The value of imputation credits as implied by the methodology of Beggs and Skeels (2006)

Report prepared for ENA, APIA, and Grid Australia

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Context, reason for report, and summary

Context

1. This report has been prepared by Professor Stephen Gray, Professor of Finance at the University of Queensland Business School and Managing Director of Strategic Finance Group (SFG Consulting), a corporate finance consultancy specialising in valuation, regulatory and litigation support advice.

2. I have previously prepared a report dated 16 September 2008 and titled *The effect of franking credits on the cost of capital of Australian firms* in relation to this decision-making process. Some elements of that report were considered by the AER in its *Review of WACC parameters: Explanatory statement* (the *Explanatory Statement*).[1] I have now been engaged by the ENA, APIA, and Grid Australia to provide a response to certain issues raised in the *Explanatory Statement*.

3. For the purposes of preparing this report I was provided with a copy of the Federal Court guidelines *Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia* dated 5 May 2008. I have reviewed those guidelines and this report has been prepared consistently with the form of expert evidence required by those guidelines. In preparing this report, I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld.

4. In a supplementary submission, the AER has been provided with a report dated 12 November 2008 and titled *The impact of franking credits on the Cost of capital of Australian companies: Supporting evidence submitted to the Australian Energy Regulator*. This report provides additional explanation of the research method and statistical output which underpinned dividend drop-off analysis which was submitted to the AER and previously submitted to the Essential Services Commission (ESC) on 25 October 2007. The AER has also been provided with the dataset used in this analysis.

Purpose of this report and summary of conclusions

Instructions for this report

5. In this report I have been asked to:

   a. Apply the Beggs and Skeels (2006) methodology to the Beggs and Skeels sub-sample of data post 2000, and confirm that this process replicates the parameter estimates reported by Beggs and Skeels.

   b. Extend the sample to incorporate more recent data, but replicate the Beggs and Skeels methodology in other respects, and report the relevant parameter estimates.

Beggs and Skeels methodology

6. The *Explanatory Statement* relies upon the result of Beggs and Skeels (2006) using only data post July 2000. In my view, the Beggs and Skeels variation of the dividend drop-off method, applied to various short sub-periods of data, does not provide the most reliable empirical estimates. I reach this conclusion primarily due to the fact that the Beggs and Skeels point estimates for theta and the value of cash dividends vary considerably across sub-periods and for some sub-periods

[1] Australian Energy Regulator (2008), Electricity transmission and distribution network service providers -- Review of the weighted-average cost of capital (WACC) parameters: Explanatory statement, December.

are simply implausible. For example, Beggs and Skeels estimate the market value of a one dollar cash dividend to be $1.18 in their Regime 6.

7. The reason for this is that:

   a. The estimates are very sensitive to the effect of a very small number of highly influential outlier observations; and

   b. The estimates for all dividend drop-off results are affected by noise in the data such that reliable estimates can only be obtained with larger data sets.

8. On the issue of sample size, as it relates to drop-off studies generally, the leading US paper concludes that:

> a significant problem confronting researchers in this area – an extremely high noise-to-signal ratio. Dividend yields vary across stocks and across time, but their variability is miniscule compared to that of daily stock returns…To illustrate these issues we estimate price drop equations annually for each of the 25 years in our sample. Simply put, the results vary enormously from year to year. The implication is that inferences based on one or a few years' data will be extremely imprecise. One solution is to examine a very long time period as is done in this study.[2]

9. In summary, in this report I have examined the Beggs and Skeels methodology applied to the post July 2000 period not because I believe this provides the most reliable estimate, but only as a way of illustrating the approach favoured in the *Explanatory Statement* as it applies to more recent data.

Beggs and Skeels sample period

10. My replication of Beggs and Skeels (2006) generates very similar coefficient estimates for the value of cash dividends and imputation credits for the period 1 July 2000 to 10 May 2004.

11. I also exclude the 1% of most influential observations (a total of 11 observations out of 1,389) to improve the consistency of estimates over time, the fit to the data (measured by R-squared values), and consequently the reliability of the estimate. This results in an estimate of theta of 0.19.

Sample period of SFG study (30 September 2006)

12. Extending this sample period to 30 September 2006, but making no other adjustments to the sample or methodology of Beggs and Skeels, results in an estimate of theta of 0.37.

13. Excluding the 1% of most influential observations results in an estimate of theta of 0.24.

14. In all cases, the estimate of theta only has a positive value to the extent that cash dividends are assumed to be less than fully valued.

[2] Boyd and Jagannathan (1994, p. 715-716).

Other considerations

15. All of the data and computer programs used in the analyses in this report have been provided to the Joint Industry Associations for provision to the AER as appropriate.

16. The AER recognises that a larger data set is desirable, but has not yet considered the data post 2004:

> Despite the advantage of providing more up-to-date estimates (i.e. to 2006), the reliability of the estimates provided by SFG in its 2008 dividend drop-off study cannot be verified. Therefore the results have not been considered further at this stage.[3]

Professor Stephen Gray
1 February 2009

[3] *Explanatory Statement*, p. 328.

Prior results and earlier report

17. My earlier report sets out the results of a comprehensive dividend drop-off analysis first conducted by SFG for the ESC's recent gas distribution review. The SFG study provides estimates using three variations of the dividend drop-off methodology:

    a. Beggs and Skeels (2006);

    b. Hathaway and Officer (2004); and

    c. ACG (2006).

18. The SFG study also provides separate estimates for three different sub-periods that correspond to Tax Regimes 5, 6, and 7 of Beggs and Skeels (2006). The results for Regime 7 extend the Beggs and Skeels sample period from May 2004 through to September 2006.

19. The SFG study also separately reports estimates after having applied various filters to the data as follows:

    a. Restricting the data to large firms only;

    b. Removing extreme drop-off values (top 1% of sample);

    c. Removing extreme dividend values (top 1% of sample);

    d. Removing the 1% most influential outlier observations as identified by Cook's D statistic.

20. The key conclusions from the SFG analysis are that:

    a. Longer data periods with a greater number of observations are more likely to produce robust and reliable results;

    b. Filtering out a small number of influential outlier observations dramatically improves the stability of estimates across sub-periods, the way the data fits the model, and the reliability of the resulting estimates;

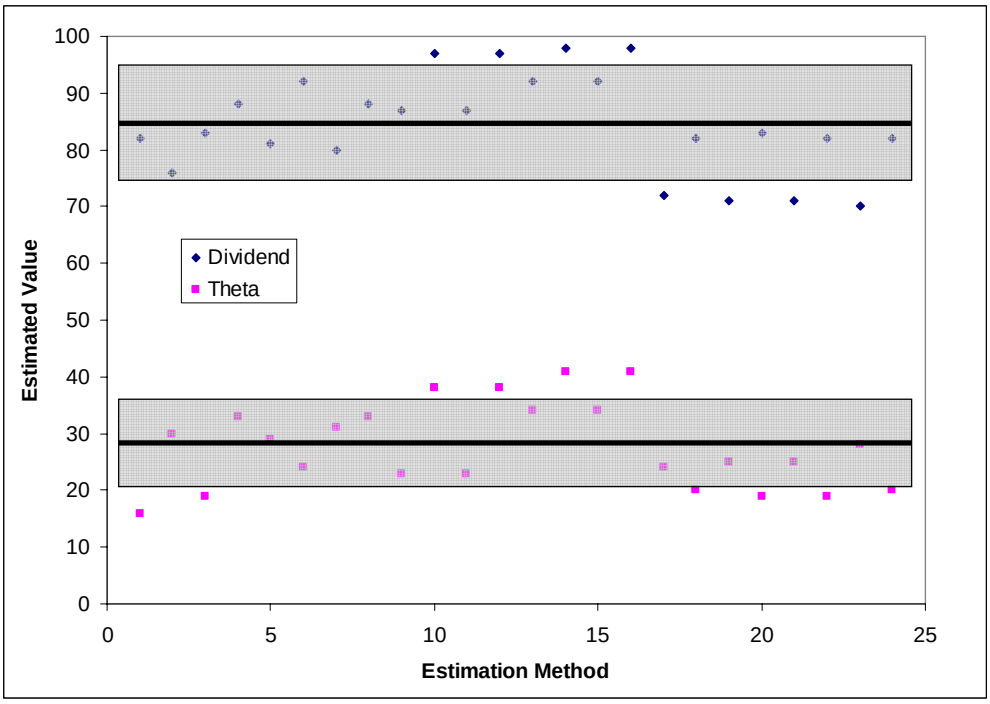
    c. There is no evidence of a change in parameter estimates from before 2000 (Regime 4) and after 2000 (Regime 6);

    d. The combined value of a one dollar dividend and the associated 43 cent franking credit is one dollar; and

    e. Any estimate of a positive value for franking credits (theta) is conditional on a dollar of cash dividends being worth less than a dollar.

21. The SFG results were summarised in Figure 6 in my earlier report as follows:

Figure 6 from Gray (2008, p.26)



22. My earlier report concluded that:

> …the majority of our estimates of theta lie in (or close to) the range of 0.2 to 0.35. Similarly, the majority of our estimates of the value of cash dividends lie in (or close to) the range of 0.75 to 0.95.[4]

and that:

> The average estimated combined value of a $1.00 dividend and the associated franking credit is 97 cents.[5]

23. In summary, the key results from my earlier report are that when the data is extended through to the end of 2006:

a. Standard dividend drop-off techniques produce estimates of theta in the range of 0.2 to 0.35; and

b. These estimates of theta are conditional on cash dividends being worth substantially less than capital gains.

[4] Gray (2008, p.28).
[5] Gray (2008, p.28).

AER approach

24. In its *Explanatory Statement,* the AER placed substantial weight on the dividend drop-off analysis of Beggs and Skeels (2006), specifically upon the estimated value of theta of 0.57 derived from ex-dividend dates from 1 July 2000 to 10 May 2004. The AER concludes that:

> …the 2006 Beggs and Skeels study provides the most comprehensive, reliable and robust estimate of theta inferred from market prices in the post-2000 period. Accordingly the AER has placed significant weight on the 2001 – 2004 estimate of theta from this study, of 0.57 (p.328).

25. In my discussion of Beggs and Skeels (2006) in my earlier report, I made the point that regression analysis simultaneously generates estimates of the value of cash dividends and imputation credits. Specifically, for the 2001 – 2004 period, Beggs and Skeels jointly estimate the value of imputation credits at 57.2 cents in the dollar and the value of cash dividends at 80.0 cents in the dollar.[6] These coefficient estimates jointly imply an estimated market value of $1.045 for the package of a one dollar dividend and the attached 43 cent franking credit.

26. In my earlier report, I also updated the results of Beggs and Skeels (2006) using dividend events ending 30 September 2006, which extends the sample period by two years and five months.[7] The sample which corresponds most closely to that of Beggs and Skeels is the "large firms" whose market capitalisation is at least 0.03% of the All Ordinaries Index, the same filter employed by Beggs and Skeels. For this sub-sample, and using the method employed by Beggs and Skeels, the estimated value of cash dividends was 91 cents in the dollar and the estimated value of imputation credits was 37 cents in the dollar.[8] These coefficient estimates jointly imply an estimated market value of $1.071 for the package of a one dollar dividend and the attached 43 cent franking credit.[9]

27. I also presented results which excluded the most influential 1% of observations, as measured by the Cook's D influence statistic.[10] For large firms, the estimated value of cash dividends was 92 cents in the dollar and the estimated value of imputation credits was 24 cents in the dollar.[11] These coefficient estimates jointly imply an estimated market value of $1.017 for the package of a one dollar dividend and the attached 43 cent franking credit.

28. In summary, my earlier report applies the methodology of Beggs and Skeels to the post 1 July 2000 period examined by Beggs and Skeels and favoured by the AER, but extended through to the end of September 2006. I report estimates of theta of 0.37 when applied to the whole data set and 0.24 when the top 1% of influential outliers is removed. In both cases, the estimate of theta is conditional on a dollar of cash dividends being valued at less than a dollar.

[6] Beggs and Skeels (2006), Table 5, p.247.

[7] These estimations were originally performed for a submission to the Victorian Gas Distribution Price Review performed by the Essential Services Commission, and data through to the end of September 2006 was available at the date of that report.

[8] Gray (2008), Table 3, p.57.

[9] Value of cash dividends × Cash dividends + Value of imputation credits × Imputation credits = 0.913 × $1.000 + 0.369 × 0.3 ÷ 0.7 = $0.913 + $0.158 = $1.071.

[10] Cook's D statistic or "Cook's Distance" is a commonly used estimate of the influence that a specific observation has on the coefficient estimates in the context of ordinary least squares regression analysis. It is used to identify outliers that have an undue influence on the coefficient estimates. It is a standard metric that is now coded into most statistics packages. See Cook (1977) and Cook (1979).

[11] Gray (2008), Table 4, p.59.

Comparison of SFG and Beggs-Skeels results

29. The results from the SFG analysis summarised in my earlier report are more comprehensive than those of Beggs and Skeels (2006) in two respects:

a. The SFG results are based on a much larger cross-section of firms; and

b. The SFG results are based on a longer and more recent data period.

30. In this report, I have been asked to demonstrate that the SFG results are consistent with those of Beggs and Skeels (2006), when restricted to the subset of firms and sub-period of data examined by Beggs and Skeels. I have also been asked to show how these results vary when more firms and a longer and more recent data period is included in the Beggs-Skeels analysis.

31. The table below presents a comparison of the statistics reported by Beggs and Skeels (2006) to those generated by my analysis. The shaded cells represent estimates for the period post 30 June 2000 upon which the AER has placed substantial weight. The columns headed "Cash" and "Franking" present estimated values for cash dividends and franking credits, corresponding to Equation 6 of Beggs and Skeels (2006) and incorporating their methodology. Standard errors are reported in parentheses.

Table 1. Comparison with Beggs and Skeels (2006)

	Beggs & Skeels (2006)			SFG (2008)			SFG (2008) excl. influential 1%		
	Cash	Franking	N	Cash	Franking	N	Cash	Franking	N
Regression analysis ending 10 May 2004									
1 July 1985 – 30 June 1988	0.465 (0.040)	0.752 (0.157)	910						
1 July 1988 – 30 June 1990	0.646 (0.064)	0.450 (0.119)	546						
1 July 1990 – 30 June 1991	0.765 (0.115)	0.376 (0.206)	236						
1 July 1991 – 30 June 1997	0.861 (0.059)	0.201 (0.103)	1,669						
1 July 1997 – 30 June 1999	0.795 (0.099)	0.418 (0.186)	573	0.773 (0.270)	0.361 (0.645)	710	0.871 (0.087)	0.142 (0.184)	699
1 July 1999 – 30 June 2000	1.168 (0.099)	0.128 (0.204)	267	0.205 (0.184)	1.163 (0.710)	329	0.746 (0.102)	0.360 (0.239)	326
1 July 2000 – 10 May 2004	**0.800** (0.052)	**0.572** (0.121)	1,310	**0.895** (0.227)	**0.526** (0.541)	1,389	0.945 (0.059)	0.190 (0.136)	1,378
			5,511	Adj-R^2	1.9%	2,428	Adj-R^2	24.1%	2,403
Regression analysis ending 30 September 2006									
1 July 1997 – 30 June 1999				0.761 (0.235)	0.437 (0.577)	710	0.844 (0.085)	0.246 (0.186)	696
1 July 1999 – 30 June 2000				0.100 (0.077)	1.439 (0.577)	329	0.797 (0.102)	0.224 (0.240)	326
1 July 2000 – 31 Dec 2006				**0.913** (0.168)	**0.369** (0.388)	2,182	0.916 (0.049)	0.235 (0.111)	2,166
				Adj-R^2	3.5%	3,221	Adj-R^2	31.0%	3,188

32. In this note, I disaggregate the data into observations coinciding with the period analysed by Beggs and Skeels (2006) – 1 July 2000 to 10 May 2004 – and the subsequent period until 30 September 2006.

33. Consider the first shaded row in the table. This corresponds to the post 1 July period analysed by Beggs and Skeels (2006). It is these results that the AER considers to be the most compelling among all dividend drop-off results – indeed among all methods that seek to estimate the *market value* of franking credits. Beggs and Skeels (2006) restrict their analysis to large firms, but do not report a list of precisely which firms were included in their sample. I seek to match their sample of firms as closely as possible by restricting the sample to those firms that account for 0.03% or more of the All Ordinaries Index (the same filter referred to by Beggs and Skeels). As a result, the sample contains 1,389 dividend events during the Beggs and Skeels sample period compared with their 1,310 events, which is a relatively close match. I note, in this regard, that Beggs and Skeels (2006, p. 252) state that they have removed a number of observations for which they were unable to obtain all required data items.

34. Specifically, Beggs and Skeels (2006) describe their sample as:

> Data are for companies and trusts whose primary listing is on the Australian Stock Exchange. The dataset has been filtered to remove all observations where the dividend payment, the corporate tax rate, the cum-dividend share price or the ex-dividend share price was not known…A second filter eliminated all cases where the market capitalisation of a company was not reported, or where the weight of market capitalisation in the All Ordinaries index was less that 0.03 per cent.[12]

35. Beggs and Skeels (2006) do not list the observations for which they were unable to obtain all of the required data items, so it is impossible to know exactly what sample they use. Having used the same size filter and the same time period, I have matched their sample data as closely as is possible. However, there remains a small number of dividend events that are in the SFG sample, but for which Beggs and Skeels could not obtain all of the required data.

36. My parameter estimates also replicate quite closely those of Beggs and Skeels (2006). The estimated value of cash dividends is 89.5 cents per dollar (compared to 80.0 cents per dollar as reported by Beggs and Skeels) and the estimated value for imputation credits is 52.6 cents per dollar (compared to 57.2 cents per dollar as reported by Beggs and Skeels).

37. In my view, these two sets of estimates are very close in the circumstances. I reach this conclusion for two reasons:

    a. Beggs and Skeels (2006) report great variation in their parameter estimates across the various sub-periods that they examine. Relative to this inter-temporal variation, the SFG and Beggs-Skeels estimates for the 2001-2004 period are very close indeed; and

    b. I demonstrate below that the parameter estimates from the Beggs-Skeels methodology are highly sensitive to a small number of influential outlier observations. Consequently, when there is not a perfect match between data samples, some degree of difference in the parameter estimates is to be expected.

38. In summary, when I apply the Beggs and Skeels methodology to the subset of my data that best matches that used by Beggs and Skeels (2006), I am able to closely replicate the parameter estimates reported by Beggs and Skeels.

[12] Beggs and Skeels (2006), p. 252. Error in original.

Extension of time period to include additional data

39. The second shaded row in the table above contains the results of my analysis where:

a. I continue to apply the Beggs-Skeels econometric methodology;

b. I continue to use only large firms by applying the Beggs-Skeels filter of firms that make up 0.03% or more of the index; and

c. I extend the sample period through to September 2006 (approximately two and half years of additional data).

40. In my view, it is important to have as long a time period as possible for this sort of analysis. A greater number of observations will produce more robust and reliable parameter estimates. Alternatively, shorter time periods with fewer observations will produce unreliable, and in some cases implausible, results. For example, the shortest sub-period examined by Beggs and Skeels (2006) is their Tax Regime 6 from September 1999 to June 2000. For that period they report that a one dollar cash dividend was valued by the market at $1.168. The Beggs-Skeels methodology is less likely to produce unreliable estimates when applied to longer data periods.

41. Incorporating the more recent data results in coefficient estimates of 0.913 for cash dividends and 0.369 for franking credits. These coefficients jointly imply a value for one dollar of fully-franked dividends (dividend plus franking credit) of $1.071.

42. That is, when more recent data is included but the estimation process remains unchanged in all other respects, the estimate of theta falls from 0.57 (as estimated by Beggs and Skeels) to 0.37.

Exclusion of outliers/influential observations

Improving the reliability of estimates

43. One issue that arises in dividend drop-off analyses is the influence of outliers and highly influential observations. There is some potential for the results to be substantially influenced by a small number of observations. Indeed, one of the reasons for Beggs and Skeels restricting their analysis to large firms is to reduce the likelihood of extreme outliers. They note that:

> Although market capitalisation alone is not critical to the analysis, companies with very small market capitalisations tend to be rarely traded on the stock exchange. Therefore the market pricing mechanisms for firms with small market capitalisations are not efficient, and the price changes on the ex-dividend date will be an unreliable measure of true scarcity.[13]

44. That is, Beggs and Skeels (2006) are concerned about some observations being unrepresentative and having an undue influence of the parameter estimates causing them to be unreliable. In response to this, they apply a filter that restricts their sample to relatively large firms only.

45. In this regard, I note that two of the key conclusions from the SFG analysis were that:

a. Longer data periods with a greater number of observations are more likely to produce robust and reliable results; and

b. Filtering out a small number of influential outlier observations dramatically improves the stability of estimates across sub-periods, the way the data fits the model, and the reliability of the resulting estimates.

46. That is, in addition to screening out small firms, the reliability of the estimates can be improved by taking a longer data period (increasing the number of observations) and by directly eliminating influential outliers that have undue influence on the results.

47. I note below that these measures produce parameter estimates that are much more stable across different sub-periods and the fit to the data (as measured by the R-squared statistic) increases dramatically.[14]

The removal of unduly influential observations using Cook's D

48. In my earlier report I noted that the Beggs and Skeels results were very consistent across the various time periods in reporting that a one dollar fully-franked dividend (dividend plus franking credit) was valued at close to one dollar, but that the separate estimates of the value of the dividend on one hand and the value of the franking credit on the other varied substantially across their sub-periods. This is symptomatic of statistical problems in the data.

[13] Beggs and Skeels (2006), Footnote 16, p. 252.

[14] The R-squared statistic measures the proportion of the dependent variable that is explained by variation in the independent variable. It is a measure of how well the proposed model fits the data. Under the Beggs and Skeels methodology, the dependent variable is the price change on the ex-dividend date and the independent variables are the dividend and the franking credit. An R-squared statistic of 20%, for example, would indicate that 20% of the variation in prices is explained by the dividend and franking credit and 80% of the variation is due to other factors.

49. Consequently, I also examine an approach that involves directly identify and excluding the 1% of observations that are most influential to the analysis. I identify these overly influential observations using the Cook's D statistic and report the results in the right-hand columns in the table above. I also reported these results in my earlier report.

50. In general, the elimination of this small number of overly influential observations dramatically improves the stability of estimates across sub-periods and the overall fit of the data, as measured by the R-squared statistic. For these reasons, I consider this set of results to be the most robust and reliable.

51. Excluding the most influential 1% of observations, and relying only on the Beggs-Skeels period (1 July 2001 to 10 May 2004) results in an estimated value for cash dividends of 94.5 cents per dollar and an estimated value for imputation credits of 19 cents per dollar. In aggregate, these coefficients jointly imply a value for one dollar of fully-franked dividends (dividend plus franking credit) of $1.026.[15]

52. That is, when the Beggs and Skeels methodology is applied to the Beggs and Skeels sample period and the 1% of most influential observations are removed from the analysis to improve stability, reliability and fit to the data, the estimate of theta is 0.19.

53. Including observations until 30 September 2006 results in an estimated value for cash dividends of 91.6 cents per dollar and an estimated value for imputation credits of 23.5 cents per dollar, implying a value for one dollar of fully-franked dividends (dividend plus franking credit) of $1.017.[16]

54. That is, when the Beggs and Skeels methodology is applied to the extended and more recent sample period and the 1% of most influential observations are removed from the analysis to improve stability, reliability and fit to the data, the estimate of theta is 0.24.

55. In summary, when the 1% of most influential observations are eliminated, the estimate of theta is:

    a. 0.19 for the Beggs and Skeels 2001-2004 period, and

    b. 0.24 for the period extended to the end of September 2006.

    Both of these estimates are conditional on a dollar of cash dividends being valued at less than a dollar.

56. There is no fundamental reason for any change in the value of cash dividends and imputation credits over this extended time period. All we are observing is the coefficient estimates being estimated with more precision once the time period and sample size is extended. The large sample of 3,221 observations (compared to 2,428 observations up to 10 May 2004) increases the adjusted R-squared statistic from the regression analysis to 3.5% from 1.9%. Excluding the most influential 1% of observations, results in sample sizes of 3,188 and 2,403. For the larger sample, the adjusted R-squared statistic is 31.0%, compared to 24.1% for the smaller sample. This also highlights the impact that a small number of influential observations can have on empirical

[15] Value of cash dividends × Cash dividends + Value of imputation credits × Imputation credits = 0.945 × $1.000 + 0.190 × 0.3 ÷ 0.7 = $0.945 + $0.081 = $1.026.

[16] Value of cash dividends × Cash dividends + Value of imputation credits × Imputation credits = 0.916 × $1.000 + 0.235 × 0.3 ÷ 0.7 = $0.916 + $0.101 = $1.017.

estimates. Excluding these observations also results in coefficients which are much more stable over different time periods.

Summary and conclusions

Beggs and Skeels sample period

57. My replication of Beggs and Skeels (2006) generates very similar coefficient estimates for the value of cash dividends and imputation credits for the period 1 July 2000 to 10 May 2004.

58. I also exclude the 1% of most influential observations (a total of 11 observations out of 1,389) to improve the consistency of estimates over time, the fit to the data (measured by R-squared values), and consequently the reliability of the estimate. This results in an estimate of theta of 0.19.

Sample period of SFG study (30 September 2006)

59. Extending this sample period to 30 September 2006, but making no other adjustments to the sample or methodology of Beggs and Skeels, results in an estimate of theta of 0.37.

60. Excluding the 1% of most influential observations results in an estimate of theta of 0.24.

61. In all cases, the estimate of theta only has a positive value to the extent that cash dividends are assumed to be less than fully valued.

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