



Peer review of SFG Consulting reports on Gamma

A report to the ENA, APIA and Grid Australia

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Executive summary

Synergies has been engaged by ENA, APIA and Grid Australia to provide a peer review of the work undertaken by SFG Consulting in respect of an estimate of gamma for electricity transmission and distribution businesses. The engagement requires Synergies to review the Explanatory Statement by the AER, various papers prepared by SFG Consulting and the work performed by other authors, particularly that of Beggs and Skeels. We conclude:

- studies using the dividend drop-off methodology need to be treated with caution given the collinearity¹ between dividends and franking credits. Under the Beggs and Skeels methodology it is not possible to separately value dividends and franking credits in a conclusive manner due to collinearity;
- the introduction of the Rebate Provision did not result in a major structural change that has fundamentally impacted the value of franking credits. Studies that seek to estimate theta using data prior to this date will not under-estimate the value of gamma.
- Beggs and Skeels (2006) provided a theta value of 0.572 for an analysis of data from 1/7/2000 to 10/5/2004. This result followed a 12 month period ending 30/6/2000 where the results appear to be distorted due to sampling error.
- SFG Consulting provide a comprehensive analysis of key dividend drop-off studies and concluded that theta should have a value of less than 0.5 but it is difficult to separate the cash dividend from the theta due to due to collinearity. Theta is conditional upon the estimated value of the cash dividend. SFG Consulting also provide empirical evidence that theta did not change moving from pre 2000 to post 2000.
- SFG Consulting also extended the Beggs and Skeels (2006) study replicating as best as possible the results. They improve upon the study by extending the study and also by removing outliers. Both valid adjustments produce results that are consistent with finance theory and will result in more reliable estimates.
- We have reviewed the work of SFG Consulting. We agree with the propositions made by them and we confirm the results that they found. We analysed the empirical work and found it to be a robust analysis. We confirm the accuracy of the results reported.

¹ There is a glossary of statistical/econometric terms in the appendix



• the SFG Consulting results are supported by several recent robust empirical investigations which have concluded that the value of franking credits is less than 0.5. Synergies provides the results of two studies that it has performed that support the SFG results.

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1 Introduction

The ENA, APIA and Grid Australia engaged Synergies to review the work undertaken by SFG Consulting in respect an estimate of the gamma parameter required for the Weighted Average Cost of Capital (WACC) for electricity transmission and distribution businesses.

The engagement requires Synergies to review the Explanatory Statement² by the AER, various papers prepared by SFG Consulting³ (SFG), the work performed by various other authors⁴ and in particular work undertaken by Beggs and Skeels.⁵

In this peer review we analyse the research performed by both Beggs and Skeels and SFG Consulting and we assess the claims made and the conclusions drawn by the authors. We express an opinion in this report about the robustness and validity of the assertions made.

This paper is structured as follows:

- section 2 provides an overview of gamma;
- section 3 sets out our approach to this peer review;
- section 4 reviews of the SFG September 2008 report;
- section 5 reviews the SFG January 2009 report which replicates, extends and improves upon the Beggs and Skeels study;
- section 6 summarises studies performed by Synergies which supports SFG Consulting; and

² Review of the weighted average cost of capital (WACC) parameters December 2008

³ The impact of franking credits on the cost of capital of Australian firms Report prepared for ENA, APIA, and Grid Australia 16 September 2008, The impact of franking credits on the cost of capital of Australian companies Supporting evidence submitted to the Australian Energy Regulator: 12 November 2008, and The value of imputation credits as implied by the methodology of Beggs and Skeels (2006) Report prepared for ENA, APIA, and Grid Australia 16 January 2009

⁴ Bellamy, D., and Gray, S. (2004). Using Stock Price Changes to Estimate the Value of Dividend Franking Credits. Working Paper, University of Queensland; Cannavan, D., Finn, F. and Gray, S. (2004). The Valuation of Dividend Imputation Tax Credits in Australia. Journal of Financial Economics, 73, 167–197; Gray, S. and Hall, J. (2006). The Relationship Between Franking Credits and the Market Risk Premium. Accounting and Finance, 46, 405–428; Gray, S. and Hall, J. (2006). Relationship Between Franking Credits and the Market Risk Premium: A Reply. Accounting and Finance, 48, 133–142; Hathaway, N. and Officer, R. (2004). The Value of Imputation Tax Credits: Update 2004 Capital Research Pty. Ltd and Partington, G. and Walker, S. (1999). The Value of Dividends: Evidence from Cumdividend Trading in the Ex-dividend Period. Accounting and Finance, 39, 275–296.

⁵ Beggs, D. J. and Skeels, C. L. (2006). Market Arbitrage of Cash Dividends and Franking Credits. Economic Record, 82, 239–252.



• section 7 summarises the findings of this study.

There are a number of appendices including a discussion of the payout ratio, details of two drop-off studies including Beggs and Skeels (2006), an explanation of the marginal investor assumption and a glossary of statistical terms.

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2 Background

2.1 Overview of the imputation tax system

In an imputation tax system, shareholders receive a cash dividend and a franking credit. The franking credit represents the amount of corporate tax prepaid by the company on the profit from which the dividend was paid.

Imputation credits are created when companies pay Australian corporate tax on their profits and distribute profits to shareholders by paying dividends on their Australian-sourced profits. Franking credits received by shareholders may then be used by Australian residents and Australian resident superannuation funds to offset their own Australian tax liabilities.

In addition to these classes of investor, domestic tax exempt and low-tax companies and individuals have been eligible to receive a cash rebate for unused credits since July 2000. Non-resident investors, on the other hand, are ineligible for the cash rebate as they have no Australian tax liabilities. This class of investor derives no value from franking credits.

The value of franking credits is intrinsically linked to the value assigned to gamma, where, broadly speaking, gamma is the value that the market places on one dollar of franking credits created.

There are two quantities to consider when calculating gamma, as it is the product of the distribution rate or payout ratio of franking credits and the market value of franking credits. That is,

 γ (gamma) = Imputation credit payout ratio x Value of Franking Credits θ (referred to as theta)

The first quantity, the payout ratio, is the proportion of franking credits created by Australian companies that are paid out to shareholders. The second item, the value of franking credits, is the value the market places on each dollar of distributed franking credit. The payout ratio represents an upper bound on gamma, so that gamma and the value of franking credits are equal only if 100% of created franking credits are paid out. Appendix A contains a brief summary of payout ratio issues.

There exists considerable disagreement regarding estimates of the value of franking credits. The first point of difference is whether the amount of the franking credit is relevant or the value of the franking credit is relevant. The amount of the franking



credit may possibly be estimated from data collected by the Australian Taxation Office (ATO).

The value of the franking credit cannot be ascertained from ATO data. For shareholders to benefit from dividend imputation, the shareholders must own shares and provide the risk capital of the business. Shareholders being placed at risk means, that the franking credits have a market value less than their stated value. The market value of franking credits is commonly estimated from dividend drop-off studies.

2.2 Valuing imputation credits - drop-off studies

A method for valuing imputation credits is an ex-date event studies, in which the dropoff of the share price over the ex-dividend date is modelled as a function of the cash dividend, the franking credit and the market return.

Box 1 Dividend drop-off

A company declares a dividend and pays the dividend to the shareholder who is on record as being the owner of the share at a particular point in time. That shareholder receives the dividend and the share has traded cum-dividend up to this time. On subsequent dates, the share trades ex-dividend, the effect being that any new owner will not receive the declared dividend. There will be a change in share price from when the dividend trades cum-dividend compared to when it trades ex-dividend. This change in price is called the dividend drop-off.

Whilst this method is very inclusive in that it allows the behaviour across many different stocks to be analysed at once, the ex-date behaviour of the stocks is clearly subject to large amounts of noise, particularly in times of high market volatility, and is also subject to microstructure issues such as the influence of ex-date arbitrageurs (see, for example, Cannavan et al., 2004).

On the other hand, other arguably more robust techniques, such as comparing the behaviour of a stock traded domestically around its ex-dividend date with the behaviour of the same stock traded on foreign exchanges, are not susceptible to the same "noise" issues. The drawback with these techniques, however, is that the number of stocks that can be analysed is dramatically reduced and the behaviour of investors in these stocks and their alternatively-traded forms may not be representative of long-term providers of equity capital in the Australian market.

Appendix C contains a summary of three relevant drop-off studies attempting to estimate the market value of franking credits.



3 Approach to peer review

Our instructions for this report involved:

- reviewing and commenting on the SFG September 2008 report; and
- performing a peer review on the SFG January 2009 report.

Our approach to the peer review involved the following steps:

- we initiated the process with a review of the SFG paper;
- we then met with representatives of SFG to confirm our understanding of the underlying methodology applied by SFG;
- we obtained and reviewed the SFG data set. We were familiar with the data set by virtue of the work that we have independently performed on the valuation of gamma. Accordingly, we reviewed the SFG data to confirm it met with our expectations. However, we did not recreate the data set from source data;
- we undertook a detailed analysis of the code used by SFG (Code) for its analysis. The process involved:
 - meeting with SFG to discuss the relevant Code;
 - we confirmed that the SFG approach (as applied in the Code) was consistent with our understanding of manipulations that should be performed for the analysis to be correctly undertaken;
 - we independently verified that the Code operated in the manner intended by SFG;
 - we performed diagnostic tests on the Code to confirm its accuracy and efficacy for the purposes of the analysis.

Our instructions require us to respond to the following:

(a) Was the write-up of the work by Professor Gray in his original report that the JIA presented to the AER transparent and amenable to replication and verification by a practitioner who is similarly qualified to Professor Gray?

Response - Yes.

(b) If the answer to a. is "no" was the work transparent and amenable to replication with the additional data and model specification provided to the AER in November 2008?



Response - Not Applicable

(c) If the answer to b. is "no" what more should Professor Gray provide to the AER for it to be transparent and be amenable to replication and verification by a person similarly qualified to Professor Gray?

Response - Not Applicable

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4 SFG September 2008 Report

SFG⁶ provided a report to the AER estimating the value of theta and gamma. The SFG report addresses a number of issues regarding the operation of dividend imputation and the measurement of theta and gamma. Each of the issues will be addressed in turn.

Market Data: Synergies believe that SFG correctly argues that the appropriate method of estimating gamma is using market data⁷ as opposed to a theoretical construct. The use of market data is consistent with the estimation of other WACC parameters. Other estimation techniques are not consistent with the estimation of the WACC parameters and additionally they cannot be statistically verified.

Marginal Investor: SFG claim that if market data⁸ is used, it is not necessary to determine the identity of the marginal investor. While this is true, Synergies approach would be to have, as a starting point, a plausible justification for the expected outcome when testing the proposition that the value of gamma is statistically less than 0.5. The assumption behind this proposition is that of the identity of the marginal investor. The marginal investor theory is relatively straight forward and Synergies believes that the foreign investor (who cannot take advantage of dividend imputation) is the marginal investor. Appendix C contains a marginal investor argument.

*Use of redemption rates*⁹: In our view, SFG correctly argue against using average redemption rates from taxation records to estimate theta. **Synergies agrees that in order to estimate gamma, an estimate of the value of theta and not the quantum of theta is required.** This difference reflects shareholders being put at risk by owning shares. The risk of share ownership affects the value of the franking credits available to them. **Synergies believes that this is a strong and compelling argument.**

2000 *rebate*¹⁰: A change in the taxation legislation allowed resident shareholders to be able to claim excess franking credits as a cash rebate as opposed to foregoing the excess franking credits. Due to this legislation change there are two arguments when estimating the value of theta:

- 8 SFG Report op cit. p.12
- ⁹ SFG Report op cit. p.12
- ¹⁰ SFG Report op cit. p.15

⁶ SFG (2008), The Impact of Franking Credits on the Cost of Capital of Australian Firms, Report prepared for ENA, APIA, and Grid Australia, 16 September

⁷ SFG Report op cit. p.10



- assume that the Rebate Provision did change the value of theta and restrict the analysis to post 2000 data; or
- test whether theta did in fact change at the time of the Rebate Provision.

SFG argue the second approach should be adopted on the basis of statistical grounds. The longer the data set, the less noise and the greater the level of significance that can be drawn or concluded from the more robust analysis. **Synergies agrees that a longer data set is preferable (refer Section 5).**

Box 2 Rebate provision

Prior to the rebate provision, franking credits could be used to offset the tax payable on dividend income and other income. If the credits were greater than the tax payable, the excess or surplus was lost as it was not rebateable nor was it able to be carried forward to subsequent years. The rebate provision allows the excess to be refunded to the taxpayer.

In our view, the introduction of the 2000 Rebate Provision would have a negligible impact on the value of theta. This proposition is supported by the results of the Synergies empirical analysis and that of Hathaway and Officer (2004), Bellamy and Gray (2004), Cannavan et al. (2004) and SFG (2008). This in turn enables a longer data set to be used to assess the market value of gamma.

Additionally Synergies agrees with SFG that it is inappropriate to use an estimate of redemption rates from taxation records as a proxy for the market value of imputation credits.

Synergies reiterates that examining redemption rates does not reflect the *value* of theta. Synergies believes that as it is inappropriate to use redemption rates and any change in redemption rates does not necessarily indicate a change in the *value* of theta.

In summary, Synergies strongly supports SFG's preference for using a longer data set as this allows a more robust analysis and is consistent with the assumption of shareholder wealth maximisation.

*Dividend drop-off*¹¹: SFG explain that the drop-off studies examine the change in share price where the change in price is the sum of the cash dividend and the value of the franking credit.

 $\Delta P = \alpha D + \theta F C$

(1)

¹¹ SFG Report op cit. p.16



The gross dividend is the sum of the cash dividend and franking credit. For a \$1 change in price, the dividend drop-off approach separately values (α) the cash dividend (D) and the value (θ) of the franking credit (FC).

Importantly it can be seen that the estimate of theta is conditional upon the estimated value of the cash dividend. For example, for a \$1 change in price, the sum of the cash dividend and the value of the franking credit must also be \$1. The greater the value of the cash dividend, the lower the value of theta (and vice versa). In the extreme, a \$1 cash dividend would have a zero theta value.

In addition to this, logic dictates that for a \$1 change in price, the maximum value that the cash dividend can take is \$1 and the value of α cannot be greater than one.

Synergies finds that Beggs and Skeels (2006) presents results for regime 6 that are in conflict to this logical presumption. This is discussed in the following section.

SFG provide evidence from Hathaway and Officer (2004)¹² illustrating that the theta did not increase after the introduction of the Rebate Provision. Additionally SFG present Allen Consulting Group results¹³ to illustrate that the value of theta is not statistically different to zero and it is the same for a three year period prior to the introduction of the Rebate Provision as it was for a three year period after its introduction.

SFG analysed the Beggs and Skeels (2006) result¹⁴. Beggs and Skeels found that the gross drop-off was consistently less than one, meaning that the market does not value the package of cash dividend and franking credit fully. Moreover, Beggs and Skeels found that the cash drop-off ratios to be consistently close to one, indicating that the cash dividend was fully-valued, but that the overall franking credit ratios are less than one and not statistically different from zero, hence the market does not value franking credits. Beggs and Skeels did segment the data into different taxation regimes (Table 1) and found that in tax regime 5 the cash dividend was 0.795 and theta was 0.418 resulting in a gross dividend of \$0.974 for a \$1 dividend. This result is what is expected for a \$1 (or near \$1) gross dividend.

By contrast, in tax regime 6 the cash dividend was valued at 1.168 and theta was 0.128 resulting in a gross dividend of \$1.223. This is very different to what would be expected (as logic dictates that the maximum value that the cash dividend can take for a \$1 change in price, is \$1 and the value of α cannot be greater than one).

¹² SFG Report op cit. p.17

¹³ SFG Report op cit. p.18

¹⁴ SFG Report op cit. p.19



In regime 7, the cash dividend was 0.800 and theta was 0.572 resulting in a gross dividend of again near \$1 being \$1.045.

Date	Cash Dividend	Theta	Gross Dividend	Ν			
Regime 5 1/7/97 – 30/6/99	0.795	0.418	\$0.974 ¹⁵	573			
Regime 6 1/7/99 – 30/6/00	1.168	0.128	\$1.223	267			
Regime 7 1/7/00 – 10/5/04	0.800	0.572	\$1.045	1,310			

Table 1 Beggs and Skeels (2006) results

From this SFG correctly illustrate the lack of consistency in the results. **Synergies is of the same opinion as SFG since the result of regime 6 appears anomalous**, **unexpected and inconsistent with other regimes**.

In regime 6 just prior to the introduction of the Rebate Provision, a \$1 dividend was valued at \$1.168 and it had an estimated gross value of \$1.223. In the vast majority of dividend drop-off studies, including the overall results of Beggs and Skeels, a \$1 dividend has an estimated gross dividend value of \$1. Regime 6 results where \$1 has an estimated value of \$1.168 are inconsistent with both logic and expectations as \$1 dividend should not be valued at more than \$1.

The results, after the introduction of the Rebate Provision, (regime 7) do value a gross dividend at approximately \$1 (\$1.045) but theta increases to 0.572. The change from regime 6 to regime 7 cannot be seen as a structural change as the Beggs and Skeels results for regime 6 are inconsistent with finance theory and are implausible (as they indicate that a \$1 dividend has a value of \$1.168).

Synergies believes that regime 7 should be compared to regime 5. Looking at the values and standard errors, there is no structural change between regime 5 and regime 7. In Synergies opinion, the results for regime 6 are anomalous and should not be used as the base upon which a structural change is tested. We agree with the SFG conclusion that the results of regime 6 are most likely due to estimation error as a result of a small sample size, noise in the data and the short sampling period.

Accordingly, we disagree with the AER's view that the change from regime 6 to regime 7 is evidence of a structural change justifying the non inclusion of pre 2000 data in the assessment of gamma.

As Beggs and Skeels (2004) have reported results for post 2000, the AER have accepted a theta value of 0.572¹⁶. We agree with the SFG conclusion that this is incorrect.

¹⁵ The gross dividend is the cash dividend 0.795 plus the franking credit 0.418 times .3/.7

¹⁶ SFG provided additional analysis in January 2009 to the AER. The results of this are summarised later.



Synergies believes that the change in coefficients from regime 6 to regime 7 should not be seen as a structural change. As SFG correctly argue, the results obtained under regime 6 are a result of small sample size and noise.

*Consistency with CAPM*¹⁷: SFG argue clearly that to be consistent with the CAPM a \$1 cash dividend should be valued at \$1 and due to the theta being conditional upon the value of the cash dividend, the value of theta should be zero. Gamma therefore should be zero. Empirical evidence provided by the Synergies studies (see section 5), Bellamy and Gray (2004), Cannavan et al. (2004) and SFG Consulting (2008) support this expectation. Practitioners also adopt a value of zero for theta.

*New Evidence*¹⁸: SFG provide additional evidence regarding the value of gamma using a dividend drop-off approach. SFG use a long data series where the data was refined to only include large firms (as per Beggs and Skeels where to be included in the final sample of firms, the value of the individual firm had to be at least 3% of the value of the market) and where outliers¹⁹ were removed.

Synergies believes that the size adjustment performed by SFG was consistent²⁰ with the adjustment described by Beggs and Skeels (2006). Synergies also believes that SFG's technique for removing outliers is an acceptable practice in this case.

SFG conclude that the value of theta is in the range from 0.2 to 0.35 if the distribution rate used is 100% or 0.14 to 0.25 if the more common 70% distribution rate is applied. Synergies agrees that the analysis undertaken by SFG is convincing as it is theoretically sound and the results are consistent with other studies.

Conclusion: The paper prepared by SFG provides convincing arguments that are theoretically sound and consistent with accepted finance theory. There are no inconsistencies in the results and the results conform to market practice and other empirical studies.

Synergies has reviewed the SFG data set, source code and output. Synergies believes that the SFG results are robust and significant.

¹⁷ SFG Report op cit. p.21

¹⁸ SFG Report op cit. p.23

¹⁹ The rejection of outliers is reasonably acceptable. The SFG approach was to only exclude points which exhibit a large degree of influence using a acceptable measure called Cook's distance.

²⁰ They are not exactly the same as Beggs and Skeels do not reveal their final data set.



5 SFG Report 16 January 2009

SFG provided an additional report to the AER replicating the Beggs and Skeels (2006) results of a theta value 0.572. This value is inconsistent with the finding of other empirical studies including those undertaken by SFG and Synergies.

The AER have adopted the 0.572 theta value on the basis of discounting other studies due to:

• the lack of reporting of statistical significance of results

In sum, even if the reliability of the results from the 2004 Hathaway and Officer study could be verified, the AER considers them to be inconclusive in terms of a structural break following the July 2000 tax changes.²¹

• the reports were private reports

to the AER's knowledge the ACG study has not been made public and therefore cannot be properly scrutinized.²²

• the studies included pre 2000 data

On this basis the AER considers there is persuasive evidence to reject pre 2000 data from consideration in estimating theta.²³

While it is justifiable to exclude results that are statistically insignificant, the Hathaway and Officer study is the leading study in the area and one that inspired much research in the area. In addition, private reports do add to the development and testing of the theory. They are valuable in there contribution to the analysis of the issue.

This last point is of most concern. As stated earlier, the inconsistent and implausible interpretation of Beggs and Skeels (2006) results does not validly support the proposition that theta has increased with the introduction of the Rebate Provision in 2000. If theta has not changed as illustrated by SFG, Synergies and others, then it is valid to include pre 2000 data.

Having a long filtered data set reduces noise and increases the robustness of the results. Consequently, a large (or long if over time) sample enables greater confidence

²¹ Explanatory Statement p. 316

²² Explanatory Statement p 314

²³ Explanatory Statement p 318



to be obtained in the results relative to a small sample of observations. In addition, the smaller the variability in observations (less noise), the greater the statistical inferences that can be reached.

The SFG study produces estimates of theta that are approximately 0.2 (conditional on cash dividends being valued at 75-80 cents per dollar), while theory suggests it to be 0 or to be close to 0. The 0.2 result is likely to be as a consequence of collinearity between the explanatory variables where the value of theta is dependant upon the value of the cash dividend. The theta estimate of 0.2 is conditional upon the cash dividend having a value of less than 1. Synergies attempts to adjust for the collinearity and presents results indicating a theta value of less than 0.5.

SFG suggest, and Synergies believes, that the Beggs and Skeels (2006) conclusion of a structural break²⁴ from regime 6 to regime 7 is due to sampling error in regime 6. If techniques are used to reduce the noise in the smaller 2000 data set, the inconsistent results (gross dividend \$1.223) may be corrected. Additionally if sampling error were to be present, then as the period of analysis post 2000 is extended the estimate of theta would become more reliable due to reduced sampling error.

SFG²⁵ replicate the Beggs and Skeels (2006) results as best they can using similar filters as Beggs and Skeels. Beggs and Skeels do not describe their filters in enough detail for SFG or anybody else to exactly replicate the data set. The results of the replication are illustrated in Table 4.

The Beggs and Skeels results in table 4 show the values for regime 5 (0.795, 0.418) are very similar to regime 7 (0.800, 0.572) indicating that there is no structural break.

For regime 7 (the post 2000 period) Beggs and Skeels have a value of the cash dividend of 0.800 and a theta of 0.572 while SFG have a cash dividend of 0.895 and a theta of 0.526. Both sets of results have a gross dividend of approximately \$1 as would be expected.

²⁴ The structural break is asserted by the AER. Synergies does not believe that there is a structural break as any apparent break would most likely be due to the noise in the data

²⁵ SFG January Report op cit. p.6



	Beggs and Skeels Results		SFG Replication			SFG Replication with outliers removed			
Date	Dividend	Theta	Ν	Divide nd	Theta	Ν	Dividend	Theta	Ν
Regime 5 1/7/97 – 30/6/99	0.795	0.418	573	0.773	0.361	710	0.871	0.142	699
Regime 6 1/7/99 – 30/6/00	1.168	0.128	267	0.205	1.163	329	0.746	0.360	326
Regime 7 1/7/00 – 10/5/04	0.800	0.572	1,310	0.895	0.526	1,389	0.945	0.190	1,378
Regime 7 to 30/9/06				0.913	0.369	2,182	0.916	0.235	2,166

Table 2	Boage and	Skoole	(2006)	roculte
i able z	Beggs and	Skeels	(2006)) results

Note the vast difference in the results in regime 6 between Beggs and Skeels (2006) and SFG. While the results for regimes 5 and 7 are consistent between the Beggs and Skeels and SFG studies, the results for regime 6 are inconsistent. This is because the Beggs and Skeels results for regime 6 are affected by the small number of observations over a short time period. As a consequence, these results are vastly different to the results produced by SFG once SFG removed the noise in the data. This provides additional support for the notion that the interpretation of the results will be distorted by the noise inherent in the data set.

SFG, in our view appropriately, remove some noise from the data set by the removal of outliers. As discussed earlier, the removal of a small number of observations that are extreme relative to the remainder of a sample is a common and is a valid approach to reduce the noise in the data set.

Once outliers are removed for regime 7 the value of the cash dividend approaches one, 0.945 and theta reduces from 0.526 to 0.19. These results are what would be expected from a theoretical perspective in that the estimated value of the cash dividend approaches one and the estimated value of theta moves below 0.5. The results that SFG produce by applying this adjustment for regime 7 are now very different to those originally reported by Beggs and Skeels. Regime 7 is now very similar to earlier regimes. The estimated value of the gross dividend is approximately one and the results are consistent with Beggs and Skeels (2006) overall results where they commented that the estimated value of the cash dividend is one and that the market does not value franking credits

It was then found that the cash drop-off ratios were consistently close to 1, but the franking credit drop-off ratios were significantly less than 1. Moreover, the franking credit drop-off ratios were not significantly different from zero for much of the sample data. This indicates that marginal investors did not value the franking credit,



and provides an explanation as to why gross drop-off ratios less than 1 were observed. 26

It appears that the Beggs and Skeels (2006) results were influenced by the outliers. Increasing the sample size also increases the robustness of the results. This is exactly what SFG achieves by extending the Beggs and Skeels (2006) data set from 2000 – 2004 to 2000 – 2006. The regime 7 results from extending the study period increases the cash dividend to from 0.895 to 0.913 and reduces the theta from 0.526 to 0.369. Note that when SFG correctly remove the outliers, increasing the sample size has little effect and the results are relatively stable. These results support the notion that the Beggs and Skeels study is suffering from noise in the data.

The SFG study supports the notion that the inconsistent Beggs and Skeels (2006) results were due to sampling error. For example for the regime 6 group where Beggs and Skeels had a result of a cash dividend of 1.168 and theta of 0.128, improving the econometric technique reduces the cash dividend to 0.746 and increase theta to 0.36. The SFG results are more in line with an expectation of a gross dividend of \$1 or less. Additionally, the value of the cash dividend is \$1 or less and not greater than \$1 which is illogical.

Conclusion: The paper prepared by SFG provides empirical results (particularly for regime 7) that are consistent with accepted finance theory. The research undertaken provides a robust analysis of the issues and the results conform with market practice. SFG effectively reconcile the anomalies in the Beggs and Skeels study relating to their findings for regime 6.

Synergies has reviewed the SFG data set, source code and output. Synergies believes that the SFG results are robust and significant. Synergies believes that the Beggs and Skeels results of:

- implausible regime 6 results;
- a structural break; and
- a theta of 0.572,

are due to noise in the data. Removing 1% of the observations in regime 6 (1% of approximately 300 is 3) changes regime 6 results to be more in line with regimes 5 and 7 as expected. Removing these 3 observations results in regime 6 being similar to regimes 5 and 7 the perceived structural break disappears. If there is no structural

²⁶ Beggs, D. J. and Skeels, C. L. (2006). Market Arbitrage of Cash Dividends and Franking Credits. Economic Record, 82, 239–252, page 249



break then pre and post 2000 data can be used and the theta value for the total sample is low as concluded by Beggs and Skeels.

Using only post 2000 data but extending the end date for the sample from 10 May 2004 to 29 September 2006 (as in the SFG study) results in a similar conclusion being that theta is low and less than 0.5.

Synergies believes that the 3 observations in regime 6 out of a total sample of more than 5,000 observations has resulted in the conclusion of a structural change and a value for theta of greater than 0.5 being made. Removing the 3 observations and retaining approximately 5,000 observations removes the anomalous results and produces more plausible, consistent and robust results. There is no persuasive evidence to suggest either a structural break nor a value of theta being greater than 0.5 and in fact the evidence supports a theta of less than 0.5.



6 Synergies Studies

Synergies has recently undertaken two gamma studies. One, a dividend drop-off study and one a simple diagnostic test.

Drop-off Study

This study aimed to provide an update to the results obtained using the ex-date dropoff methodology of Hathaway and Officer (2004) and Beggs and Skeels (2006). The key difference in this Synergies study when compared to these other studies is the removal of the effects of multicollinearity.

Like the earlier studies, to prevent arbitrage, the change in stock price on the ex-date should be a linear combination of the dividend, the franking credit and the market return.

$$\Delta P_i = \beta_1 D_i + \beta_2 F_i + \beta_3 rm_{i} + \varepsilon_i \tag{4}$$

In practice, the signs of the change in price have been reversed, so that decreases in price on the ex-date are positively associated with dividends and franking credits. The problems with model (4) are the collinearity between D_i and F_i (in that for fully franked dividends $F=0.43 \times D$, in which case the two independent variables are a constant multiple of each other) so that it is difficult to interpret the coefficient values and their level of significance. In addition, the model has no intercept term, and so it is difficult to test how well the model fits the data.

The model was scaled by the dividend to produce

 $\Delta P_i / D_i = \beta_1 + \beta_2 F_i / D_i + \beta_3 rm_{i} / D_i + \varepsilon_i$ (5)

thus removing D_i as being an explanatory term by itself and introducing an intercept term β_1 . Now there is an intercept term and the two independent variables are orthogonal or independent of each other allowing for valid conclusions to be drawn from the results.

Preliminary analysis suggested that the market return was not important in explaining ex-date behaviour in the presence of dividends and franking credits. Therefore, the market return term was excluded from the analysis to improve the confidence that could be place upon the parameter estimates by reducing the noise. The results and conclusions were not in any way materially affected by this omission.



Between 1990 and 2008 there have been two major taxation reforms that *could* have changed the value of theta and hence gamma. These two reforms are the 45-day rule and the Rebate Provision. Studies by Bellamy and Gray (2004) and others have tested whether the introduction of the 45-day rule (on 1 July 1997) caused a fundamental change in the behaviour of market participants. In the case of the Rebate Provision (on July 1, 2000), Beggs and Skeels (2004) tested whether this caused structural break.

The AER claim that allowing investors and superannuation funds to receive the cash equivalent of excess franking credits may have led to a structural break in the sense that again there was a fundamental change in the behaviour of market participants (Cannavan et al., 2004; Beggs and Skeels, 2006).

Therefore, equation (5) is estimated as

 $\Delta P_{i} / D_{i} = \beta_{1} + \beta_{2}F_{i} / D_{i} + \beta_{3}R_{i} + \beta_{4}(F_{i} / D_{i}) R_{i} + \beta_{5}T_{i} + \beta_{6}(F_{i} / D_{i}) T_{i} + \epsilon_{i}$ (6)

where R_i is a dummy variable taking the value unity if event i occurs after July 1, 1997 and zero otherwise, and T_i is a dummy variable taking the value unity if event i occurs on or after July 1, 2000 and the value zero otherwise. This approach takes into account any structural break associated with the amendments and is similar to the methodology of Beggs and Skeels (2006).

The coefficients in expression (6) are to be interpreted as follows:

- β_1 represents the ex-date drop-off attributable to one dollar of cash dividend;
- β_2 represents the drop-off due to one dollar of distributed franking credits;
- β₃.represents the additional change in price on the ex-date due to the cash dividend after the 45 day rule was introduced in 1997;
- β₄ represents the additional market value of one dollar of distributed franking credits after the 1997 tax amendment;
- β_5 represents the additional change in price on the ex-date due to the cash dividend after the Rebate Provision amendment of 2000; and
- β_6 represents the additional market value of one dollar of distributed franking credits after the 2000 tax amendment.

The assumption of homoskedastic error terms ε_i in the model (6) is invalid. To apply the OLS model requires that the error terms be normally distributed around the 'line of best fit', that is the line that best represents the relationship between the variables. There is a large amount of variability associated with both very high and very low levels of franking, and little variability associated with moderate levels of franking. As



a consequence, standard errors as calculated under the classic OLS regression model would be incorrect.

In addition the different scaling practices employed by Hathaway and Officer (2004) and Beggs and Skeels (2006) would have the effect of reducing noise but not homoskedasticity. To overcome the problem and to allow for valid results, the heteroskedasticity-consistent estimation procedure and standard errors of White (1980)²⁷ are used.

Data that we used in this analysis consisted of the net dividend, the gross dividend and the ex-date price change for all final and interim dividend events for all stocks in the S&P/ASX300 as at October 7, 2008, from January 1, 1990. Whilst some studies use larger indexes such as the S&P/ASX300 or the entire exchange, in many of these studies (see, for example, Hathaway and Officer, 2004; Beggs and Skeels, 2006) an arbitrary liquidity filter is applied to exclude stocks that are determined to be thinly-traded. For example, Beggs and Skeels exclude firms that are less than 0.03% of the market index. Synergies believes that no such subjective filtration needs to be applied for the stocks in the S&P/ASX300 index.

The daily market returns were calculated from the S&P/ASX300 index. We excluded special dividends from the analysis as they do not represent typical distribution of profits to shareholders. The observations were then filtered to remove all events for which the ex-date price change was not known. This resulted in a data set consisting of 4,325 observations/events.

In their study, Hathaway and Officer (2004) mention a clientele effect in which only the investors most able to utilize franking credits would be attracted to stocks paying partially franked or fully-franked dividends. On the other hand, investors unable to utilise franking credits would invest in these stocks. As the aim of this analysis is to determine whether the market values franking credits, all dividend events for unfranked dividends, were excluded. This results in reducing the sample size to 3,128 events.

The coefficients estimated from the model (6) are shown in Table 3, in which an asterisk indicates significance at the 5% level²⁸. Only β_1 , the coefficient of the dividend, is significant in explaining the ex-date price change. This coefficient is estimated at 1.036 which implies that cash dividends are fully valued as expected. This is consistent

²⁷ A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, H. White, Econometrica, 1980, vol. 48, issue 4, pages 817-38

²⁸ A level of significance of 5% means that 95 times out of 100, the results should hold.



with the results of Bellamy and Gray (2004), SFG (2008), Beggs and Skeels (2006) (overall conclusion) and Cannavan et al. (2004). Importantly, the fact that this is the only significant variable and that its estimated value is approximately one implies that the full ex-date price change is due solely to the cash dividend. This in turn implies that theta has a value of 0.

Parameter	Estimate	Standard error
β ₁	1.036*	0.281
B ₂	-0.469	0.465
B ₃	-0.425	0.324
B ₄	0.863	0.623
B ₅	0.079	0.201
B ₆	0.095	0.554

Table 3 Parameter Estimates

Estimates excluding unfranked dividends. Adjusted $R^2 = 0.998$

The estimate of any of β_2 , β_4 and β_6 are not individually different from zero, supporting the suggestion that franking credits were both worthless both before and after the introduction of any of these amendments. Neither of the amendments seem to cause any change in the market value of franking credits. This is also consistent with Bellamy and Gray (2004), SFG (2008) and Cannavan et al. (2004).

Our analysis supports the claim that there is no structural break caused by either the 45-day rule or the Rebate Provision, during the period of analysis from 1990 to 2008. These results are contrary to the AER's interpretation of the Beggs and Skeels (2006) result of a structural break. In addition, Synergies results confirm the overall results of Beggs and Skeels in that the value of the franking credits is less than 0.5.

In addition, a joint test to assess whether these coefficients are all jointly equal to zero, that is, that the market has consistently applied a value of zero to franking credits, is not rejected at any conventional level of significance. The test statistic is J = 3.687, corresponding to a p-value of 0.297.

The overwhelming conclusion, then, is that in the Australian market, cash dividends have consistently been fully-valued and franking credits and have consistently been worthless. Additionally pre 2000 data is relevant in determining the value of theta.

Synergies results are consistent with Beggs and Skeels (2006) to the extent:

• that the sum of the cash dividend and the franking credit for a \$1 dividend sums to \$1 (we estimate the gross dividend value of \$1.036 which compares to Beggs and Skeels estimate of \$1.045 for post 2000);



- the cash drop-off ratios were found to be consistently close to one indicating that the cash dividend was fully-valued;
- the franking credit ratios are less than one and not statistically different from zero, so the market does not value franking credits.

Importantly Synergies find, as does Bellamy and Gray (2004), Cannavan et al. (2004) and SFG (2008) that the theta value both prior to and post 2000 is unchanged and has a value that is not statistically different to zero.

The major difference between the Beggs and Skeels (2006) study and the Synergies study is that Synergies removes the collinearity so that the value of the franking credit can be validly assessed. Synergies found that the franking credit had a value of 0 and was unchanging across different tax regimes.

Synergies has made the data available to the JIA.

Diagnostic Study

In order to circumvent the numerous econometric and sampling issues discussed previously when with estimating gamma, a basic and straight-forward behaviour test can prove fruitful. The test aims to determine whether or not the average share price reaction to a dividend is different for franked dividends compared to the share price reaction for unfranked dividends.

In particular, it tests whether or not the ratio of the ex-date price change to cash dividends is significantly greater for franked dividends than unfranked dividends. That is, if it is found that shares with franked dividends behave in a manner that is not significantly different from shares with unfranked dividends on the ex-dividend date, this would lead to the conclusion that franking credits are valued at zero (leading to a zero value of gamma).

If, on the other hand, shares with franked dividends do behave in a manner that is significantly different, it would be concluded that this difference is due to the market placing value on franking credits. If this were the case, gamma would not be zero and further empirical investigations would need to be undertaken to estimate its value.

The data used in this investigation was sourced from Bloomberg²⁹ and contains observations on firms listed in the S&P ASX 200 from January 1996 to January 2006. Trusts and other entities which have a dissimilar tax structure to companies were excluded, resulting in an available sample of 3188 observations in total. Whilst this

²⁹ Bloomberg is recognised as being an accepted source of financial data.



sample only spanned the top 200 stocks, because ex-date behaviour is analysed it is important to exclude observations that had a delay of more than one day about the exdividend date. Partially franked dividends were excluded from the examination to avoid the complication of selecting an appropriate level of franking as the cut-off point.

For the full period, there were 516 events with unfranked dividends and 2138 events with fully franked dividends. The sample standard deviations of the drop-offs ratios were such that a test for equality of variance would conclude that the standard deviations of the samples were unequal³⁰. As a consequence, the common parametric test for equality of means is invalid so the simple, non-parametric paired test is used instead.

The sample of fully franked events is substantially larger than that of unfranked events, so a random sample of it is taken to produce the same number of observations, which was then paired with the full set of unfranked observations. If the theoretical hypothesis is true (that is, the market value of franking credits is zero), it would be the case that half of the fully franked drop-off ratios are greater than the unfranked drop-off ratios and half less so that on average the drop-off ratios are the same for the two groups. In summary, if the franking credit was to have no value, then the share price reaction to franked and unfranked dividends would be equal.

Synergies found to be insufficient evidence to reject this hypothesis³¹ and, as such, Synergies concludes that the market responds equally to fully franked and unfranked dividends. This same test is used for the sample of data from 1 July 1997 onwards as the parametric test is invalid ³² and the nonparametric test leads to the same conclusion³³.

This evidence that the market does, on average, respond equally to fully franked and unfranked dividends is further evidence that the market places no value upon franking credits.

This test was also be extended to see whether the drop-off for franked dividends behaves significantly differently from unfranked dividends if franking credits are valued at some proportion of their face value.³⁴ In this case, we tested the proportional value will be 50% and 100%. In other words, rather than testing the hypothesis that the

³⁰ F-test for variance equality: $s_1 = 5.6736$, $s_2 = 1.9994$, p-value < 0.0001

³¹ Paired sample test: sample proportion = 0.527, theoretical proportion = 0.50, p-value = 0.11

³² F-test for variance equality: $s_1 = 6.0972$, $s_2 = 2.0996$, p-value < 0.0001

³³ Paired sample test: sample proportion = 0.528, theoretical proportion = 0.50, p-value = 0.12

³⁴ That is, rather than consider the ratio of price decline to cash dividend, the ratio of price decline to cash dividend and some proportion of the face value of the franking credit is considered.



value of franking credits do not have a value other than zero, we are testing the hypothesis that these credits have some value, which in this case is either 0.5 or 1.

We had already been found that, on average, shares (and therefore the market) behave the same way for franked and unfranked dividends on the ex-date, only moving on average by the amount of the cash dividend. Synergies thought it important to question whether the data could perhaps disguise franking credits having a value of 50% and 100% of face value, yet still behaving as observed.

We thought that if it is found that these new ratios (with franking credits assumed to be valued at 50% and 100% of face value) were to be significantly different across franked and unfranked dividends, this would be inconsistent with the actual market data. Therefore, this would imply that if franking credits had a significant non zero value the data would not disguise this. Thus, this would provide further evidence that the market does not value franking credits.

We restricted the data to observations after 1 July 1997 and also to fully-franked and unfranked dividends. The same nonparametric test is used and we found that the ratios are different across fully-franked and unfranked dividends with a half-valued franking credit³⁵ and with a fully-valued franking credit³⁶.

On this basis, we can reject the hypothesis that franking credits have a value of 0.5 or 1. In addition, we believe this is likely to be the finding irrespective of the value tested for the valuation of franking credits. This inconsistency with the result for the ratio of price decline to cash dividend only, is further evidence that the market does not value franking credits.

³⁵ Paired sample test: sample proportion = 0.590, theoretical proportion = 0.50, p-value < 0.0001

³⁶ Paired sample test: sample proportion = 0.595, theoretical proportion = 0.50, p-value < 0.0001



7 Conclusion

A number of studies have sought to estimate the value of gamma and the results vary considerably. The key concerns we have with some of these studies are that:

- studies using the dividend drop-off methodology need to be treated with caution given the collinearity between dividends and franking credits. It is not possible to separately value dividends and franking credits in a conclusive manner;
- the introduction of the Rebate Provision did not result in a major structural change that has fundamentally impacted the value of franking credits. As no structural change has occurred, studies that seek to estimate theta using data prior to this date will not under-estimate the value of gamma;
- recent robust empirical investigations have concluded that the value of franking credits is less than 0.5 (Bellamy and Gray, 2004; Cannavan, Finn and Gray, 2004; Feuerherdt, Gray and Hall, 2007, Synergies 2009). Finding the value of franking credit being less than 0.5 does not require that the marginal investor is foreign;
- Nevertheless a foreign marginal investor assumption does provide justification for the results and moreover it is appropriate to make this foreign marginal investor assumption under the standard domestic CAPM framework, as this acknowledges the practical and significant influence foreign investors have in the Australian market;
- Beggs and Skeels (2006) provided a theta value of 0.572 for an analysis of data from 1/7/2000 to 10/5/2004 (regime 7). Adjusting by either extending the time period of the analysis or removing outliers should and does reduce the over-estimated value of theta;
- Beggs and Skeels (2006) findings for regime 6 appear to be distorted by sampling error. Removing outliers which comprise 1% of the data or just 3 observations, from regime 6, in our view, produces more plausible results.
- Beggs and Skeels do not provide evidence of a structural break with the introduction of the Rebate Provision. The results for regime 6 are affected by noise and outliers. Using the distorted results from regime 6 as the base for a test of a structural break is incorrect. Our interpretation is that any change in the value of theta is as a result of noise in the data and sampling error.
- SFG Consulting provide a comprehensive analysis of key dividend drop-off studies and concluded that setting theta to zero is consistent with the use of the Sharpe



CAPM to estimate the required return on equity and with market practice. Due to econometric issues, being collinearity, it is difficult to separately estimate the cash dividend and theta as the estimate of theta is conditional upon the estimate of the cash dividend.

- SFG Consulting also provide compelling empirical evidence that theta did not change moving from pre 2000 to post 2000.
- SFG Consulting also extended the Beggs and Skeels (2006) study replicating as best as possible the results. They improve upon the study by extending the study and also by removing outliers. Both valid adjustments produce results that are consistent with finance theory.
- Synergies provides the results of two studies that it has performed that support the SFG results.



A Payout ratio

There are three approaches to the consideration of the value of the payout ratio and these are:

- estimate the payout ratio from official taxation statistics;
- assume that the value of gamma will be less than the value of theta³⁷; or
- assume that the payout ratio is 100% as at some stage all dividends will be distributed.

It is this last method that the AER considers to be appropriate:

In terms of estimating the 'gamma' parameter, as discussed in section 10.5.1 the AER considers Handley's advice regarding the distribution of free cash flows to be persuasive, as it accords with the standard approach to valuation. Accordingly, the AER will adopt a payout ratio of 1.0 in the assessment of gamma.³⁸

The AER's assessment of the value of the payout ratio is different to that of other researchers. The payout ratio can be estimated from official taxation statistics. Hathaway and Officer (2004) estimated a payout ratio of 71% across all Australian companies for the period 1988-2002. Provided this value is correct, it immediately implies the maximum permissible value of gamma is 0.71, which occurs only if franking credits are fully valued by the market.

There is an inconsistency in the AER's assumption of a 100% payout ratio whilst the actual payout ratio was 71%. The AER's justification for ignoring the actual payout ratio is based on the grounds that in a valuation model, it is appropriate to value 100% of the free cash flows³⁹.

The AER state that the valuation model ignores the actual distribution and therefore in estimating gamma, the payout ratio is not a consideration. The effect of ignoring the payout ratio is that same as ascribing it a value of 100%. The conclusion from this is that gamma should be equal to the theta in the eyes of the AER.

Synergies believes that the above conclusion of the AER is incorrect. In a valuation of corporate cash flows, the cash flows being analysed are after corporate taxation. What

³⁷ The is the approach adopted by Hathaway and Officer (2004).

³⁸ AER, Explanatory Statement, December 2008, p 302

³⁹ This is the assertion made by the AER's consultant Associate Professor Handley.



(7)

is estimated as a component in the free cash flow is the actual corporate taxation payment in that particular year. Gamma is an adjustment that is applied to the corporate taxation payment in a particular year so it logically follows that gamma must reflect that portion of corporate taxation that is a prepayment of personal taxation in that particular year. The distribution or payout ratio is extremely relevant to the valuation process if one considers gamma to be of value.

B Drop-off studies

Hathaway and Officer (2004)

The ex-dividend share price change ΔP is regressed against its components as follows:

 $\Delta P = \beta_1 D + \beta_2 F + \beta_3 rm + \varepsilon$

Where:

 ΔP = change in stock price

D = the cash dividend paid

F = the franking credit paid with the cash dividend

rm = the market return

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\epsilon = is an error term
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 β_1 = the market value of \$1 of cash dividends

 β_2 = the market value of \$1 of distributed franking credits – also known as theta.

Hathaway and Officer (2004) estimate this model using data on all stocks in the S&P/ASX500 from August 1986 to August 2004. They estimate a number of different forms of the relationship in an attempt to control for heteroskedasticity⁴⁰. Hathaway and Officer filter the data in an attempt to reduce the effect of hetroskedasticity. From the estimation of large-cap stocks (to control for illiquidity), they suggest that franking credits are priced at around 50% of their face value.

These results are dubious. First in the model estimated, D and F are highly collinear⁴¹, so the estimates are unreliable. Second standard errors are not reported, nor are tests of

⁴⁰ Heteroskedasticity has the effect of distorting the coefficients valuing the cash dividend and the franking credit. Additionally the more severe the heteroskedasticity, the more that it renders the approach invalid.

⁴¹ Collinearity and multicollinearity is illustrated in the next study reported.



significance. Given the amount of noise associated with the ex-date, it is important to test whether the market assigns a non-zero value to franking credits. As tests of significance are not reported, the AER dismisses this study.

Beggs and Skeels (2006)

The ex-date drop-off methodology of Hathaway and Officer (2004) and Bellamy and Gray (2004) is extended by Beggs and Skeels (2006) who examine changes to the gross, cash and franking credit drop-off ratios.

Their test was:

 $P_{e,i} - P_{x,i} = \gamma_0 + \gamma_1 D_i + \gamma_2 F_i + \varepsilon_i$, i = 1,...,n (8)

Where

 $P_{e,i} - P_{x,i}$ = change in stock price

 D_i = the cash dividend paid

 F_i = the franking credit paid with the cash dividend

$$\varepsilon$$
 = is an error term

 γ_1 = the market value of \$1 of cash dividends

 γ_2 = the market value of \$1 of distributed franking credits – also known as theta

This model is very similar to the Hathaway and Officer (2004) model. Unfortunately these results too must be dubious. D and F are highly collinear, so the estimates are unreliable. Effectively the model can be re-written as:

$$P_{e,i} - P_{x,i} = \gamma_0 + \gamma_1 D_i + \gamma_2 D_i (t/(1-t)) + \epsilon_i$$
(9)

It can be seen that the first two independent variables are highly related. As such they are not independent and caution must be exercised in interpreting the value of the coefficients and relying upon their level of significance.

Both Beggs and Skeels and the AER state the multicollinearity is mitigated:

...where the dataset incorporates information such as unfranked and partially franked dividends, observations at different tax rates, observations where untaxed income is distributed (such as listed property trusts) and observations where



foreign-sourced company income does not attract a tax credit, the effects of multicolinearity should be mitigated.⁴²

Synergies expects that the above adjustments would reduce the noise in the data but the degree of the reduction (if any) in collinearity is unknown. The variables are not orthogonal as required by the model. Caution must still be exercised when interpreting the values and level of significance of the cash dividend and theta.

Their data spans the period from April 1986 to May 2004, which encompasses seven different tax regimes pertaining to different tax rates on capital gains and different franking credit amendments, namely the introduction of the 45-day rule and the cash Rebate Provision.

They find that the gross drop-off was consistently less than one, meaning that the market does not value the package of cash dividend and franking credit fully. Moreover, the cash drop-off ratios were found to be consistently close to one, indicating that the cash dividend was fully-valued, but that the franking credit ratios are less than one and not statistically different from zero, so the market does not value franking credits.

However, the amendment allowing eligible investors to receive a cash rebate for their unused franking credits (their regime 7) was found to significantly increase the value of franking credits to the marginal investor. The results of their study are illustrated in Table 4.

⁴² D.Beggs and C.L. Skeels, op. cit., 2006, p243. AER Explanatory Statement p326.



Date	Cash Dividend	Theta	Ν
Regime 1 1/7/85 – 30/6/88	0.465	0.752	910
Regime 2 1/7/88 – 30/6/90	0.646	0.450	546
Regime 3 1/7/90 – 30/6/91	0.765	0.376	236
Regime 4 1/7/91 – 30/6/97	0.861	0.201	1,669
Regime 5 1/7/97 – 30/6/99	0.795	0.418	573
Regime 6 1/7/99 – 30/6/00	1.168	0.128	267
Regime 7 1/7/00 – 10/5/04	0.800	0.572	1,310

 Table 4
 Beggs and Skeels (2006) results

From this change in the level of value, the AER conclude the period prior to 2000 should be ignored (and therefore discount the results of studies incorporating pre 2000 data).



C Marginal investor

Synergies proposes that franking credits should attract a zero or near zero market value, because foreign investors, who derive no value from franking credits, are likely to be the marginal price-setting investor.

The reason for this proposal is that Australia has an open capital market and the Australian economy has large capital requirements. The internal capital source is insufficient to meet these requirements and so external capital must be drawn upon. This means that both foreign and domestic investors will hold shares in Australian companies.

Domestic investors receive capital gains, cash dividends and imputation credits. On the other hand, due to a number of developments in taxation legislation, foreign investors derive very little, if any, value from franking credits.

The most notable of these taxation law amendments was the introduction of the socalled 45-day rule, effective 1 July 1997. Under this law, investors are required to hold shares for a period of 45 days around the dividend ex-date without hedging in order to be eligible to rebate franking credits against their tax liabilities. This amendment was designed to thwart schemes that previously allowed foreign investors to extract value from franking credits by selling their stocks to domestic investors in the cum-dividend period and then buying the share back after the ex-dividend date.

The price at which the foreign investor bought back the share would be such that the foreign investor received a small premium from the domestic investor, as the domestic investor received value from the franking credit. By extending the window of eligibility to 45 days, the holding period rule made the price risk borne by the parties sufficiently large to render such schemes infeasible.

As a consequence, foreign investors receive the same return as the domestic investors return net of franking credits. Under the assumption of homogeneous expectations, the foreign investor would demand a lower price than the domestic investor, because the foreign investor receives a comparatively lower return. Therefore, in the presence of insufficient domestic capital, foreign investors would be the marginal investors. Moreover, even if the clear majority of the shareholders are domestic but there are some foreign investors, this reasoning still implies that the marginal investor will be foreign and, as a consequence, the marginal investor would not value franking credits.



Tests to determine whether or not franking credits are valued in the Australian market should always test the null hypothesis of the market placing no value upon franking credits, against the alternative hypothesis of the market valuing franking credits.

ENA



D Terms

5% level of significance

If a model is significant at the 5% level of significance, then this is akin to there being a greater than 95% chance that the model adequately explains the phenomenon. Similarly, if a variable is significant at the 5% level of significance, then this is akin to there being a greater than 95% chance that the variable influences the phenomenon. Choice of a 5% lever instead of a 1% level or 10% level, is a rule-of-thumb that is practised widely throughout econometrics and statistics.

Advantage of a long dataset

Models and tests often derive their power from approximations that become valid under very large data sets (i.e. data sets that contain a greater number of observations of the phenomenon and associated variables). In addition, the precision with which coefficients are estimated is higher when the coefficients are estimated from longer data sets.

Coefficients

These are values that are estimated from the data. A coefficient indicates both the size and direction with which each variable affects some phenomenon like a dividend payment.

Collinearity and Multicollinearity and the problems, statistical confidence of coefficients and value of coefficients

A regression model assumes that the variables used to explain some phenomenon do not share a straight-line relationship amongst themselves. For example, a linear regression is an analysis of the relationship between one or more independent variables and another variable, called dependent variable. The independent variables must be independent of each other. Collinearity or multicollinearity is a violation of this assumption. If mild, collinearity/multicollinearlity has little effect on the results. If severe, there are two consequences. First, it is impossible to separately identify the effects of each independent variable. Second, the estimated coefficients for the effect of the independent variables lack credibility.

Dummy variable

A variable used to capture a qualitative characteristic that cannot be quantified.

Econometric



Statistical, but with greater application to modelling and forecasting economic and financial phenomena.

Empirical evidence

Evidence gathered by performing a statistical/econometric analysis of actual data.

Estimation

The process of determining the values of coefficients in a model.

Homoskedastic and hetroskedastic

Homoskedasticity is a fundamental assumption of a regression model. Homoskedasticity occurs when the "fit" of the model is even throughout the sample. In simple linear regression analysis, one assumption of the fitted model is that the standard deviations of the error terms are constant and importantly do not depend on the explanatory or predictor variables. This means that each probability distribution for the response variable has the same standard deviation regardless of the value of the predictor variable.

Heteroskedasticity occurs when the "fit" of the model is uneven throughout the sample, for example, the model may fit well for observations associated with small values of a particular variable, but may fit poorly for observations associated with large values of that variable. Unless steps are taken to mitigate heteroskedasticity, standard errors, tests of significance and conclusions drawn from the standard regression model will be invalid.

Intercept term and econometric consequence of no intercept

If a regression model lacks an intercept term, the usual method of assessing how well the model fits the data is invalid.

Noise

This is the uncertainty or variability in observations in a data set. The greater the noise in the data results in greater uncertainty in the estimation of a model. The greater the noise, the less precision the model has and the less confidence that can be placed on the results.

Non parametric test

A non parametric model/test is not based on estimating a set of coefficients. The assumptions under which a non parametric model/test may be used are typically



milder than for a parametric model/test, but it may be of comparatively lower statistical power.

Null Hypothesis

A null hypothesis is a plausible scenario which may explain a given set of data. The null hypothesis is tested to determine whether the data provides enough reason to consider an alternative hypothesis. The null hypothesis is accepted unless statistical evidence indicates otherwise. There is a certain level of confidence (95%) that the null hypothesis does not explain the data.

Orthogonal or Linearly independent

Two variables used for explaining a phenomenon are said to be linearly independent if they do not share a straight-line relationship. Violation of linear independence is referred to as collinearity or multicollinearity.

Outlier

An outlier is an observation from a data set that is numerically distant from the rest of the data. Statistics that are derived from data that include outliers may be misleading.

Parametric test

A parametric model/test is based on estimating a set of coefficient/s, then drawing statistical conclusions based on the assumed distribution of the coefficient/s.

Regression

A regression model is used to explain a particular phenomenon by expressing some quantum associated with the phenomenon as a straight-line function of a number of explanatory variables. The estimated coefficients show the magnitude and direction with which each variable influences the phenomenon, and the standard error of the variables help to identify their statistical significance.

Sampling error

Statistics/Econometrics is the process of trying to draw conclusions about an entire population based on data from a subsample of the population. Sampling error is the uncertainty inherent in predicting some characteristic of the entire population based on only observing a subsample of the population.

Statistically different from zero

In many cases in statistics/econometrics, one wishes to determine whether a variable has some effect upon a phenomenon, or alternatively, whether the variable has no



effect at all. If a variable has no effect upon a phenomenon, then its estimated coefficient is zero to within sampling error. If there is sufficient statistical evidence to suggest that the coefficient is different from zero, then the coefficient is said to be "statistically different from zero", and its associated variable is important in explaining the phenomenon.

Structural change

A structural change is said to have taken place if an underlying change in the behaviour of the phenomenon has occurred at some point during the sample period. If a structural change has occurred, the variables affect the phenomenon differently before and after the change. Estimation of a model using data from the pre- and post-change period, if unaccounted for, may yield misleading coefficients.

Standard error

The standard error of a variable's coefficient gives an indication of the level of precision with which the coefficient is estimated from the data. The standard error of a variable's coefficient can be used to determine the statistical significance of the variable.

Tests of significance

A statistically significant result is one that is unlikely to have occurred by chance. The significance level is the probability of making a decision to reject the null hypothesis when the null hypothesis is in fact true. The decision is normally made using the p-value i.e. if the p-value is less than the significance level, then the null hypothesis is rejected. The smaller the p-value, the more significant the result.