and Skeels (2006). Note that there are 228 less observations for 1986 and 17 less observations for 2003 in the ComSec dataset than in the Beggs and Skeels (2006) dataset, which might explain some of the differences.
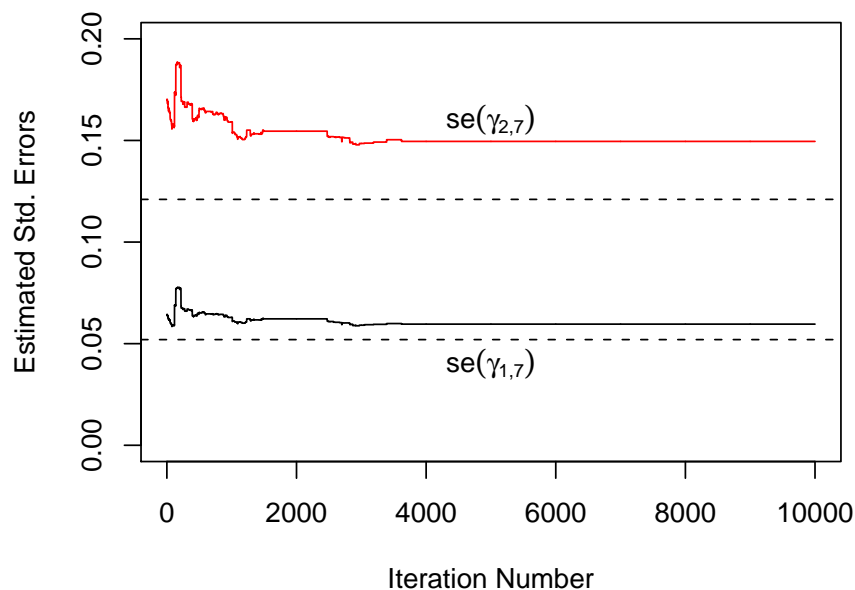
Figure 2: Standard errors of estimated values of $\gamma_{1,7}$ and $\gamma_{2,7}$ for 10,000 iterations. The dotted lines correspond to the Beggs and Skeels standard errors.

3 Conclusions

We have, so far, not been able to replicate the Beggs and Skeels results exactly. We are able to get samples that give very close parameter estimates to those given by Beggs and Skeels (2006). The standard errors of those estimates are higher than those reported by Beggs and Skeels, although this might be partly explained by differences between the ComSec database and that used by Beggs and Skeels.

This is not to say that the Beggs and Skeels (2006) results cannot be replicated but that the method we have used has failed to do so. It should be borne in mind that there are differences in the two datasets, so exact replication is impossible.

The number of possible combinations of filtered observations is exceedingly large and for this reason we have resorted to simulation. All the simulations so far have given higher $\gamma_{1,7}$ and $\gamma_{2,7}$ standard errors than those presented by Beggs and Skeels (2006).

References

Beggs, D.J. and Skeels, C.L., (2006), "Market arbitrage of cash dividends and franking credits," *Economic Record*, **82** (258), 239–252.

Strategic Finance Group Consulting (2009), "The Value of Imputation Credits as Implied by the Methodology of Beggs and Skeels (2006).

Strategic Finance Group: SFG Consulting (2010a). "Response to AER Draft Determination in relation to gamma", January.

Strategic Finance Group: SFG Consulting (2010b). "Further Analysis in response to AER Draft Determination in relation to gamma: Report prepared for ETSA Utilities,", February.

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6th August 2010

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Dr Neil Diamond
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Dear Dr Diamond,

Expert report on the value of imputation credits

The Australian Energy Regulator (**AER**) is currently conducting its five-yearly review of pricing proposals submitted by the five Victorian electricity distribution businesses, United Energy, Citipower, Powercor, Jemena and SP Ausnet. As part of the review process, the AER must determine an appropriate return on capital, which is a function of the valuation of dividend imputation credits, also referred to as gamma. The AER has taken account of a number of dividend drop-off studies in its consideration of the value of gamma, including:

- A 2006 study by Beggs and Skeels;[1] and
- A February 2010 study by SFG Consulting[2]

One of the concerns raised by the AER with the more recent SFG study is multicollinearity. This is one of the reasons for the AER's rejection of the SFG findings and reliance on the Beggs and Skeels study.

In this context, we request a report setting out your expert opinion on the following matters:

1. Whether you consider multicollinearity to significantly impact on the findings of the SFG study.
2. Whether you consider the Beggs and Skeels study should be relied upon by the AER, given that the dataset has not been made available by the authors and the results cannot be reproduced.

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[1]   Beggs, D. J. and Skeels, C.L., (2006), 'Market arbitrage of cash dividends and franking credits', *Economic Record*, 82 (258), 239 – 252.

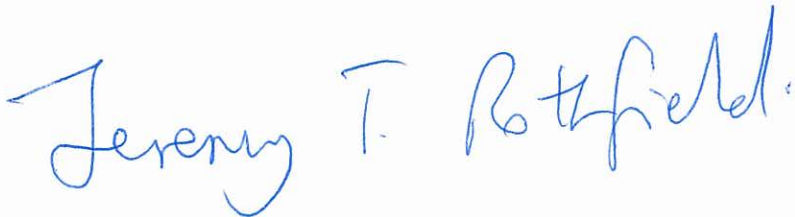## Guidelines in preparing your report

Attached are Expert Witness Guidelines issued by the Federal Court of Australia. Although this brief is not in the context of litigation, the Victorian electricity distribution businesses are seeking a rigorously prepared independent view for use in the context of regulatory decision making and you are requested to follow the Guidelines to the extent reasonably possible in the context.

In particular, please:

Identify your relevant area of expertise and provide a curriculum vitae setting out the details of that expertise:

1.1.1. only address matters that are within your expertise;

1.1.2. where you have used factual or data inputs please identify those inputs and the sources;

1.1.3. if you make assumptions, please identify them as such and confirm that they are in your opinion reasonable assumptions to make;

1.1.4. if you undertake empirical work, please identify and explain the methods used by you in a manner that is accessible to a person not expert in your field;

1.1.5. confirm that you have made all the inquiries that you believe are desirable and appropriate and that no matters of significance that you regard as relevant have, to your knowledge, been withheld from your report; and

1.1.6. please do not provide legal advocacy or argument and please do not use an argumentative tone.

Yours sincerely,

Jeremy Rothfield
Regulatory Economist

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[2] SFG, *Further analysis in response to the AER Draft Determination in relation to gamma: Prepared for ETSA Utilities*, 4 February 2010

FEDERAL COURT OF AUSTRALIA
Practice Note CM 7
EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

1. Practitioners should give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

2. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[1], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court[2]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential[3].

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert Evidence[4]

2.1 An expert's written report must give details of the expert's qualifications and of the literature or other material used in making the report.

2.2 All assumptions of fact made by the expert should be clearly and fully stated.

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[1] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].
[2] See rule 35.3 Civil Procedure Rules (UK); see also Lord Woolf "Medics, Lawyers and the Courts" [1997] 16 CJQ 302 at 313.
[3] See *Sampi v State of Western Australia* [2005] FCA 777 at [792]-[793], and *ACCC v Liquorland and Woolworths* [2006] FCA 826 at [836]-[842]
[4] See rule 35.10 Civil Procedure Rules (UK) and Practice Direction 35 – Experts and Assessors (UK); *HG v the Queen* (1999) 197 CLR 414 per Gleeson CJ at [39]-[43]; *Ocean Marine Mutual Insurance Association (Europe) OV v Jetopay Pty Ltd* [2000] FCA 1463 (FC) at [17]-[23]

2.3 The report should identify and state the qualifications of each person who carried out any tests or experiments upon which the expert relied in compiling the report.

2.4 Where several opinions are provided in the report, the expert should summarise them.

2.5 The expert should give the reasons for each opinion.

2.6 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.7 There should be included in or attached to the report: (i) a statement of the questions or issues that the expert was asked to address; (ii) the factual premises upon which the report proceeds; and (iii) the documents and other materials that the expert has been instructed to consider.

2.8 If, after exchange of reports or at any other stage, an expert witness changes a material opinion, having read another expert's report or for any other reason, the change should be communicated in a timely manner (through legal representatives) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[5].

2.9 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report (see footnote 5).

2.10 The expert should make it clear when a particular question or issue falls outside the relevant field of expertise.

2.11 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[6].

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

M E J BLACK
Chief Justice
25 September 2009

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[5] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565
[6] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240