The impact of franking credits on the cost of capital of Australian firms

Report prepared for ENA, APIA, and Grid Australia

16 September 2008

PO Box 29, Stanley Street Plaza
South Bank QLD 4101
Telephone +61 7 3844 0684
Email s.gray@sfgconsulting.com.au
Internet www.sfgconsulting.com.au

STRATEGIC FINANCE GROUP
SFG CONSULTING

Level 1, South Bank House
Stanley Street Plaza
South Bank QLD 4101
AUSTRALIA

Contents

Background

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. I have attached a copy of my Curriculum Vitae at Appendix E to this report. I have been engaged by ENA, APIA, and Grid Australia to provide an opinion on the use of market data to estimate the gamma parameter in the context of the issues paper released by the Australian Energy Regulator (AER) on 6 August 2008 entitled "Review of the weighted average cost of capital (WACC) parameters for electricity transmission and distribution."

2. Since Officer (1994) it has been generally recognised, in the finance literature and in the Australian regulatory process, that consideration must be given to the extent to which dividend imputation may affect the corporate cost of capital of Australian firms. Specifically, to the extent that the value of franking credits is capitalised into the prices of Australian stocks, an adjustment must be made to either the definition of the cash flows or to the discount rate. Officer (1994) derives a number of formulas for this purpose, which involve a parameter that he defines to be gamma (γ).

3. It is also generally recognised[1] in the finance literature and in the Australian regulatory process that gamma should be interpreted as the value of franking credits at the point of creation (by the payment of Australian corporate tax). There are two components of this value:

   a. **The distribution rate (*F*):** the rate at which franking credits that are created by the firm are distributed to shareholders, attached to dividends; and

   b. **Theta (θ):** the value to investors of a franking credit at the time they receive it.

4. This second component is referred to by some as a "utilisation rate," which can be misleading. In particular, what is required is an estimate of the *value* of franking credits to investors, not an estimate of how many investors redeem the franking credits that they might receive. For the same reason, we estimate the risk-free rate by reference to the price of government bonds, not by reference to the number of investors who choose to buy them. Indeed, the relevant Rules (6.A 6.4 and 6.5.3) refer to gamma as being the "assumed utilisation of franking credits." This must be interpreted widely to allow for the facts that (a) the distribution rate must be considered when estimating gamma and (b) the rate at which franking credits are utilised is not an estimate of market value, as explained in this report.

5. This paper is primarily concerned with how market data can be used to estimate the value of franking credits. What the empirical techniques do is to estimate the value of franking credits at the time they are received by investors. Consequently, the focus of this paper is on the estimation of theta from market data. To the extent that a particular firm does not immediately distribute all franking credits that are created, the value of gamma will be lower than the estimate of theta. For example, Hathaway and Officer (2004) conclude that theta is 0.5 and that 70% of created franking credits are distributed to shareholders – they consequently present an estimate of gamma of 0.35.

6. In the remainder of this paper, I consider estimates of gamma based on (a) a distribution rate of 70%, consistent with that of the average firm as reported in Hathaway and Officer (2004), and (b)

[1] See the specific comments on this in Officer (1994) and Hathaway and Officer (2002, 2004) and the Essential Services Commission of Victoria's gas distribution review, ESC (2008).

a distribution rate of 100% on the basis only that this estimate was adopted in a recent Australian energy distribution regulation case.[2] In particular, I am unaware of any empirical evidence to suggest that Australian energy distribution or transmission firms immediately distribute all franking credits at the time they are created by the payment of corporate tax. Rather, in its gas distribution case, the ESCV modelled expected tax payments and then derived the amount of dividends that would have to be paid to distribute those franking credits. In that case, the modelled tax payments were small relative to the regulated asset base (less than 1% for all firms), so the amount of franking credits is small and the ESCV concluded that they could be distributed via a moderate dividend yield.

7. Under the assumption of a 100% distribution rate, the estimate of theta is multiplied by 1, and becomes the estimate of gamma. To the extent that the distribution rate was less than 100% (which would be the case if dividends were not sufficiently high to enable the distribution of all franking credits created in a particular year – e.g. 70% for the average Australian firm), the estimates of gamma are proportionately less than theta.

[2] The Essential Services Commission of Victoria's gas distribution review, ESC (2008). I make no judgment about the reliability or appropriateness of that estimate – I simply adopt it here for convenience, my primary focus being on the use of empirical data to estimate theta.

1. Summary of Conclusions

All WACC parameters, including theta, should be estimated using appropriate market data. [See Section 2]

8. There is a question as to whether a value for theta should be assumed or whether it should be estimated from market data. My view is that all WACC parameters should be estimated with reference to market data and they should not be assumed. Technical theoretical discussions about the definition of the market, the identity of the marginal investor, and so on are likely to confuse and side-track the analysis. When estimating all other WACC parameters, consideration is given to the available market data and empirical estimates. The weight that is applied to a particular estimate then depends upon the precision with which it is estimated, the statistical reliability of that estimate, and whether the estimate is economically reasonable. The same should apply to the estimation of theta, and consequently gamma.

Redemption rates are *not* empirical market data and are consequently not relevant to the estimation of theta. [See Section 2]

9. One approach that has been considered when estimating theta (and consequently gamma) is to examine the average redemption rate of franking credits. This involves using aggregate tax statistics to see how many investors use the franking credits that are distributed to them. In my view, measuring how many investors use a particular type of asset does not give us a *value* of that asset. When estimating the risk-free rate, for example, we do not consider how many investors use government bonds, we examine their market price.

10. Relevant empirical evidence requires an estimate of the market *value* to investors and redemption rates are not such an estimate.

11. To see why this is the case, consider two Australian companies that are identical in all respects except that one operates under foreign ownership restrictions and the other does not. Specifically, suppose the first firm is prevented from raising any foreign equity. For this firm, all franking credits that were distributed would go to resident investors who could redeem them. The average redemption rate would be 100%.[3] If this were used to estimate theta (and consequently gamma) the downward adjustment to the cost of equity[4] would be much greater than even is the case where gamma is assumed to be 0.5. That is, the implication of using average redemption rates to estimate theta (and consequently gamma) is that a firm's cost of capital could be substantially reduced, relative to that of its peers, by imposing foreign investment restrictions on it. However, the exact reverse is true – less foreign investment means a lower supply of capital and consequently an *increase* in its cost. In my view, this simple counterfactual analysis provides a compelling reason why average redemption rates should be considered to have no relevance to empirically estimating from market data the effect that franking credits have on the cost of capital of Australian firms. Note that this example makes one point – the use of redemption rates to estimate theta (and consequently gamma) logically leads to the conclusion that franking credits would be more valuable and the Australian corporate cost of capital would

[3] But for those that are excluded by the 45 day rule and cases where investors inadvertently neglect to redeem them at the end of the relevant tax year.

[4] The estimated required return on equity (from CAPM) is adjusted by a factor of $\frac{1-\tau}{1-\tau(1-\gamma)}$. For higher values of gamma, the downward adjustment is greater. See Appendix C for an explanation of this downward adjustment.

be consequently lower if foreign investment were banned in order to maximise those redemption rates.

Empirical estimates of theta come from the analysis of dividend drop-offs and simultaneous security prices. [See Appendix A]

12. Two empirical approaches have been used in the finance literature and by regulators to empirically estimate the value of franking credits from market data. The *dividend drop-off method* involves examining stock price changes on ex-dividend days.[5] The amount by which stock prices change (on average) is assumed to reflect the value of the dividend and franking credit that has separated from the shares. An estimate of the value of the cash dividend is subtracted from the estimate of the combined value of dividend plus franking credit to leave an estimate of the value of the franking credit.

13. Perhaps the best-known example of the *simultaneous security price method* is Cannavan, Finn and Gray (2004). They examine the simultaneous prices of shares (which entitle the holder to receive dividends and franking credits) and futures contracts (which do not). The difference in the respective prices is then used to obtain estimates of the value of cash dividends and the value of franking credits.

14. These techniques are based on market prices of traded securities, which in my view is appropriate. The average redemption method is not based on market prices, and in my view is inappropriate.

A comprehensive data set should be used to estimate the value of theta and there is no reason to exclude pre-2000 data. [See Section 3]

15. There is a question as to whether the data set should be restricted to post-2000 data on the basis that they consider the 2000 Rebate Provision significantly increased the value of franking credits. Focussing on a smaller sub-set of data is more likely to lead to error, so a particular section of the data should only be rejected if there is a compelling reason to do so. I conclude that there is no reason at all to reject the pre-2000 data and that it should be included in the analysis. [6]

The whole empirical result should be used, not half of it. [See Section 4]

16. The dividend drop-off method is the empirical technique that is most commonly used to estimate theta. Examples include Hathaway and Officer (2002, 2004) and Beggs and Skeels (2006). Both of these papers report that the combined value of a $1.00 cash dividend and the attached 43 cent[7] franking credit is about $1.00. They then estimate the value of the $1.00 cash dividend to be around 80 cents and subtract this from the combined value of $1.00, leaving around 20 cents of

[5] These are days on which the dividend and associated franking credit separate from the shares. An investor who buys the shares prior to the ex-date is entitled to receive the dividend and franking credit, but an investor who buys the shares after the ex-date is not.

[6] Specifically, two of the three empirical studies examined report that there is no statistically significant difference between pre- and post-2000 estimates of theta. The one study that does find a change occurring in 2000 reports that $1.00 of cash dividends was worth $1.168 prior to 2000 and 80 cents afterwards, even though the 2000 Rebate provision had nothing at all to do with cash dividends. Since I no not believe that it is economically plausible that (a) cash dividends were valued at almost 120% of their face value, and (b) the Rebate Provision caused the value of cash dividends to fall by 30%, I also reject the implied values of theta that are *conditional* on these economically implausible results.

[7] Under Australian dividend imputation legislation, a fully-franked dividend has $T/(1\text{-}T)$ franking credits attached to it, where T is the relevant corporate tax rate. At a 30% corporate tax rate, a franking credit of 43 cents is attached to a $1.00 dividend.

value to be ascribed to the 43 cent franking credit. This is the basis for the conclusion that franking credits are worth about half of their face value to investors.

17. The first part of this result suggests that shareholders require a lower return than they otherwise would, because they also receive franking credits that are worth about 50 cents in the dollar to them. Consequently, regulated prices would be lower than otherwise – to reflect the value that shareholders are assumed to receive by way of franking credits. But this is only half of the one empirical result. It is *conditional* on dividends being worth only 80 cents in the dollar. Consequently, to the extent that the firm in question pays dividends, shareholders would require *higher* returns to reflect the extent to which those dividends are worth less than their face value.[8]

18. In my view, it would be inconsistent and wrong:

a. to reduce the required return (and the regulated price) to reflect the estimated value of franking credits, but

b. to not then take account of the offsetting effect of dividends being estimated to be worth only 75-80 cents in the dollar,

especially when these two effects are part of a single estimation exercise in which the first estimate is *conditional* on the second. If the required return is to be reduced on the basis of these estimates (as in (a) – which is the present regulatory practice) then the effect of dividends being worth less than their face value (as in (b)) should be taken into account. Conversely, if the value of dividends in (b) is not taken into account, then the reduction in the required return should also not be taken into account.

In my view, the *correct* interpretation of the empirical estimates is a lower value of theta (and consequently gamma). [See Section 4]

19. As noted above, the empirical technique that is most commonly used, in the finance literature and by regulators, to estimate theta estimates the *combined* value of a $1.00 cash dividend plus the attached 43 cent franking credit to be around $1.00. If one estimates the value of $1.00 of cash dividends to be worth $1.00 (which is consistent with other empirical evidence, and is also the assumption that is made in the CAPM) the estimated value of franking credits is negligible. That is, if the combined value of the $1.00 dividend and the 43 cent franking credit is $1.00, and if the cash dividend is valued at $1.00, there is no surplus to be attributed to the franking credit.

20. This is important in a regulatory setting in which the CAPM is used to estimate the total return required by equity holders, because the CAPM is based on a $1.00 dividend being worth $1.00.[9] Consequently:

a. If the CAPM is used to estimate the required return on equity, one is assuming that dividends and capital gains are equally valued by the market; and

---

[8] For example, suppose that shareholders require a return of 10% on their $100 stock. If the return is to be paid entirely as a dividend, the amount of the dividend would have to be $12.50, which if valued at 80 cents in the dollar would provide the 10% return that is required. That is, 0.8 × 12.50 = 10, and 10 / 100 = 10%.

[9] Specifically, the CAPM does not differentiate between returns that are in the form of dividends and returns in the form of capital gains, valuing them equally.

b. If one is relying on empirical estimates from dividend drop-off studies such as Hathaway-Officer and Beggs-Skeels to support an estimate of theta in the order of 0.5[10], one is assuming that dividends are substantially less valuable than capital gains.

21. In my view, assuming that a $1.00 cash dividend is valued at (a) $1.00 when estimating the required return on equity, but (b) 75-80 cents when estimating the effect of franking credits, presents a clear inconsistency that must be resolved. The inconsistency can be resolved by estimating theta conditional on a $1.00 cash dividend being worth $1.00 (consistent with CAPM).[11] If this is done, the estimate of theta (and consequently gamma) is negligible.

22. Also in this regard, I note that the standard practice of Australian firms and independent expert valuation practitioners is to make no adjustment for dividend imputation franking credits when estimating WACC.[12] [13] [14] This is also consistent with published data using other empirical techniques. It is also consistent with new evidence which shows that Australian stock prices were unaffected by the introduction of dividend imputation.

The most recent empirical estimates of theta (and consequently gamma) are lower than 0.5. [See Section 5 and Appendix E]

23. Even if one passes over the issues of (a) internal consistency and (b) using the entire empirical result and not half of it, when the most recent, up-to-date and comprehensive data set is employed, the standard dividend drop-off method produces an estimate of the value of theta in the range of 0.2 to 0.35, with an average estimate of 0.28. Based on an assumed franking credit distribution rate of 100%, this in turn produces an estimate of gamma in the range of 0.2 to 0.35 (average of 0.28). Based on an assumed franking credit distribution rate of 70%, this in turn produces an estimate of gamma in the range of 0.14 to 0.25 (average of 0.19). This is lower than the 0.5 estimate that is based on older and smaller subsets of data and which forms the basis of Australian regulatory precedent on this issue.

24. In particular, our analysis shows that on average:

a. The combined value of a $1.00 dividend and the attached franking credit is approximately $1.00, corroborating this part of the result in Hathaway and Officer and Beggs and Skeels;

b. Cash dividends are estimated to have an average value of 84.6 cents in the dollar (range of 75 to 95); and

c. Franking credits are estimated to have an average value (theta) of 27.8 cents in the dollar (range of 20 to 35). This represents an estimate of gamma of 0.28 under the assumption of a 100% distribution rate and 0.19 under the assumption of a 70% distribution rate.

25. The value of cash dividends estimated using this technique remains well below face value and is therefore inconsistent with the use of the CAPM, as explained above. However, to the extent that this inconsistency is to be disregarded and the results of dividend drop-off analysis are to be

[10] And consequently an estimate of gamma in the range of 0.35 to 0.5 where the distribution rate ranges between 70% and 100%.

[11] Rather than conditional on a $1.00 cash dividend being worth 75-80 cents, which is inconsistent with CAPM, but is the basis for theta estimates as high as 0.5.

[12] Truong, G., G. Partington and M. Peat, 2005, Cost of Capital Estimation & Capital Budgeting Practice in Australia," *Australian Journal of Management,* 33 (1), 95 – 121.

[13] Lonergan, W., 2001, The Disappearing Returns. JASSA, 1(Autumn), 8-17.

[14] KPMG. (August 2005). The Victorian Electricity Distribution Businesses Cost of Capital - Market practice in relation to imputation credits Victorian Electricity Distribution Price Review 2006 – 10.

relied upon at face value, it is my view that this study provides the most recent, up-to-date and comprehensive estimates and that these estimates support a value of theta in the range of 20-35% of face value. Based on an assumed franking credit distribution rate of 100%, this in turn produces an estimate of gamma in the range of 0.2 to 0.35. Based on an assumed franking credit distribution rate of 70%, this in turn produces an estimate of gamma in the range of 0.14 to 0.25. These estimates are lower than the 0.5 estimate that is based on older and smaller subsets of data and which forms the basis of Australian regulatory precedent on this issue.

26. In my view, there is persuasive empirical evidence to support the use of an estimate of gamma less than 0.35 and that a gamma estimate of 0.5 is no longer empirically supportable.

Professor Stephen Gray
15 September 2008

2. Basis of Estimation: Market Data or Assumption

Context

27. I begin by noting that it is generally recognised[15] that gamma should be interpreted as the value of franking credits at the point of creation (by the payment of Australian corporate tax). There are two components of this value:

a. **The distribution rate:** the rate at which franking credits that are created by the firm are distributed to shareholders, attached to dividends; and

b. **Theta (θ):** the value to investors of a franking credit at the time they receive it.

28. This paper is primarily concerned with how market data can be used to estimate the value of franking credits. What the empirical techniques do is to estimate the value of franking credits at the time they are received by investors. Consequently, the focus of this paper is on the estimation of theta from market data. This estimate is then a component of the estimate of gamma, which is one of the parameters that is the subject of the AER's Cost of Capital Review.

29. In the remainder of this paper, , I consider estimates of gamma based on (a) a distribution rate of 70%, consistent with that of the average firm as reported in Hathaway and Officer (2004), and (b) a distribution rate of 100% on the basis only that this estimate was adopted in a recent Australian energy distribution regulation case.[16] In particular, I am unaware of any empirical evidence to suggest that Australian energy distribution or transmission firms immediately distribute all franking credits at the time they are created by the payment of corporate tax. Rather, in its gas distribution case, the ESCV modelled expected tax payments and then derived the amount of dividends that would have to be paid to distribute those franking credits. In that case, the modelled tax payments were small relative to the regulated asset base (less than 1% for all firms), so the amount of franking credits is small and the ESCV concluded that they could be distributed via a moderate dividend yield.

30. Under the assumption of a 100% distribution rate, the estimate of theta is multiplied by 1, and becomes the estimate of gamma. To the extent that the distribution rate was less than 100% (which would be the case if dividends were not sufficiently high to enable the distribution of all franking credits created in a particular year – e.g. 70% for the average Australian firm), the estimates of gamma are proportionately lower.

31. Before turning to my analysis, I note that there is a single correct way to interpret gamma. I discuss this in some detail in Appendix D, and my Appendix C shows why it is that gamma affects the cost of equity capital and derives (intuitively) the adjustment factor presented in Officer (1994).

Market data vs. theoretical assumption

32. Two broad approaches have been proposed for determining a value for gamma:

---

[15] See the specific comments on this in Officer (1994) and Hathaway and Officer (2002, 2004).

[16] The Essential Services Commission of Victoria's gas distribution review, ESC (2008). I make no judgment about the reliability or appropriateness of that estimate – I simply adopt it here for convenience, my primary focus being on the use of empirical data to estimate theta.

a. **Market data approach:** Estimating gamma from market data (the prices of traded securities);

b. **Theoretical Assumption:** Assuming a value for gamma without having regard to market data.

33. The theoretical assumption approach has been advocated by Associate Professor Lally of the Victoria University of Wellington. Lally suggests that when estimating gamma, one should simply assume away the existence of non-resident investors. For example, in work for the Queensland Competition Authority, Lally (2004)[17] summarises the position as follows:

> Since national capital markets are assumed to be segregated, it would be inconsistent to recognise foreigners. Accordingly they are omitted from consideration.[18]

34. Lally goes on to suggest that if all foreign investors are omitted from consideration, the only remaining investors are residents. Since all resident investors can utilise franking credits, Lally suggests that an appropriate estimate of theta is one.

35. The alternative to simply *assuming* that theta is equal to one, is to empirically *estimate* it using market data. When estimating all other WACC parameters, consideration is given to the available market data and empirical estimates. The weight that is applied to a particular estimate then depends upon the precision with which it is estimated, the statistical reliability of that estimate, and whether the estimate is economically reasonable. The same should apply to the estimation of theta, and consequently gamma.

36. Another way of looking at this issue is that the theoretical assumption approach involves estimating theta not as it *is*, but as it *would be* if there were no foreign investors. But if we estimate theta on this basis, consistency demands that we should do the same for *all* WACC parameters. For example, the risk-free rate would presumably be higher if no foreign investment were allowed, as there would be less demand for Australian government bonds.

37. In summary, when estimating theta the first choice one must make is whether to:

a. Assume a value for theta by omitting from consideration the impact of foreign investors, in which case all WACC parameters should also be estimated not as they are, but as they would be if there were no foreign investors; or

b. Estimate theta with reference to market data (weighting that evidence in line with the statistical precision and reliability and economic reasonableness of the estimates) in the same way that all other WACC parameters are estimated.

38. In my view, it is appropriate to estimate theta, and consequently gamma, from market data in the same way that all other WACC parameters are estimated. While theory can explain why theta, and consequently gamma, is expected to be less than 0.5, empirical evidence from market data (properly weighted in line with statistical precision, reliability and economic reasonableness) provides the best estimate.

[17] Lally, M., 2004, The Cost of capital for regulated entities, QCA, October 14.

[18] Lally (2004, pp. 44-5).

The Identity of the Marginal Investor

39. The identity of the marginal price-setting investor is an issue that is closely related to the choice of whether to assume a value for theta or estimate it from market data. The issue here is whether the marginal investor should be considered to be a resident, a non-resident, or a weighted average across all investors in the market. The latter definition also requires a definition of "the market." Restricting the market to Australian investors only is equivalent to assuming that theta is 1.00, whereas allowing foreign investors to be included in the market is equivalent to assuming that theta is negligibly small, given Australia's small proportion of global capital.

40. These considerations are complex and technical and are likely to be the subject of much debate.[19] They are also unnecessary because theta (and consequently gamma) can be estimated with reference to market data without any consideration of the identity of the marginal investor whatsoever. For no other WACC parameter is any consideration given to identifying the marginal investor.

41. Government bonds trade in a free market, transactions occur, and a market-clearing price is determined. We observe that market clearing price, infer a yield to maturity from it, and use that as an estimate of the risk-free rate. In economic theory, that market-clearing price was determined by the marginal investor. But the identity of the marginal investor does not need to be determined or assumed in order to estimate the risk-free rate. We simply observe traded market prices, use them to obtain the parameter estimate and move on.

42. Exactly the same applies to the estimation of theta. None of the empirical techniques that are used to estimate theta are based on, or require, any assumption whatsoever about the identity of the marginal investor. The dividend drop-off approach, for example, is a mechanical procedure that is applied in exactly the same way irrespective of any theoretical debate about how we should think about the concept of a marginal investor.

43. Under the alternative approach of *assuming* a value of theta (rather than *estimating* one from market data) the value of theta will imply something about the identity of the marginal investor. For example, if one assumes that theta equals 1.00 on the basis that anyone who does not fully value franking credits is omitted from consideration, then only (identical) resident investors remain and the marginal investor must be a resident.

44. If one seeks to estimate theta using market data there is no need for any theoretical debate about how we should think about the concept of a marginal investor. None of the empirical techniques that are used to estimate theta are based on, or require, any assumption whatsoever about the identity of the marginal investor.

Use of redemption rates to estimate theta

45. One approach that has been considered when estimating theta (and consequently gamma) is to examine the average redemption rate of franking credits. This involves using aggregate tax statistics to see how many investors use the franking credits that are distributed to them. In my view, measuring how many investors use a particular type of asset tells us nothing about its value. When estimating the risk-free rate, for example, we do not consider how many investors use government bonds, we examine their market price.

[19] In this regard, see Appendix D.

46. Relevant empirical evidence requires an estimate of the market *value* to investors and redemption rates are not such an estimate

47. To see why this is the case, consider two Australian companies that are identical in all respects except that one operates under foreign ownership restrictions and the other does not. Specifically, suppose the first firm is prevented from raising any foreign equity. For this firm, all franking credits that were distributed would go to resident investors who could redeem them. The average redemption rate would be 100%.[20] If this were used to estimate theta (and consequently gamma) the downward adjustment to the cost of equity[21] would be much greater than even is the case where gamma is assumed to be 0.5. That is, the implication of using average redemption rates to estimate theta (and consequently gamma) is that a firm's cost of capital could be substantially reduced, relative to that of its peers, by imposing foreign investment restrictions on it. However, the exact reverse is true – less foreign investment means a lower supply of capital and consequently an *increase* in its cost.

48. In my view, this simple counterfactual analysis provides a compelling reason why average redemption rates should be considered to have no relevance to empirically estimating from market data the effect that franking credits have on the cost of capital of Australian firms.

Note that this example makes one point – the use of redemption rates to estimate theta (and consequently gamma) logically leads to the conclusion that franking credits would be more valuable and the Australian corporate cost of capital would be consequently lower if foreign investment restrictions were imposed in order to maximise those redemption rates.

49. In a recent paper, Handley and Maheswaran (2008) estimate redemption rates over a number of sub-periods. The focus of this paper is on what the authors refer to as the efficacy of the imputation system – the extent to which franking credits are redeemed by investors. That is, the point of the paper is simply to describe which classes of investor redeem franking credits and which classes do not.[22] To a large extent, the paper is unnecessary – we already know that franking credits distributed to non-residents will not be redeemed and that most[23] franking credits distributed to resident investors will be redeemed. Thus, this paper really tells us more about the residency of investors than about how franking credits affect the corporate cost of capital. Indeed the terms "theta" and "gamma" are not referred to at all in the paper.

Summary and Conclusions

50. When estimating theta the first choice one must make is whether to:

---

[20] But for those that are excluded by the 45 day rule and cases where investors inadvertently neglect to redeem them at the end of the relevant tax year.

[21] The estimated required return on equity (from CAPM) is adjusted by a factor of $\frac{1-\tau}{1-\tau(1-\gamma)}$. For higher values of gamma, the downward adjustment is greater. See Appendix C for an explanation of this downward adjustment.

[22] A very early version of this paper did refer to "gamma" and suggested that redemption rates might be relevant to the estimation of gamma. I note that these references have been removed entirely from the published version of the paper after the refereeing process.

[23] But for those that are excluded by the 45 day rule and cases where investors inadvertently neglect to redeem them at the end of the relevant tax year.

a. Assume a value for theta based on theoretical assumptions that eliminate the impact of foreign investors, in which case all WACC parameters should also be estimated not as they are, but as they would be if there were no foreign investors; or

b. Estimate theta with reference to market data (weighting that evidence in line with the statistical precision and reliability and economic reasonableness of the estimates) in the same way that all other WACC parameters are estimated.

51. If one follows the second of these options (estimating theta using market data in the same way that other WACC parameters are estimated) there is no need for any theoretical debate about how we should think about the concept of a marginal investor. None of the empirical techniques that are used to estimate theta are based on, or require, any assumption whatsoever about the identity of the marginal investor.

52. The use of redemption rates is more akin to using theoretical assumption rather than market data to estimate theta (and consequently gamma). The techniques for estimating theta that are properly based on market data are the dividend drop-off and simultaneous security price techniques that are discussed below. These techniques estimate the *value* of franking credits to investors who are trading in the market. When investors are buying and selling shares and/or futures contracts, the traded prices will reflect how much investors value the dividends and franking credits that are available to them. By actually trading, investors put their own wealth at stake in which case prices reflect how much they *value* dividends and franking credits. Redemption rates are simply a measure of how many franking credits investors have, not how much they value them.

3. What data should be used, and how should it be analysed?

The 2000 Rebate Provision

53. The remainder of this paper addresses various aspects of the estimation of theta (and consequently gamma) from market data. If the value of theta is to be assumed, rather than empirically estimated, one does not need to consider any market data at all and the remainder of the paper is largely redundant.[24]

54. When using market data to estimate theta, the first decision to be made is what data period should be used. In general, a longer data period provides estimates that are more precise and statistically reliable. If, however, a significant change has occurred that fundamentally changed the value of theta,[25] there may be good reason to use only data from after the break point.

55. One such break point that has been proposed is the Rebate Provision that came into effect on 1 July 2000. Prior to this time, resident investors with zero taxable income could not redeem excess franking credits. The Rebate Provision allows those investors to now redeem excess franking credits. Note that the Rebate Provision only applies to resident investors with zero taxable income.

56. There are two possible approaches to this issue:

   a. Assume that the Rebate Provision will have substantially changed the value of theta and restrict the analysis to post-2000 data, or

   b. Empirically test whether the estimated value of theta did change at the time of the Rebate Provision.

57. In my view, the second approach should be preferred. If it turns out that the Rebate Provision had no effect on the estimated value of theta, one should include pre-2000 data to improve the precision and statistical reliability of the estimates. In general, a longer data set with more observations will yield more precise and statistically reliable estimates. This is especially the case where the data that is being examined is known to be "noisy."[26] In a dividend drop-off analysis the data are indeed known to be noisy.[27] That technique examines the stock price change from one day to the next and compares it with the dividend and franking credit that were paid. But there are many reasons other than the payment of the dividend for the stock price to change over the course of a day. These other reasons will be "random" in the sense that some will tend to cause stock prices to increase and some will tend to cause them to decrease. In a large sample, the law of averages[28] will apply and the random noise will cancel out leaving the dividend payment as the only systematic effect. In smaller samples, however, it is possible that we will have more positive random noise than negative (or the reverse).[29] That is, in a small sample there

[24] That is, one must first make a clear choice about whether the value for theta should be assumed or estimated. If it is to be assumed, there should be no consideration of market data. If it is to be estimated, this should be on the basis that the approach of simply assuming a value has been rejected. The two approaches are mutually exclusive.

[25] This is known as a "structural break" in econometrics.

[26] As one example, Hathaway and Officer (2004) note that "there is considerable 'noise' in the individual results (p. 5) and that "the 'noise' in the data may mask any such finessing of the results (p. 6).

[27] For example, consider a $10 stock paying a 10 cent dividend. Factors completely unrelated to the dividend could quite easily drive the stock price up or down by 1% over the course of a day. In this case, the "noise" is just as large as the effect that we are seeking to measure.

[28] In statistical terms this is the "law of large numbers."

[29] That is, in a sample that is too small for the law of large numbers to apply.

is a greater chance that our estimate is contaminated by random noise and that the resulting estimate is unreliable.

58. It is my view that longer time series data should be used to estimate theta (and consequently gamma) to improve the statistical reliability of the estimate, unless there is compelling empirical evidence of a material structural break.[30] [31]

59. The empirical technique that has most commonly been used by Australian regulators for estimating theta (and consequently gamma) using time series data is the dividend drop-off method. Some regulators have concluded that this technique provides evidence of a change in the value of franking credits in 2000. In the remainder of this section, I show that this is an incorrect interpretation of the available evidence.

The dividend drop-off method

60. This sub-section contains a brief summary of the dividend drop-off method and explains how estimates from this technique should be interpreted. Appendix A provides a more detailed explanation and summarises the results from the literature in more detail.

61. Essentially the dividend drop-off method involves examining stock price changes on ex-dividend days.[32] The amount by which stock prices change (on average) is assumed to reflect the value of the dividend and franking credit that has separated from the shares. On average, we have

$$\Delta P = aD + \theta FC \qquad (1)$$

where ΔP represents the change in stock price, D represents the amount of the cash dividend, FC represents the amount of franking credits, a is the estimated value of a \$1.00 dividend and θ (theta) is the estimated value of a \$1.00 franking credit.

62. One of the key points here is that the estimate of theta is *conditional* on the estimated value of cash dividends, a. To see this, note that the equation above can be re-arranged to give:

$$\frac{\Delta P - aD}{FC} = \theta \qquad (2)$$

63. Equation (2) says that to estimate theta, we start with the average stock price change on the ex-dividend date, ΔP. This is an estimate of the combined value of dividend plus franking credit. We subtract from this the estimated value of the dividend, aD. This then gives the component of the total value that is ascribed to the franking credit. We divide this by the face value of the franking credit, FC, so that we can interpret theta as the estimated value of a \$1.00 franking credit.

[30] Recall from Paragraph 0 above that the weight that is applied to a particular estimate should depend upon the precision with which it is estimated, the statistical reliability of that estimate, and whether the estimate is economically reasonable.

[31] I show in the following paragraphs that there is no basis for concluding that any statistically significant change has occurred to the value of theta.

[32] These are days on which the dividend and associated franking credit separate from the shares. An investor who buys the shares prior to the ex-date is entitled to receive the dividend and franking credit, but an investor who buys the shares after the ex-date is not.

64. For example, at a 30% corporate tax rate, a \$1.00 fully franked dividend has a 43 cent franking credit attached to it,[33] so $D = 1.00$ and $FC = 0.43$. If the combined value of this dividend and franking credit were valued by the market at \$1.00 (which is what all of the literature suggests[34]), the stock price would fall by \$1.00, on average, when it separates from the share on the ex-date, so $\Delta P = 1.00$. Finally, if a \$1.00 cash dividend were valued by the market at 80 cents (again, this is what the literature suggests[35]) we have $a = 0.80$ and:

$$\theta = \frac{\Delta P - aD}{FC} = \frac{1.00 - 0.80 \times 1.00}{0.43} = 0.47\,.$$

65. This example shows that an estimate of theta of about 0.5 is *conditional* on cash dividends being valued at around 80 cents in the dollar. A higher estimate of the value of cash dividends would result in a lower estimate of theta. If a \$1.00 cash dividend is estimated to be worth \$1.00 (so $a = 1.00$), the estimate of theta becomes negligibly small. This suggests that the current regulatory estimate for gamma of 0.5 is very high, and is conditional on cash dividends being worth substantially less than their face value.

Theta estimates before and after the Rebate Provision

66. To determine whether the Rebate Provision had a substantial effect on the estimate of theta, one simply needs to compare estimates of theta from pre-2000 data with those from post-2000 data. Three studies do this, and their results are summarised below. These studies, and the interpretation of their results, are discussed in more detail in Appendix B.

Hathaway and Officer (2004)[36]

67. Hathaway and Officer present a rolling average of theta estimates for a subset of the firms in their data set. Their Figure 12 includes an estimate of the value attributable to franking credits, *conditional* on cash dividends being worth exactly 80 cents in the dollar throughout.[37] Figure 1 below presents the relevant results. In this figure, the arrow points to the introduction of the Rebate Provision. The rolling average begins to incorporate post-2000 data at this point. As more and more post-2000 data is introduced, the estimated value of franking credits begins to *fall*. This fall continues for two and a half years, and at the end of their sample period the estimated value of franking credits is still no higher than it was when the Rebate Provision was introduced. There is no evidence here of an increase in the estimated value of franking credits coinciding with the introduction of the Rebate Provision.

---

[33] A \$1.00 fully-franked dividend has attached to it a franking credit of $\frac{\tau}{1-\tau}$, which is 43 cents when $\tau = 0.3$.

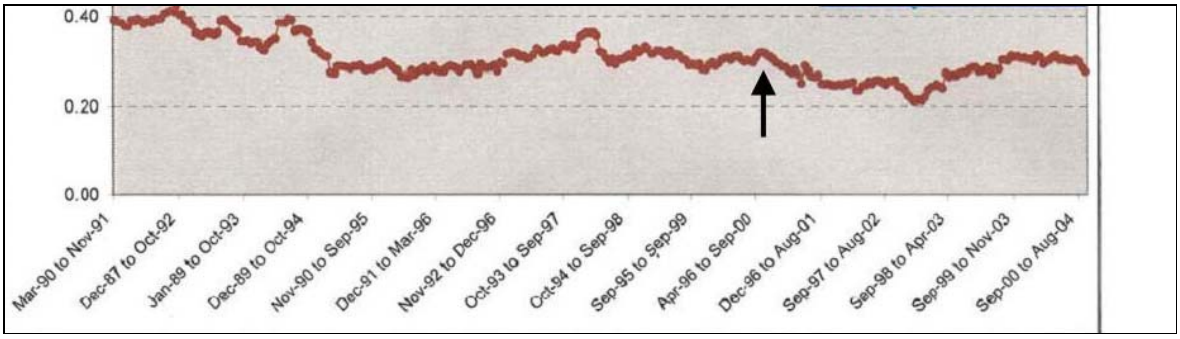
[34] See, for example, Hathaway and Officer (2002, 2004), Beggs and Skeels (2006), Bellamy and Gray (2004) and SFG (2007).

[35] See, specifically, Hathaway and Officer (2002, 2004) and Beggs and Skeels (2006).

[36] Hathaway, N. and R. Officer, 2004 "The Value of Imputation Tax Credits," Working Paper: Capital Research.

[37] This figure plots $\theta \times FC$ in terms of the notation above.

Figure 1: Rolling Estimated Value of Franking Credits – Hathaway and Officer (2004)



Source: Hathaway and Officer (2004), Figure 12, p. 24.

ACG (2006)[38]

68. ACG report estimates of theta for three-year periods before and after the introduction of the Rebate Provision, summarised in the excerpt from the relevant table in their report below. For both periods, their estimates of theta are insignificantly different from zero. Again, there is certainly no evidence here of an increase in the estimated value of franking credits coinciding with the introduction of the Rebate Provision.[39]

Figure 2: Estimated Value of Theta – ACG (2007)

Dividend Drop-Off	July 1997 – June 2000	July 2000 – June 2003
Implied θ	-0.05	-0.08

Source: ACG (2006), Table 6.14, p. 61.

Beggs and Skeels (2006)[40]

69. Another paper that examines the effect that the Rebate Provision might have had on the estimate of theta is Beggs and Skeels (2006) who apply a statistical test for a structural break around July 1 2000. In particular, they examine data from a short period prior to July 2000 with a three-year period after. The relevant results are reported in their Table 5, an excerpt from which is reproduced in the figure below.

[38] Allen Consulting Group, (2006), "Envestra's Proposed Revisions to its Access Arrangement," Report to Essential Services Commission of South Australia.

[39] ACG go on to examine sub-periods after 2003 and report positive estimates of theta in some years. However, a number of errors were identified in that work. ACG subsequently reported that when those errors were corrected, the estimate of theta was insignificantly different from zero in all years but 2005, when it was 0.72. No reason was provided for why the value of franking credits might have temporarily spiked above zero in that year.

[40] Beggs, D. and C.L. Skeels, 2006, Market Arbitrage of Cash Dividends and Franking Credits, *The Economic Record*, 82, 258, pp.239-252.

Figure 3: Test for change in value of theta – Beggs and Skeels (2006)

TABLE 5

Tests for Structural Breaks in Franking Credit Drop-off Ratios at Tax Regime Changes

Tax regime	Period	Estimated cash drop-off ratio ($\gamma_{1,j}$)	Estimated franking credit drop-off ratio ($\gamma_{2,j}$)	Null hypothesis	*P*-value
6	2000	1.168 (0.099) C	0.128 (0.204) A	$\gamma_{2,5} = \gamma_{2,6}$	0.047
7	2001–2004	0.800 (0.052)	0.572 (0.121)	$\gamma_{2,6} = \gamma_{2,7}$	B 0.003

The numbers in parentheses are estimated standard errors and the *P*-values are from conventional *F*-tests of the hypotheses.

Source: Beggs and Skeels (2006), Table 5, p. 61.

70. The key result in this table is that the estimated value of franking credits increased from 12.8 cents in the dollar (and insignificantly different from zero) immediately before the Rebate Provision to 57.2 cents in the dollar afterwards (see Point A). This change is also estimated to be statistically significant (see Point B, *P*-value is less than 0.05).

71. Recall from the previous sub-section that the value of franking credits is estimated by taking the combined value of a $1.00 cash dividend plus the attached franking credit and then subtracting the estimated value of the cash dividend. When the estimated value of the cash dividend is high, the estimated value of the franking credit will be low, and vice versa.

72. Beggs and Skeels estimate the value of a $1.00 cash dividend to have decreased from $1.168 immediately before the Rebate Provision to 80 cents afterwards (see Point C). That is, the result here is not so much one of an increase in the value of franking credits, but one of a massive decrease in the estimated value of cash dividends from an implausibly high level. Not only is there no explanation for why a $1.00 dividend might possibly be worth $1.168 prior to the Rebate Provision, but there is also no reason why the Rebate Provision would negatively affect the value of cash dividends.

73. When interpreting empirical results, it is important to consider the results in their entirety. In this case, if it is to be accepted that these results establish that the Rebate Provision has increased the value of franking credits, it must also be accepted that:

   a. A $1.00 cash dividend was worth $1.16 prior to the Rebate Provision; and

   b. The Rebate Provision caused the value of cash dividends to fall by over 30% (from $1.168 to 0.80) even though it has nothing to do with cash dividends.

74. The alternative explanation is simply that estimation error, of the type that is expected from time to time when market data is used, has resulted in economically implausible estimates in the short period immediately prior to the Rebate Provision.

75. In this regard, I note that the Beggs-Skeels paper has been through the academic refereeing process required for publication, but that the implausible result in (a) above is not addressed in the paper and has not been the subject of any subsequent academic work. My point here is again that the dividend drop-off method estimates the value of theta *conditional* on the estimated value of cash dividends. When the estimated value of cash dividends falls dramatically (as in (b) above) the estimated value of franking credits must rise. It would be incomplete and wrong to accept

that the value of franking credits increased significantly, but to disregard the other half of that result – a 30% decrease in the value of cash dividends.

76. One might not accept that the value of cash dividends fell by 30% in July 2000, preferring the explanation that the Beggs and Skeels analysis has been affected by estimation error resulting from noise in the data. If this is the case, one must then also reject the conclusion that the value of franking credits increased in July 2000.

Summary and Conclusion

77. The Hathaway-Officer and ACG results are both consistent with there being no increase in the value of franking credits around the time the Rebate Provision was introduced. Beggs-Skeels report that there was no statistically significant change in the estimated value of franking credits at any time other than in 2000, when the value of a $1.00 cash dividend increased to over $1.16 and then fell to 80 cents over the course of a year. The (residual) estimated value of franking credits accordingly varied in the opposite direction.

78. My view is that there is a strong weight of evidence to support the conclusion that the Rebate Provision did not cause a significant increase in the value of franking credits in July 2000. Accordingly, data from before and after 2000 should be included in the analysis in order to improve the precision and statistical reliability of the estimates.

4. Consistency with CAPM

The issue of inconsistency

79. The standard corporate and regulatory practice in Australia is to estimate the required return on equity using the Capital Asset Pricing Model (CAPM). The CAPM is a mathematical formula of the relationship between stock returns and market returns. These equity returns can take two forms – dividends and capital gains. Under the CAPM, no distinction is made between how much of the return comes in the form of dividends and how much comes in the form of capital gains. There *are* asset pricing models that make such a distinction, but they are not the CAPM. It is universally accepted that the CAPM treats dividends and capital gains as having equal value to investors.

80. The dividend drop-off method compares capital gains (the stock price change, ΔP) with dividends (D). As noted above, estimates of theta in the region of 0.5 are *conditional* on cash dividends being worth 75-80 cents in the dollar.[41] (Appendix A also establishes this point in more detail.) This is equivalent to saying that a $1.00 dividend has the same value to investors as a 75-80 cent capital gain.[42]

81. Consequently:

   a. If the CAPM is used to estimate the required return on equity, one is assuming that dividends and capital gains are equally valued by the market; and

   b. If one is relying on empirical estimates from dividend drop-off studies such as Hathaway-Officer and Beggs-Skeels to support an estimate of theta in the order of 0.5, one is assuming that dividends are substantially less valuable than capital gains.

82. In my view, assuming that a $1.00 cash dividend is valued at (a) $1.00 when estimating the required return on equity, but (b) 75-80 cents when estimating the effect of franking credits, presents a clear inconsistency that must be resolved.

The whole empirical result should be used, not half of it

83. The inconsistency that has been identified above has important implications when estimating the WACC. To see this, take the estimates from Hathaway-Officer and Beggs-Skeels, where theta is estimated to be around 0.5, based on cash dividends having a value of around 80 cents in the dollar.

84. The first part of this result suggests that shareholders require a lower return than they otherwise would, because they also receive franking credits that are worth about 50 cents in the dollar to them. Consequently, regulated prices would be lower than otherwise – to reflect the value that shareholders are assumed to receive by way of franking credits.

85. But this is only half of the one empirical result. It is *conditional* on dividends being worth only 75-80 cents in the dollar. Consequently, to the extent that the firm in question pays dividends, shareholders would require *higher* returns to reflect the extent to which those dividends are worth

[41] These are the results reported by Hathaway and Officer (2004) and Beggs and Skeels (2006).

[42] This indicates that when a $1.00 dividend separates from the share, the price falls by 75-80 cents on average.

less than their face value. For example, suppose that shareholders require a return of 10% on their $100 stock. If the return is to be paid entirely as a dividend, the amount of the dividend would have to be $12.50, which if valued at 80 cents in the dollar would provide the 10% return that is required.[43]

86. It would be inconsistent and wrong to (a) reduce the required return (and the regulated price) to reflect the estimated value of franking credits, but (b) disregard the offsetting effect of dividends being estimated to be worth only 75-80 cents in the dollar, especially when these two effects are part of a single estimation exercise in which the first estimate is *conditional* on the second. If the required return is to be reduced on the basis of these estimates (as in (a) – which is the present regulatory practice) then the effect of dividends being worth less than their face value (as in (b)) should be taken into account. Conversely, if the (less than full) value of dividends in (b) is disregarded, then the reduction in the required return in (a) should also be disregarded.

Resolving the inconsistency

87. The easiest way to resolve the inconsistency is to continue to use the standard CAPM and to estimate theta in a way that is consistent with the CAPM. This is straightforward. We know that there is a consistent result that the combined value of a $1.00 dividend and the attached franking credit is $1.00. This has been consistently and reliably estimated from market data. (Again, see Appendix A for a detailed description of this.) The estimated value of franking credits is obtained by subtracting from this the estimated value of a $1.00 cash dividend. Under the CAPM, this $1.00 dividend must have a value of $1.00. This leaves negligible value to be ascribed to the franking credit.

Market practice

88. Finally on this point, I note that the procedure outlined above accords precisely with the dominant commercial market practice. The conventional approach in the Australian market is to estimate the required return on equity using the CAPM and to make no adjustment for the assumed effect of franking credits when estimating cost of capital.[44] This is borne out by survey evidence from Australian CFOs[45] and the practice adopted in expert valuation reports.[46] [47]

---

[43] That is, 0.8 × 12.50 = 10, and 10 / 100 = 10%.

[44] That is, the required return on equity is estimated as $r_e = r_f + \beta_e \times MRP$ and no adjustment is made to it for any assumed effect of franking credits. In this regard, I note that there is no such thing as a version of CAPM that includes a value of gamma. The CAPM is the single equation as above. Its role is to provide an estimate of the total return that is required by shareholders. The role of gamma (if it is to be set above zero) is to disaggregate that total required return into the component that is provided by government (by way of franking credits) and the component that must be provided by the firm. This disaggregation is quite separate from the CAPM, which only provides an estimate of the total required return.

[45] Truong, G., G. Partington and M. Peat, 2005, Cost of Capital Estimation & Capital Budgeting Practice in Australia," *Australian Journal of Management,* 33 (1), 95 – 121.

[46] Lonergan, W., 2001, The Disappearing Returns. JASSA, 1(Autumn), 8-17.

[47] KPMG. (August 2005). The Victorian Electricity Distribution Businesses Cost of Capital - Market practice in relation to imputation credits Victorian Electricity Distribution Price Review 2006 – 10.

5. Relevant results and new evidence

Other methods

89. Empirical approaches other than the dividend drop-off method have been used to estimate theta. Perhaps the best-known example of this is Cannavan, Finn and Gray (2004).[48] They examine the simultaneous prices of shares (which entitle the holder to receive dividends and franking credits) and futures contracts (which do not). The difference in the respective prices is then used to obtain estimates of the value of cash dividends and the value of franking credits.

90. This technique has a number of advantages relative to the dividend drop-off method. Whereas the drop-off method uses only two observations each year (the interim and final dividend), the simultaneous prices technique uses hundreds or thousands (every time the stock and futures trade at around the same time another observation is created). Also, it is well known in the finance literature that trading volumes increase substantially around ex-dividend dates. We are seeking to estimate the value of dividends and franking credits to long-term providers of equity capital. But the additional trading may be driven by short-term investors seeking to capture the dividend and franking credit, affecting the resulting estimates.

91. The authors conclude that the combined value of a $1.00 cash dividend and the attached franking credit is approximately $1.00, consistent with the results from dividend drop-off studies. They also conclude that cash dividends are fully valued and that theta is close to zero, after the 1997 tax amendment that effectively prevented non-residents from "selling" franking credits to residents.

92. In my view, this paper provides strong evidence in support of theta (and gamma) taking a value close to zero.[49] It is based on a large sample size, involves thousands of observations for each stock that is examined (whereas each stock only has two ex-dividend dates per year), and has met the criteria for publication in the leading journal. I also note that the empirical result from this paper (that theta, and consequently gamma, has a negligible value) is consistent with the practice of Australian companies and expert valuation professionals.

New evidence

93. Another relevant consideration is what happened to Australian stock prices when dividend imputation was introduced. If gamma really is 0.5, the cost of equity capital would have been reduced substantially and stock prices would have risen accordingly – in the order of 30% or more. To see this, consider the constant dividend growth model in which prices are set as the present value of a constantly growing stream of dividends:

$$P = \frac{D}{r_e - g} \qquad (3)$$

where D is the next dividend to be paid, r_e is the required return on equity, and g is the rate at which dividends are expected to grow.

---

[48] This paper was published in the *Journal of Financial Economics*, which is one of the world's leading finance journals. It is one of only three finance journals world wide to be classified as an A+ journal in the Commonwealth Government's university research quality exercise.

[49] In particular, if theta is zero, then gamma is also zero, regardless of what value is used for the distribution rate.

94. Suppose, by way of example, that the next dividend to be paid by a firm was $1.00, the required return on equity was 12% and the expected dividend growth is 5%. The stock price for this firm would be:

$$P = \frac{D}{r_e - g} = \frac{1.00}{0.12 - 0.05} = 14.29\,.$$

95. If gamma is 0.5, Officer (1994) shows that the cost of equity is reduced to:

$$r_e \frac{1-\tau}{1-\tau(1-\gamma)} = 0.12\% \times \frac{1-0.3}{1-0.3(1-0.5)} = 9.88\%$$

where τ represents the corporate tax rate.

96. This should result in the stock price increasing to:

$$P = \frac{D}{r_e - g} = \frac{1.00}{0.0988 - 0.05} = 20.49\,.$$

which is an increase in price of more than 40%.[50]

97. Of course this is just an example, but it makes the point that if gamma really is 0.5 stock prices would have increased very substantially with the introduction of dividend imputation. That is, to the extent that gamma is positive, the value of franking credits are capitalised into stock prices.

98. So what did happen to Australian stock prices when imputation was introduced? A recent study by Ickiewicz (2007)[51] controls for things like US market movements, exchange rates, interest rates, commodity prices and so on. He then plots whatever *cannot* be explained by these things to see whether there was a significant positive effect around the introduction of imputation. He carefully examines every announcement related to the introduction of imputation and looks at a period of more than a year around the introduction.

99. His results are summarised in the two figures below. Figure 4 plots the month-by-month residuals from a regression of Australian stock returns[52] on a range of explanatory variables including US stock returns, commodity prices, exchange rates, and interest rates. What each of those residuals represents is the amount of the Australian stock return that cannot be explained by the set of explanatory variables. The figure also shows a significance band of plus and minus two standard deviations – residuals outside this range are considered to be statistically significant, although a small number of such cases would be expected just by chance. If the introduction of dividend imputation had caused a significant increase in Australian stock prices (such as would be implied by setting gamma to 0.5 or 1) we would expect to see a pattern of statistically significant positive residuals. However, the data shows that over the period there is an equal number of positive and negative residuals and that the residuals are evenly distributed around zero. That is, month-by-month over the relevant period it is equally likely that the change in Australian stock

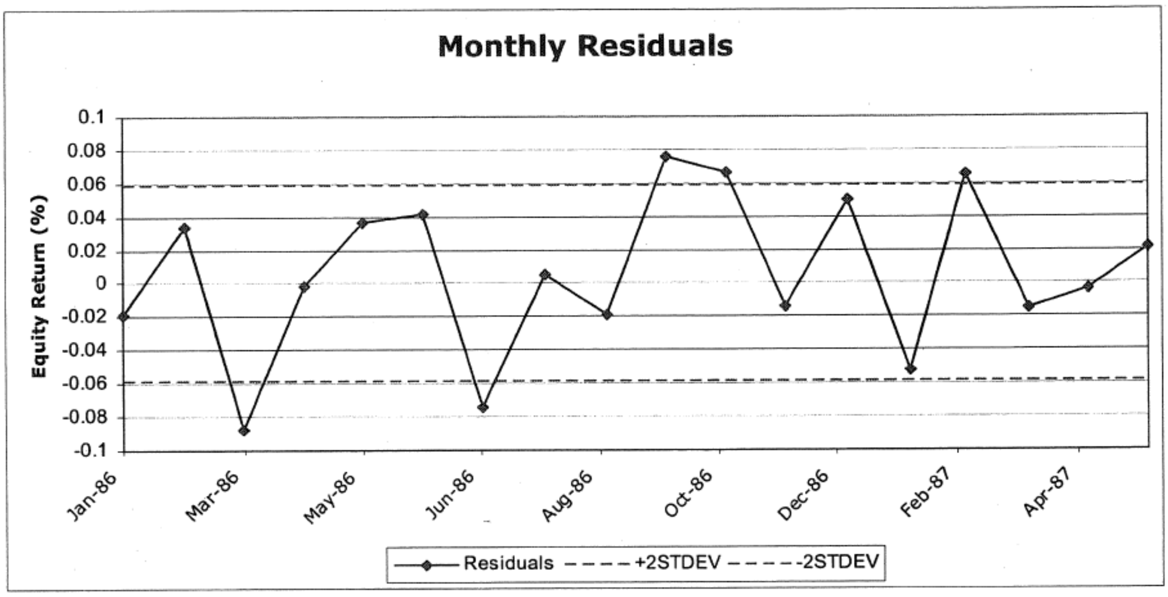
[50] A similar calculation, with gamma set to one, would produce an increase in stock prices of around 100% -- they would have doubled.

[51] Ickiewicz, J., (2007), "Valuing dividend imputation credits in Australia: An alternate approach," Honours thesis, University of Queensland Business School.

[52] Specifically, the return on the All Ordinaries Accumulation Index.

prices is above or below what would have been expected, given US stock returns, commodity prices, exchange rates, interest rates, and so on – on average, Australian stocks behaved as expected, given the values of the various explanatory variables. There is no evidence of an upward revaluation of Australian stocks of 30% or more over the relevant period.

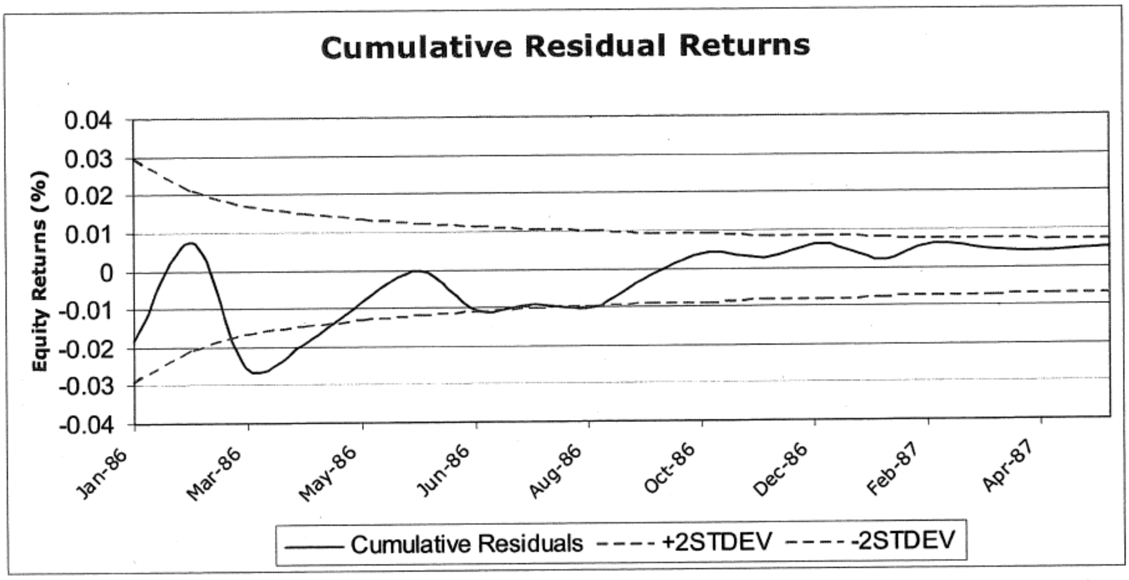
Figure 4: Residuals for Australian stock returns prior to the introduction of dividend imputation – Ickiewicz (2007)



Source: Ickiewicz (2007), Figure VI.III, p. 79.

100. Figure 5 plots these residuals on a cumulative basis. This accumulates the residual return over the relevant period. Again, a confidence band of plus and minus two standard deviations is plotted. This confidence interval narrows over time as more observations are included. The cumulative residual never exceeds 1% and is never outside the upper confidence band. This confirms the conclusion that over the period Australian stock returns simply behaved as one would expect, given US stock returns, commodity prices, exchange rates, interest rates, and so on. There is no evidence of a 30% (or more) boost in stock prices caused by the introduction of dividend imputation.

Figure 5: Cumulative residuals for Australian stock returns prior to the introduction of dividend imputation – Ickiewicz (2007)



Source: Ickiewicz (2007), Figure VI.VII, p. 85.

101. In summary, there is nothing in Figures 4 and 5 to suggest that Australian stock prices were driven upward significantly by the introduction of dividend imputation. There is certainly no unusual price run-up and no movement in the Australian market that could not already be explained by what the US market and commodity prices and so on were doing. Certainly there is no 30 or 40% boost to Australian stock prices such as setting gamma to 0.5 would imply.[53]

Dividend drop-off analysis

102. I have noted above that the results of Beggs and Skeels (2006) and Hathaway and Officer (2002[54], 2004) are consistent in finding that on average:

a. The combined value of a $1.00 dividend and the attached franking credit is approximately $1.00;

b. Cash dividends are estimated to have a value of 75-80 cents in the dollar;[55] and

c. Franking credits are estimated to have a value of approximately 50 cents in the dollar.[56]

---

[53] Look particularly at Figure 5. At no point is the cumulative residual significantly positive nor does it ever reach even 1%, when gamma estimates of 0.5 or 1 suggest a massive increase in Australian stock prices as franking credits are capitalised.

[54] Hathaway, N. and R. Officer, 2004. The Value of Imputation Tax Credits, Working Paper: Capital Research.

[55] This estimate of the value of cash dividends is consistent across the various analyses conducted by Beggs and Skeels and Hathaway and Officer, except for two one-year periods in the Begss and Skeels results. I have discussed above why I assign negligible weight to these aberrant results. For example, Beggs and Skeels report that a $1.00 cash dividend was valued at $1.168 in 2000 – just for that one year.

[56] This follows from (a) and (b) above. At a 30% corporate tax rate, a $1 dividend has a 43 cent franking credit attached. If the combined value of these two components is $1, and if the cash dividend accounts for 75-80 cents of the total value, then 20-25 cents of value remains to be attributed to the franking credit. This represents about 50% of the face value of the franking credit. This estimate of theta must be interpreted as being conditional on cash dividends being worth only 75-80% of their face value.

103. SFG has conducted a more recent study (SFG, 2007) which is based on a more comprehensive data set that includes more recent data than that examined by any of the earlier studies. This study was provided as part of a submission to the recent Victorian Gas Distribution Review.[57] In that study, we examine data through to the end of 2006, whereas the Beggs and Skeels sample ends in May 2004. This results in our sample including substantially more observations in the post-2000 period. We apply the dividend drop-off methods of Hathaway and Officer and Beggs and Skeels to this larger and more recent data set.

104. We also examine a number of reduced samples as follows:

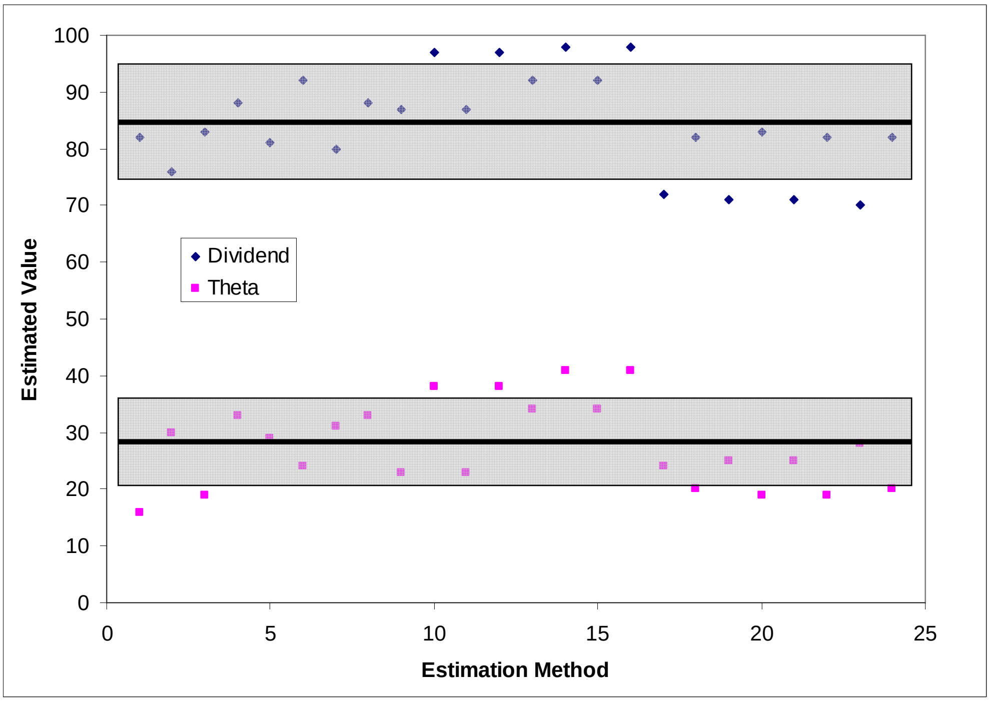
- Large firms only (using the same definition of large as employed by Beggs and Skeels – greater than 0.03% of the All Ordinaries index at the time);
- Large firms, excluding those with drop-off ratios in the top or bottom 1% of the sample;
- Large firms, excluding those with drop-off ratios in the top or bottom 1% of the sample and gross dividends in the top 1% of the sample.

105. For each of these sub-samples, we also re-estimate the results after excluding the top 1% of influential observations assessed using Cook's D-statistic.[58] The reason for examining these various sub-samples is to explore the stability of the estimates and to determine whether the estimate is being driven by a small number of extremely influential observations.

106. We also report separate estimates for the different tax regimes identified by Beggs and Skeels. Consistent with Beggs and Skeels, we find that the results for their Regime 5 (a short period prior to July 2000) are highly variable and unreliable. This is likely due to the small number of observations in that short period. Consequently, we prefer to rely on the results from Regimes 4 and 6, which are based on much larger samples and provide more stable estimates. We examine six variations of the drop-off methodology (in Tables 3 to 8 of our earlier report) and we focus on the bottom two panels of each table, as these have filtered out extreme values and consequently produce more stable and reliable estimates. This results in a total set of 24 estimates which are summarised in Figure 6 below. The full results are reported in Appendix E to this report.

[57] The entire data set and all computer programs for this study were supplied, at the request of the Victorian regulator, as part of the Review.
[58] Cook's D statistic identifies which individual observations have the greatest influence on the final estimate. This can be due to their size or because the observation represents a substantial outlier data point.

Figure 6: Summary of empirical estimates from SFG (2007)



Source: SFG (2007), Tables 3 to 8.

107. In Figure 6 the solid lines represent the average (across the 24 sets of estimates) estimate of the value of cash dividends and theta:

a. The average estimated value of a $1.00 cash dividend is 84.6 cents;

b. The average estimate of theta is 27.8% of face value;

c. The average estimated combined value of a $1.00 dividend and the associated franking credit (not shown in the figure) is 97 cents.

108. Figure 6 shows that there is some variation in estimates, which inevitably occurs when there is some variation in the empirical method and in the data to which it is implied. The shaded areas in Figure 6 show 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.

109. In summary, the results of our analysis imply that on average:

a. The combined value of a $1.00 dividend and the attached franking credit is approximately $1.00 (average 97 cents), corroborating this part of the result in Hathaway and Officer and Beggs and Skeels;

b. Cash dividends are estimated to have an average value of 84.6 cents in the dollar (range of 75 to 95); and

c. Franking credits are estimated to have an average value of 27.8 cents in the dollar (range of 20 to 35). This represents an estimate of gamma of 0.28 under the assumption of a 100% distribution rate and 0.19 under the assumption of a 70% distribution rate.

110. The implied value of cash dividends remains below face value and is therefore inconsistent with the use of the CAPM, as explained above. However, to the extent that this inconsistency is to be disregarded and the results of dividend drop-off analysis are to be relied upon at face value, it is my view that this study provides the most recent, up-to-date and comprehensive dividend drop-off estimates and that these estimates support a value of theta in the range of 20-35% of face value. Based on an assumed franking credit distribution rate of 100%, this in turn produces an estimate of gamma in the range of 0.2 to 0.35. Based on an assumed franking credit distribution rate of 70%, this in turn produces an estimate of gamma in the range of 0.14 to 0.25. These estimates are lower than the 0.5 estimate that is based on older and smaller subsets of data and which forms the basis of Australian regulatory precedent on this issue. In my view, there is persuasive empirical evidence to support the use of an estimate of gamma below 0.35 and that a gamma estimate of 0.5 is no longer empirically supportable.

Conclusions

111. In my view, the additional evidence reviewed in this section supports a value of theta (and consequently gamma) that is below 0.35:

a. Studies that examine simultaneous stock and futures prices report estimates of theta close to zero;

b. Ickiewicz (2007) shows that over the introduction of imputation, Australian stock returns simply behaved as one would expect, given US stock returns, commodity prices, exchange rates, interest rates, and so on. There is no evidence of a 30% (or more) boost in stock prices caused by the introduction of dividend imputation – as would be implied by a value of 0.5 for gamma.

c. The standard dividend drop-off approach, when applied to the most recently available data, produces estimates of theta in the range of 20-35% of face value. Based on an assumed franking credit distribution rate of 100%, this in turn produces an estimate of gamma in the range of 0.2 to 0.35. Based on an assumed franking credit distribution rate of 70%, this in turn produces an estimate of gamma in the range of 0.14 to 0.25. These estimates are lower than the 0.5 estimate that is based on older and smaller subsets of data and which forms the basis of Australian regulatory precedent on this issue.

6. Summary and Conclusions

112. The conclusions from my analysis are as follows:

a. WACC parameters should be estimated from market data (properly weighted in line with statistical precision, reliability and economic reasonableness) – they should not be assumed.

b. Redemption rates are *not* relevant empirical market data. The implication of using average redemption rates to estimate theta (and consequently gamma) is that the government could substantially reduce the cost of capital of Australian firms by banning all foreign capital.

c. A comprehensive data set should be used. Focussing on a smaller sub-set of data is more likely to lead to error, so a particular section of the data should only be rejected if there is a reason to do so. There is no reason to reject the pre-2000 data.

d. The whole empirical result should be used, not half of it. In my view, it would be inconsistent and wrong:

   i. to reduce the required return (and the regulated price) to reflect the estimated value of franking credits, but

   ii. to disregard the offsetting effect of dividends being estimated to be worth only 75-80 cents[59] in the dollar,

   especially when these two effects are part of a single estimation exercise in which the first estimate is *conditional* on the second.

e. The empirical technique that is most commonly used estimates the combined value of cash dividends plus franking credits, then subtracts an estimate of the value of cash dividends. If one estimates the value of $1.00 of cash dividends to be worth $1.00 (which is consistent with other empirical evidence, and is also the assumption that is made in the CAPM) the estimated value of franking credits is smaller again, and in fact negligible. Consistent with this, setting gamma to zero is consistent with market practice.

f. Even if one passes over the issues of internal consistency and using the entire empirical result that are set out above, when the most recent, up-to-date and comprehensive data set is employed, the standard dividend drop-off method produces an estimate of the value of theta in the range of 0.2 to 0.35. Based on an assumed franking credit distribution rate of 100%, this in turn produces an estimate of gamma in the range of 0.2 to 0.35. Based on an assumed franking credit distribution rate of 70%, this in turn produces an estimate of gamma in the range of 0.14 to 0.25. These estimates are lower than the 0.5 estimate that is based on older and smaller subsets of data and which forms the basis of Australian regulatory precedent on this issue.

113. In my view, setting gamma to 0.5 is not correct. In my view, the most comprehensive and up-to-date dividend drop-off analysis of the available data produces estimates of theta in the range of 0.2 to 0.35. This in turn results in estimates of gamma in the range of 0.2 - 0.35 or 0.14 - 0.25 for distribution rates of 100% and 70% respectively. Moreover, maintaining consistency with CAPM

[59] The estimated value of cash dividends reported by Hathaway and Officer (2002, 2004) and Beggs and Skeels (2006).

results in even lower estimates, which is consistent with other empirical evidence and market practice.

References

Allen Consulting Group, (2006), "Envestra's proposed revisions to its access arrangement." Report to Essential Services Commission of South Australia.

Beggs, D. and C.L. Skeels, (2006), Market Arbitrage of Cash Dividends and Franking Credits, *The Economic Record*, 82, 258, pp.239-252.

Bellamy, D., & Gray, S., (2004), "Using Stock Price Changes to Estimate the Value of Dividend Franking Credits," Working Paper, University of Queensland, Business School.

Cannavan, D., Finn, F., & Gray, S., (2004), "The Value of Dividend Imputation Tax Credits in Australia," *Journal of Financial Economics*, 73, 167-197.

Copeland, T. E., Koller, T., & Murrin, J., (2000), "Valuation: Measuring and Managing the Value of Companies (3rd ed.)," New York: McKinsey and Company Wiley.

Costello, D., S. Gray, J. Hall, and A. McCrystal, "The unique diversification benefits of investing in Australia," forthcoming in *JASSA*.

Dempsey, M. and G. Partington, (2008), "Cost of capital equations under the Australian imputation tax system," *Accounting and Finance*, 48, 3, 439-460

Essential Services Commission, 2008. "Gas Access Arrangement Review 2008 – 2012: Final Decision," 7 March.

Handley, J. and K. Maheswaran, (2008), "A measure of the efficacy of the Australian imputation system," *Economic Record*, 84, 264, 82-94

Hathaway, N., & Officer, R.R., (2002), "The Value of Imputation Tax Credits," Capital Research Pty Ltd.

Hathaway, N., & Officer, R.R., (2004), "The Value of Imputation Tax Credits Update 2004," Capital Research Pty Ltd.

Hird, T. and B. Quach, (2003), "International versus domestic CAPM," Report by NERA, June 2003.

Ickiewicz, J., (2007), "Valuing dividend imputation credits in Australia: An alternate approach," Honours thesis, University of Queensland Business School.

KPMG, (2005), "The Victorian Electricity Distribution Businesses Cost of Capital - Market practice in relation to imputation credits Victorian Electricity Distribution Price Review 2006 – 10."

Lally, M., (2004), "The Cost of Capital for Regulated Entities: Report prepared for the Queensland Competition Authority," School of Economics and Finance (Victoria University of Wellington).

Lonergan, W., (2001), "The Disappearing Returns: Why Imputation Has Not Reduced the Cost of Capital," *JASSA*, Autumn 1, 1-17.

Officer, R. R., (1994), "The Cost of Capital of a Company Under an Imputation Tax System," *Accounting and Finance*, 34(1), 1-17.

Strategic Finance Group, (2007), "The impact of franking credits on the cost of capital of Australian companies," Report prepared for Envestra, Multinet and SP Ausnet, 25 October 2007.

Truong, G., G. Partington and M. Peat, 2008, Cost of Capital Estimation & Capital Budgeting Practice in Australia, *Australian Journal of Management,* 33 (1), 95 – 121.

Appendix A: Explanation of Empirical Estimates

Dividend drop-off methodology

114. In recent determinations, Australian regulators have relied more heavily on a technique known as "dividend drop-off analysis" than on any other form of empirical estimate. Essentially this involves examining stock price changes on ex-dividend days.[60] The amount by which stock prices change (on average) is assumed to reflect the value of the dividend and franking credit that has separated from the shares.

115. This is implemented via regression analysis whereby the stock price changes are compared with dividends and franking credits as follows:

$$\Delta P = aD + \theta FC + \varepsilon \qquad \text{(A.1)}$$

where ΔP represents the change in stock price, D represents the amount of the cash dividend, FC represents the amount of franking credits, and ε is a residual term that represents the extent to which the stock price might change for reasons other than the payment of the dividend and franking credit.

116. In this analysis, a is the estimated value of a \$1 dividend and θ is the estimated value of a \$1 franking credit. At the present 30% corporate tax rate, a \$1 fully-franked dividend will have \$0.43 of franking credits attached to it. If both are fully valued by investors, a and θ would both equal one and on average the stock price would fall by \$1.43 on the ex-date, where:

$$\begin{aligned}\Delta P &= aD + \theta FC \\ &= 1\times 1 + 1\times 0.43 \\ &= 1.43.\end{aligned}$$

117. Different researchers will estimate a and θ using slight variations of equation (A.1) above,[61] but the essence of what is being estimated is well-described by (A.1) above – on average the stock price is expected to change by the market's assessment of the combined value of the dividend and franking credit.

The combined value of dividend and franking credit

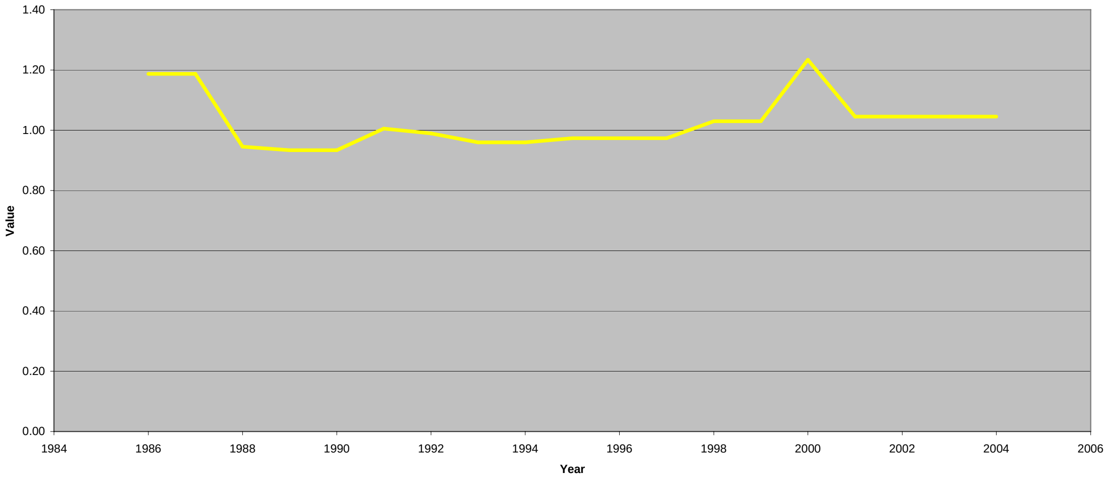
118. The first point to note when interpreting the empirical evidence from dividend drop-off analyses is that there is essentially uniform agreement among the various studies[62] that for a fully-franked dividend the \$1.00 dividend and the \$0.43 franking credit that is attached to it have a combined value of about \$1.00.

Beggs and Skeels (2006)

119. For example, Beggs and Skeels compute this combined value over various different time periods, producing the results in Figure A.1 below.

[60] These are days on which the dividend and associated franking credit separate from the shares. An investor who buys the shares prior to the ex-date is entitled to receive the dividend and franking credit, but an investor who buys the shares after the ex-date is not.
[61] For example, Hathaway and Officer divide both sides of the equation by D to scale by the amount of dividends.
[62] I examine three of these studies in some detail in the remainder of this appendix.

Figure A.1: Combined Value of Dividend Plus Franking Credit – Beggs and Skeels



Source: Beggs and Skeels, Table 5, p. 247. Computed as estimated value of cash dividend × 1.00 + estimated value of franking credit × amount of franking credit.

120. This figure shows that the estimate of the combined value of a $1.00 dividend and the associated franking credit is very close to $1.00 for most of the periods examined. The only exceptions to this are the first year of the sample and the year prior to 30 June 2000. I show below that these unusual spikes in the above graph are highly likely to be due to estimation error. In particular, I show that when examined in more detail they imply economically unreasonable results. For this reason, I disregard those two points at this stage and conclude that the combined value of a $1.00 cash dividend plus the associated franking credit is consistently close to $1.00 over time.

Hathaway and Officer (2002)

121. Hathaway and Officer (2002) perform separate estimates for different kinds of companies, based on size and sector. For all of the subsets of companies that they examine, the estimated combined value of cash dividend plus franking credit is close to one. This is summarised in Table A.1 below.

Table A.1: Combined Value of Dividend Plus Franking Credit – Hathaway and Officer (2002)

Sector	Small Companies	Large Companies	All Companies
Industrials	0.97	1.11	1.02
Resources	1.00	1.00	1.00
All	0.97	1.08	1.02

Source: Hathaway and Officer (2002), Table 1, p. 17. Computed as estimated value of cash dividend × 1.00 + estimated value of franking credit × amount of franking credit.

122. The table above shows clearly that for all types of companies examined, the combined value of a $1.00 cash dividend plus the associated franking credit is close to $1.00.

Hathaway and Officer (2004)

123. Hathaway and Officer (2004) perform estimates using slight variations of the dividend drop-off technique. For example, they restrict their analysis to high-yield companies in some cases and

they make adjustments for market movement over the ex-dividend day in others. I do not discuss the merits of these variations here, rather the focus of this section is simply on the stability of the results across techniques and the sub-samples that are examined.

124. Hathaway and Officer argue that some of the variations and sub-samples they examine are likely to provide more reliable results than others. Again, I do not address the merits of these arguments here. Rather, I focus my examination on those results that the authors believe to be most reliable. Those are the results that are shaded in Table A.2 below.

Table A.2: Combined Value of Dividend Plus Franking Credit – Hathaway and Officer (2004)

Standard Equation	
Big Cap	1.00
Mid Cap	0.96
Small Cap	0.59
All	0.71
Standard Equation High Yield	
Big Cap	1.10
Mid Cap	1.01
Small Cap	0.71
All	0.80
Revised Equation (excluding market moves)	
Big Cap	1.09
Mid Cap	1.11
Small Cap	0.78
All	0.81
Revised Equation (including market moves)	
Big Cap	1.07
Mid Cap	1.12
Small Cap	0.78
All	0.81

Source: Hathaway and Officer (2004), Table 3, p. 21. Computed as estimated value of cash dividend × 1.00 + estimated value of franking credit × amount of franking credit.

125. As for the previous studies, the variations of the dividend drop-off method produce consistent estimates of the combined value of cash dividends and franking credits for large and mid-cap stocks (the results that the authors argue are the most reliable). Again, the conclusion is that the combined value of a $1.00 cash dividend plus the associated franking credit is close to $1.00.

Separately valuing cash dividends and franking credits

Context

126. There is a clear and strong relationship between the two right-hand side variables in the dividend drop-off regression analysis. Under the Australian imputation system a fully franked dividend

has franking credits equal to $D\frac{\tau}{1-\tau}$ where D represents the cash dividend and τ represents the corporate tax rate. For a $1.00 dividend and a 30% corporate tax rate, we have $D\frac{\tau}{1-\tau}=1\times\frac{0.3}{1-0.3}=0.43$.

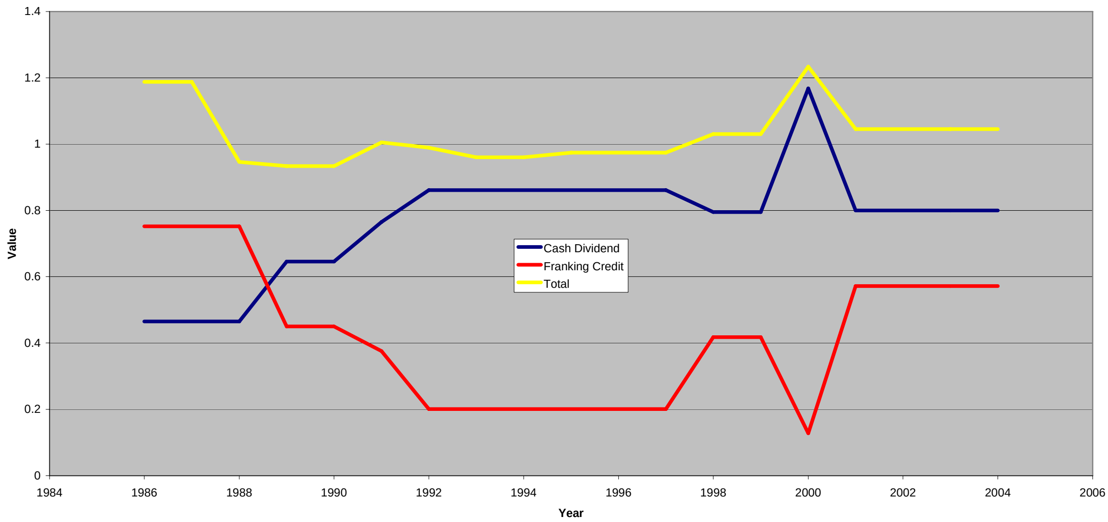
127. Bellamy and Gray (2004) note that statistical problems can arise when there is a strong relationship between the right-hand side variables in a regression analysis. In the statistics literature this is known as multicollinearity, which can result in difficulty in properly estimating the individual right-hand side variables. That is, even though the combined value of the dividend plus franking credit can be reliably estimated, disaggregating this combined value into the separate contributions from the dividend and franking credit can be difficult.

128. Ultimately this is an empirical question. Various researchers do attempt to separately value dividends and franking credits. To show how this is done, I continue the example of a $1.00 fully franked dividend with a $0.43 franking credit. We know from above that the combined value of the dividend plus franking credit is $1.00. We then require an estimate of the value of the $1.00 cash dividend. Whatever is left is then attributed to the $0.43 franking credit. If one attributed $1.00 of value to the $1.00 cash dividend, there would be nothing remaining to be ascribed to the franking credit. However, Hathaway and Officer and Beggs and Skeels value the $1.00 cash dividend at less than $1.00 and then ascribe the difference to franking credits.

Beggs and Skeels (2006)

129. Figure A.2 below shows, for the various sub-periods that they examine, the values that Beggs and Skeels ascribe to cash dividends and the residual value that is ascribed to franking credits.

Figure A.2: Separate Value of Dividends and Franking Credits – Beggs and Skeels



Source: Beggs and Skeels, Table 5, p. 247. Combined value computed as estimated value of cash dividend × 1.00 + estimated value of franking credit × amount of franking credit.

130. The figure above shows how the dividend drop-off method works. The combined value of a $1.00 cash dividend plus the attached franking credit is relatively constant at around $1.00. The estimated value of the $1.00 cash dividend is then subtracted from this, and whatever is left over is ascribed to the franking credit. Consequently, when there is a higher estimate of the value of

the $1.00 dividend (blue line) there is a lower estimate of the value of the franking credit (red line), and vice versa.

131. In fact, the blue and red lines in the figure above are essentially mirror images – when the blue line is low, the red line is high and vice versa. The total combined value of the dividend and the franking credit (the yellow line), however, is relatively constant other than for two short periods that I discuss below.

132. That is, the estimated value of the franking credit is *conditional* on the estimated value of a $1.00 cash dividend. The franking credit *only* has value to the extent that the value of the $1.00 cash dividend is estimated to be less than $1.00. The only reason that the estimated value of franking credits changes over time is because the estimated value of a $1.00 cash dividend changes over time. In particular, the estimated value of franking credits only increases as a result of a decrease in the estimate of the value of cash dividends.

133. Some of the literature in this area focuses unduly on interpreting changes in the estimated value of franking credits. However, what the figure above shows is that the combined value of dividends and franking credits is quite stable and that it is only a decrease in the allocation of this value to the cash dividend that results in any increase in the allocation to franking credits. Consequently, the proper focus is on why the value of a $1.00 cash dividend might change considerably over time. In the figure above, the estimated value of a $1.00 cash dividend (the blue line) starts at 50 cents, then increases to 80-85 cents, spiking at $1.16 for a short period, before returning to the 80-85 cents range. The estimated value of franking credits (the red line) simply offsets the variation in these estimated values of cash dividends.

134. There are two possible explanations for these results:

a. The true value of dividends and franking credits actually does vary substantially over time, with increases in the value of cash dividends being offset by decreases in the value of franking credits, and vice versa, such that the combined value of both remains relatively stable; or

b. Whereas the combined value of dividends plus franking credits can be more reliably estimated, statistical issues or estimation error makes it difficult to reliably disaggregate this combined value between its component parts.

135. The latter point was made by Bellamy and Gray (2006). In a more recent paper, Dempsey and Partington (2008) expand on this point. They specifically note that it is difficult to reliably disaggregate the combined value between its component parts. For this reason, they develop a procedure that estimates the cost of equity based on this combined value, arguing that the cost of equity is likely to be mis-estimated if one is required to provide separate estimates of the values of cash dividends and franking credits.

136. At this stage, three points should be clear from the figure above and the results of Beggs and Skeels:

a. The combined value of a $1.00 cash dividend and the attached franking credit is relatively stable at around $1.00;

b. There is considerable variation in how this total value is disaggregated among the component parts. When there is a higher estimate of the value of the $1.00 dividend (blue line) there is a lower estimate of the value of the franking credit (red line), and vice versa; and

c. The estimated value of the franking credit depends upon the extent to which the value of a $1.00 cash dividend is estimated to be less than $1.00.

137. Finally, I note that there are two unusual periods in the above figure:

a. For the first two years of the sample period, the estimated value of cash dividends is less than 50 cents per dollar while franking credits are valued at almost 80 cents in the dollar. In reality, there is no possibility that franking credits would actually be more valuable than cash dividends.

b. The other unusual period is for the one-year around the second half of 1999 and the first half of 2000. Over this period, the value of a $1.00 dividend is estimated to be over $1.16, which is also clearly impossible.

138. There are two possible interpretations of these periods:

a. The true value of cash dividends and franking credits actually did change dramatically during these short periods (with cash dividends being even less valuable than franking credits during the first episode, but then being worth more than 116% of their face value during the second), before quickly reverting back to long-term average levels; or

b. These short periods, which imply economically implausible outcomes, have been affected by the kind of estimation error which inevitably affects results from time to time when using actual market data.

In my view, the second of these explanations is the more likely. Consequently, I focus on interpreting the loner-term average results, rather than focusing unduly on the two short periods that produce unusual and economically implausible results.

Hathaway and Officer (2002)

139. Hathaway and Officer also attempt to separate the combined value of dividends and franking credits into their component parts. Recall from Table A.2 above that for all of the sub-samples they examine the combined value of a $1.00 dividend and the attached franking credit was close to $1.00. Table A.3 below shows the results of their attempt to separate this value into its component parts.

Table A.3: Separate Value of Dividend Plus Franking Credit – Hathaway and Officer (2002)

Sector	Small Companies		Large Companies		All Companies	
	Dividend	Franking Credit	Dividend	Franking Credit	Dividend	Franking Credit
Industrials	0.86	0.17	0.80	0.49	0.83	0.30
Resources	0.55	0.70	0.72	0.44	0.61	0.61
All	0.71	0.41	0.77	0.49	0.44	0.44

Source: Hathaway and Officer (2002), Table 5, p. 247. Computed as estimated value of cash dividend × 1.00 + estimated value of franking credit × amount of franking credit.

140. In many respects, these results are similar to those of Beggs and Skeels above. The Beggs and Skeels results suggest that the combined value of dividend plus franking credit is stable across time but that the separate values of the component parts vary considerably across time. The same applies to the Hathaway and Officer results above, except that the variation is across type of company rather than across time. Whereas the combined value of a $1.00 cash dividend and the attached franking credit is close to $1.00 across all company types, there is great variation in the separate values of the component parts.

141. The estimates in the table above suggest that for small industrial stocks dividends are much more valuable than franking credits, but for small resource stocks the reverse is true. For larger resource stocks the result flips back again, and so on.

142. The results are also similar to those of Beggs and Skeels in that the separate estimates of the values of cash dividends and franking credits tend to offset each other. In subsamples where the estimated value of cash dividends is higher, the estimated value of franking credits is lower, and vice versa. This is inevitable when the combined value is relatively constant (at $1.00) and the estimated value of franking credits is simply this combined value less the estimated value of cash dividends.

143. As for Beggs and Skeels, the results in the table above show that:

a. The combined value of a $1.00 cash dividend and the attached franking credit is relatively stable at around $1.00;

b. There is considerable variation in how this total value is disaggregated among the component parts. When there is a higher estimate of the value of the $1.00 dividend there is a lower estimate of the value of the franking credit, and vice versa; and

c. The estimated value of the franking credit depends upon the extent to which the value of a $1.00 cash dividend is estimated to be less than $1.00.

Hathaway and Officer (2004)

144. Table A.4 below shows the values that Hathaway and Officer (2004) estimate for cash dividends and franking credits. Again, they prefer to focus on the last three variations, applied to larger firms, which are the shaded cells in the table below.

Table A.4: Separate Value of Dividend Plus Franking Credit – Hathaway and Officer (2004)

	Cash Dividend	Franking Credit
Standard Equation		
Big Cap	0.50	0.89
Mid Cap	0.75	0.37
Small Cap	0.47	0.21
All	0.56	0.27
Standard Equation High Yield		
Big Cap	0.81	0.52
Mid Cap	0.77	0.43
Small Cap	0.59	0.21
All	0.68	0.21
Revised Equation (excluding market moves)		
Big Cap	0.80	0.52
Mid Cap	0.78	0.59
Small Cap	0.84	-0.11
All	0.83	-0.04
Revised Equation (including market moves)		
Big Cap	0.80	0.48
Mid Cap	0.77	0.62
Small Cap	0.84	-0.11
All	0.83	-0.04

Source: Hathaway and Officer (2004), Table 3, p. 21.

Summary of dividend drop-off results

145. The key results from the dividend drop-off method are as follows:

a. The combined value of a \$1.00 dividend and the attached franking credit has consistently been estimated at around \$1.00;

b. Determining how much of this combined value of \$1.00 is attributable to the \$1.00 cash dividend and how much is attributable to the franking credit has proven to be difficult. The results are unstable and tend to vary over time and across company types. When there is a higher estimate of the value of the \$1.00 dividend, there is a lower estimate of the value of the franking credit, and vice versa; and

c. The estimated value of the franking credit depends upon the extent to which the value of a \$1.00 cash dividend is estimated to be less than \$1.00. When the value of a \$1.00 cash dividend is estimated to be 75-80 cents, the corresponding estimated value of franking credits is around 50% of their face value. For example, at a corporate tax rate of 30%, a \$1.00 fully-franked dividend has \$0.43 of franking credits attached to it. If the \$1.00 cash dividend is estimated to have a value of 80 cents, and if the 43 cent franking credit is estimated to have a value of $0.5 \times 43 = 21.5$ cents, then the combined value is \$1.015.

146. This all means that an estimated value of franking credits of 50% of their face value is *conditional* on cash dividends being worth substantially less than their face value. Also, the amount by which cash dividends are estimated to differ from their face value varies considerably over time and type of company.

Appendix B: The Effect of the 2000 Rebate Provision

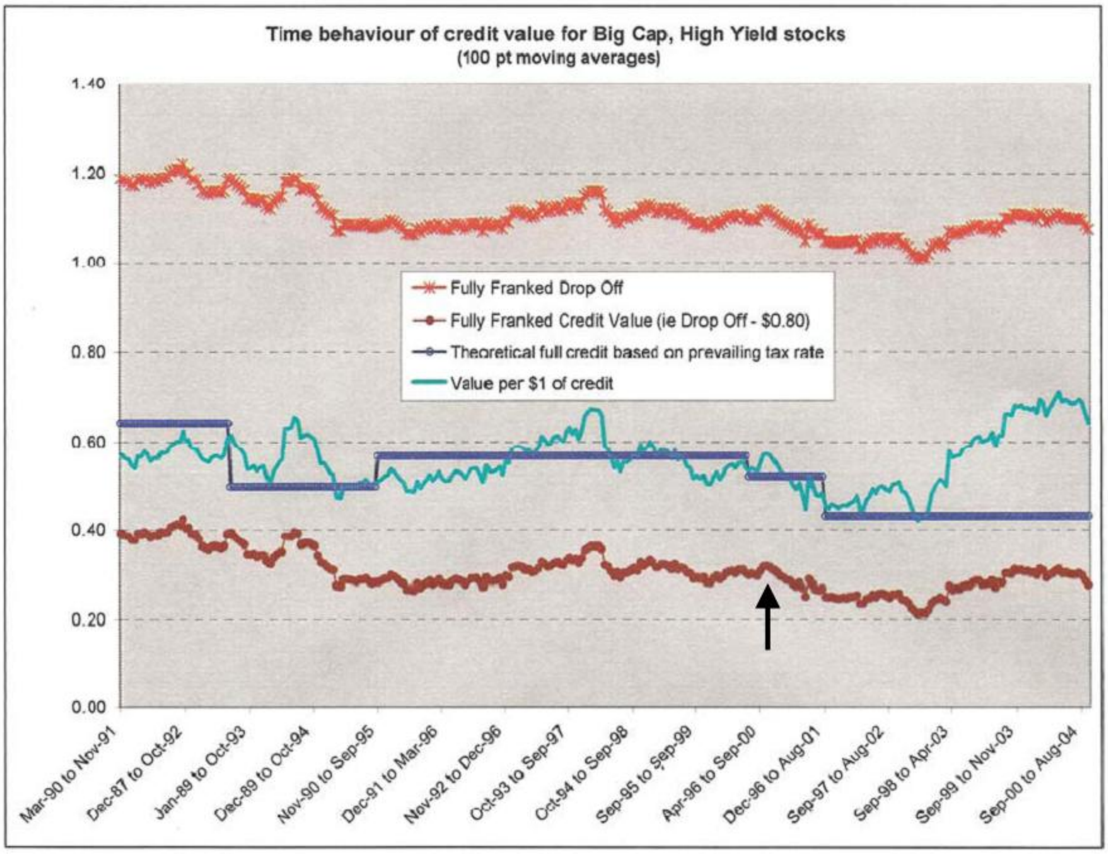
147. This appendix provides some additional detail in relation to some of the papers discussed in the body of the report insofar as they examine the effect of the 2000 Rebate Provision.

Hathaway and Officer (2004)

148. Hathaway and Officer (2004) report their estimated value of franking credits on a rolling basis. They restrict their analysis to fully-franked dividends on large, high-yield stocks only, which is a relatively small subset of all available observations. At each point of time, they take the most recent 100 observations in their sample and estimate the average drop-off (i.e., the stock price change over the ex-dividend day divided by the amount of the cash dividend, $\Delta P / D$). This then becomes their estimate of the combined value of a $1.00 dividend plus the attached franking credit (the red line in the figure below). This is relatively constant at (or slightly above) one. They then subtract from this 0.80, being their constant estimate of the value of a $1.00 cash dividend. The remainder is then the estimated value ascribed to the franking credit (the brown line in the figure below).

149. The Rebate Provision came into effect in July 2000, which is the point marked with the arrow in the figure below. As we move from left to right past the arrow, observations post July 2000 start to be introduced into the rolling average of 100 observations. As this occurs, the estimated value of franking credits (the brown line) begins to fall. As more and more post-July 2000 observations are included in the sample, the brown line falls even further and this continues for over two years. In this respect, the results are consistent with those of the ACG study discussed in the body of the report.

Figure B.1: Rolling Estimated Value of Franking Credits – Hathaway and Officer (2004)



Source: Hathaway and Officer (2004), Figure 12, p. 24.

Beggs and Skeels (2006)

150. Australian regulators have primarily relied on the results of Beggs and Skeels as the basis for concluding that the 2000 Rebate Provision had the effect of increasing the estimated value of franking credits. This comes from Table 5 of Beggs and Skeels, which is reproduced below.

Figure B.2: Test for change in value of theta – Beggs and Skeels (2006)

TABLE 5

Tests for Structural Breaks in Franking Credit Drop-off Ratios at Tax Regime Changes

Tax regime	Period	Estimated cash drop-off ratio ($\gamma_{1,j}$)	Estimated franking credit drop-off ratio ($\gamma_{2,j}$)	Null hypothesis	*P*-value
1	1986–1988	0.465 (0.040)	0.752 (0.157)	$\gamma_{2,1} = \gamma_{2,2} = \ldots = \gamma_{2,7}$	0.000
2	1989–1990	0.646 (0.064)	0.450 (0.119)	$\gamma_{2,1} = \gamma_{2,2}$	0.126
3	1991	0.765 (0.115)	0.376 (0.206)	$\gamma_{2,2} = \gamma_{2,3}$	0.757
4	1992–1997	0.861 (0.059)	0.201 (0.103)	$\gamma_{2,3} = \gamma_{2,4}$	0.447
5	1998–1999	0.795 (0.099)	0.418 (0.186)	$\gamma_{2,4} = \gamma_{2,5}$	0.305
6	2000	1.168 (0.099) C	0.128 (0.204) A	$\gamma_{2,5} = \gamma_{2,6}$	0.047
7	2001–2004	0.800 (0.052)	0.572 (0.121)	$\gamma_{2,6} = \gamma_{2,7}$ B	0.003

The numbers in parentheses are estimated standard errors and the *P*-values are from conventional *F*-tests of the hypotheses.

Source: Beggs and Skeels (2006), Table 5, p. 61.

151. The key result in this table is that the estimated value of franking credits increased from 12.8 cents in the dollar immediately before the Rebate Provision to 57.2 cents in the dollar afterwards (see Point A). This change is also estimated to be statistically significant (see Point B).

152. Recall, however, that the value of franking credits is estimated by taking the combined value of a \$1.00 cash dividend plus the attached franking credit and then subtracting the estimated value of the cash dividend. When the estimated value of the cash dividend is high, the estimated value of the franking credit will be low, and vice versa.

153. Beggs and Skeels estimate the value of a \$1.00 cash dividend to have decreased from \$1.168 immediately before the Rebate Provision to 80 cents afterwards (see Point C). That is, the result here is not so much one of an increase in the value of franking credits, but a decrease in the estimated value of cash dividends from an implausibly high level. Not only is there no explanation for why a \$1.00 dividend might be worth \$1.168 prior to the Rebate Provision, but there is also no reason why the Rebate Provision would affect the value of cash dividends.

154. When interpreting empirical results, it is important to consider the results in their entirety. In this case, if it is to be accepted that these results establish that the Rebate Provision has increased the value of franking credits, it must also be accepted that:

   a. A \$1.00 cash dividend was worth \$1.16 prior to the Rebate Provision; and

   b. The Rebate Provision caused the value of cash dividends to fall by over 30% (from \$1.168 to 0.80) even though it has nothing to do with cash dividends.

155. The alternative explanation is simply that estimation error, of the type that is expected from time to time when market data is used, has resulted in economically implausible estimates in the period immediately prior to the Rebate Provision.

Appendix C: Derivation of adjustment for franking credits

156. Officer (1994) shows that under a dividend imputation system the required return on equity (r_e)[63] must be adjusted for the assumed value of franking credits (γ) by a factor of $\frac{1-T}{1-T(1-\gamma)}$. This appendix provides some intuition for this adjustment.

157. Consider a firm that earns a $100 profit and pays $30 of Australian corporate tax, leaving $70 to be paid out as a dividend to shareholders. These shareholders will receive a $70 dividend from the firm and $30 of franking credits, which would have a value of $15 if we assume that gamma is 0.5. This is summarised in Table C.1 below.

Table C.1: Derivation of franking credit adjustment

	Example	General Expression
Firm Level		
Company Profit	100	1
Company Tax, and franking credits created	-30	T
After-tax profit and distribution to shareholders	70	1-T
Shareholder Level		
Dividend Received	70	1-T
Franking Credit	30	T
Value of Franking Credit	0.5×30	γT

158. Table C.1 shows that the shareholders receive a dividend of $70 from the firm. The government, via the tax system, provides a franking credit that is worth $15. Consequently, the firm is responsible for providing 70/85=82% of the total return to shareholders and the government provides the other 18%.

159. The CAPM provides an estimate of the *total* return that is required by shareholders. The WACC, however, requires only that fraction of the total required return that must be provided by the firm. Consequently, the estimated total required return (from CAPM) must be adjusted downward to reflect the assumed value of franking credits. In my example, the firm was required to contribute $70 of the $85 total return to shareholders. In general, the firm must pay $(1-T)$ and government will contribute γT, so the firm's share of the total is:

$$\frac{1-T}{(1-T)+\gamma T}=\frac{1-T}{1-T(1-\gamma)}.$$

160. Officer (1994) also shows that an adjustment for the assumed value of franking credits can be applied to the firm's cash flows, rather than to the discount rate. The remainder of this appendix reviews Officer's derivations and shows that the intuition for the cash flow adjustment is identical to that in Table C.1 above.

[63] This would typically be estimated using the CAPM.

161. Officer (1994) begins by defining after corporate tax cash flows as $X_o(1-T)$, consistent with the standard textbook treatment. Here X_o represents operating cash flows and T represents the relevant corporate tax rate. The definition of the after corporate tax discount rate that is consistent with this definition of cash flows is stated in his Equation (7) as:

$$r_i = r_E \frac{S}{V} \frac{1-T}{1-T(1-\gamma)} + r_D \frac{D}{V}(1-T)$$

where:
r_i is the weighted-average cost of capital, reflecting the tax deductibility of interest and the value of franking credits,
r_E is the return on equity capital required by investors,
r_D is the return on debt capital required by investors,
$\frac{S}{V}$ is the proportion of equity finance,
$\frac{D}{V}$ is the proportion of debt finance,
T is the corporate tax rate, and
γ is the value of franking credits.

162. In this framework, r_D is the return that debtholders require (before personal tax) to compensate them for the risk involved in lending to the firm. Since these interest payments are tax deductible at the corporate level, the firm's after-tax cost of debt capital is $r_D(1-T)$. That is, if debtholders require a return of 7% and the corporate tax rate is 30%, the firm's after-tax cost of debt is 4.9%. Of the 7% required return, 4.9% is provided by the firm and 2.1% is effectively provided by government via the tax system.

163. The same applies to the cost of equity. Here, r_E is the return that equityholders require (before personal tax) to compensate them for the risk involved in owning shares in the firm. In the Australian regulatory framework, and in commercial practice, r_E is usually estimated using the Capital Asset Pricing Model (CAPM). This provides an estimate of the return that the equityholders require. As is the case for debt, there is a difference between the investors' required return and what the firm must pay if a government tax subsidy is relevant. In particular, equityholders require a total after corporate tax return of r_E. This return potentially has three components: dividends, capital gains, and franking credits. The firm is responsible for generating dividends and capital gains. Franking credits are paid by government via the tax system. Officer's WACC formula quantifies the proportion of r_E that must be generated by the firm, $\frac{1-T}{1-T(1-\gamma)}$, and the proportion that is paid by government via the imputation tax system, $\frac{\gamma T}{1-T(1-\gamma)}$. Thus, the firm's after-tax cost of equity capital is $r_E \frac{1-T}{1-T(1-\gamma)}$. Indeed this is the key contribution of Officer (1994). He derives the proportion of the required return on equity that must be generated by the firm via dividends and capital gains.

164. This point is well recognized in the academic and practitioner literature. Copeland, Koller and Murrin (2000, p. 134), for example, note that the WACC is "the opportunity cost to all the capital providers weighted by their relative contribution to the company's total capital." They also note (p. 134-5) that, "the opportunity cost to a class of investors equals the rate of return the investors could expect to earn on other investments of equivalent risk. The cost to the company equals the

investors' costs less any tax benefits received by the company (for example, the tax shield provided by interest expense)." In a dividend imputation system, the government may also subsidize equity returns via the payment of franking tax credits.

165. In the detailed numerical example in his Appendix, Officer (1994, pp. 11 - 17), shows how the CAPM can be used to derive a required return on equity of 17.7% and that the firm's cost of equity is:

$$r_E \frac{1-T}{1-T(1-\gamma)} = 17.7\% \frac{1-0.39}{1-0.39(1-0.5)} = 13.4\%$$

using the parameter values assumed in the example. That is, the imputation tax system has reduced the firm's cost of equity capital by 4.3% in this case. The value of this reduction in the firm's cost of equity is capitalized into the stock price. In this case, the value of equity increases from \$120 million (under a classical tax system) to \$158.361 million (under an imputation system in which $\gamma = 0.5$). Officer demonstrates that the equityholders' required return does not change. What changes is the proportion of this return that must be generated by the firm. In a classical system, the firm has to generate all of this return. In an imputation system, the government funds some of this required return (in fact 4.3%) which reduces the firm's after tax cost of equity from 17.7% to 13.4%. That is, the CAPM tells us what return equityholders require (a return that is measured after company tax but before personal tax) and Officer (1994) derives the proportion of that return that must be generated by the firm, $\frac{1-T}{1-T(1-\gamma)}$.

166. Alternatively, Officer (1994) also shows how the value of franking credits can be incorporated in the firm's cash flows rather than the discount rate. In his Equation (12), Officer defines the vanilla WACC as:

$$r_{iii} = r_E \frac{S}{V} + r_D \frac{D}{V}.$$

167. This discount rate should be applied to cash flows defined as in his Equation (11):

$$(X_0 - X_D)(1 - T(1-\gamma)) + X_D,$$

where X_D represents interest payments to debtholders.

168. That is, under an imputation system, the cash flow to equity holders is:

$$(X_0 - X_D)(1 - T(1-\gamma)).$$

169. Without imputation $(\gamma = 0)$, the cash flow to equity holders would be:

$$(X_0 - X_D)(1 - T).$$

170. Thus, the component of the cash flow to equity that is due to the value of franking credits is the difference between the two:

$$(X_0 - X_D)\gamma T.$$

171. Therefore, the proportion of the total cash flow to equity that is due to franking credits is:

$$\frac{(X_0 - X_D)\gamma T}{(X_0 - X_D)(1 - T(1-\gamma))} = \frac{\gamma T}{1 - T(1-\gamma)}.$$

172. This is the same proportion of the cost of equity that was due to franking credits, as derived above. That is, if we prefer to incorporate the value of franking credits in the discount rate, we can conclude that $\frac{\gamma T}{1-T(1-\gamma)}$ proportion of the cost of equity is paid by the government via franking credits. If we prefer to put the value of franking credits into the cash flows instead, we conclude that $\frac{\gamma T}{1-T(1-\gamma)}$ proportion of the total cash flow to equity is paid by the government via franking credits. In both cases, the balance, $\frac{1-T}{1-T(1-\gamma)}$, must be generated by the firm itself.

Appendix D: What does gamma measure?

173. One argument that is sometimes made is that gamma cannot be less than 0.5 because more than half of the shareholder base of the particular firm are resident investors who can redeem any franking credits that they receive. In this appendix, I show that this argument is incorrect – that is *not* what gamma is, or what it measures. The correct way to think about what gamma measures is the relative sensitivity of Australian vs. foreign investors to the prices of Australian stocks. That is, to the extent that franking credits do affect the cost of capital of Australian firms, their value will be capitalised into stock prices – stock prices will increase. Gamma measures the relative sensitivity of Australian vs. foreign investors to those price increases. I cite evidence which suggests that it is likely that foreign investors are more likely to go elsewhere to find substitutes than are Australian investors, in which case gamma must be less than 0.5 – even though all of the Australian investors value franking credits.

174. The estimate of gamma is a component of the estimation of the firm's cost of capital. That is, the role of gamma is to quantify the effect that franking credits have on the corporate cost of capital of Australian firms. This is very different from an estimate of how many investors redeem the franking credits that they might receive. It is entirely possible that many investors value franking credits but that this has little effect on the cost of capital of Australian companies. Consistent with this, Hird and Quach (2003) note that the correct definition of gamma is "the proportion of the face value of imputation credits that is capitalised into current equity prices."

175. In this regard, one argument that is sometimes made is that gamma cannot be less than 0.5 because more than half of the shareholder base of the particular firm are resident investors who can redeem any franking credits that they receive. This argument is incorrect – that is *not* what gamma is or what it measures.

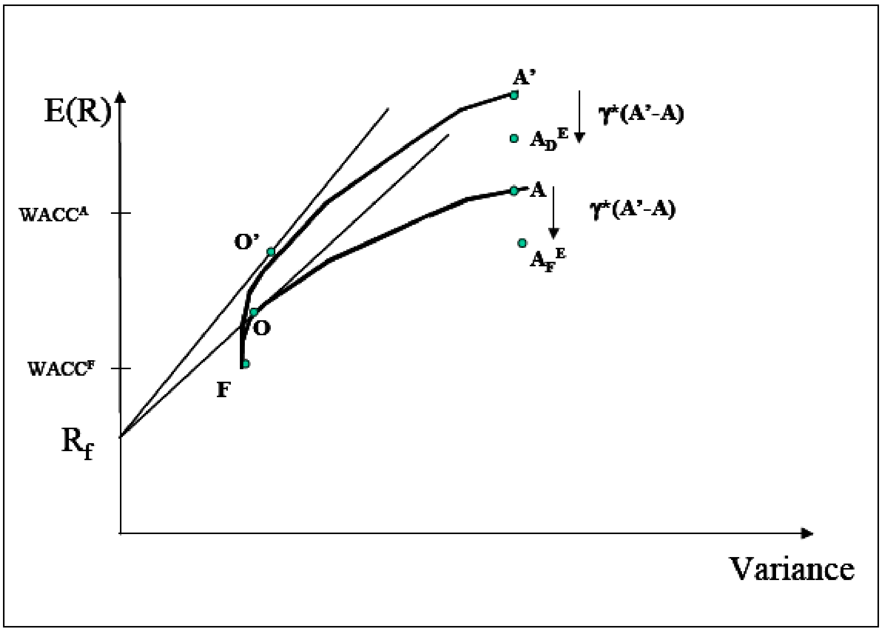
176. The correct way to think about what gamma measures is the relative sensitivity of Australian vs. foreign investors to the prices of Australian stocks. That is, to the extent that franking credits do affect the cost of capital of Australian firms, their value will be capitalised into stock prices – stock prices will increase. Gamma measures the relative sensitivity of Australian vs. foreign investors to those price increases.

177. Other things equal, if a particular company's shares become relatively more expensive the demand for them will decrease – a basic demand-supply result. The key question here is *whose* demand will decrease most – Australian or foreign investors? If it is equal, gamma would be 0.5. If, however, foreign investors are more likely to go elsewhere to find substitutes than are Australian investors then gamma must be less than 0.5 – even though all of the Australian investors value franking credits.

178. Hird and Quach (2003) present the following graph. Prior to imputation, the efficient frontier of risky assets is the curve F-O-A. Under the CAPM, all investors will hold the risk-free asset and the market (tangency) portfolio O in some proportion. When imputation is introduced, the return available to resident investors increases. For residents the efficient frontier shifts to F-O'-A'. But resident investors will respond to this by increasing their demand for Australian stocks. Hird and Quach (2003) then note that:

> The attempt to re-weight Australian investor's portfolios will tend to push the price of the Australian asset up and its expected return downs (and the price of the foreign asset down). This in turn will reduce the expected return received on these assets by *both* domestic and foreign residents. In our graph, A' will start moving back towards A and F will start moving up above its current position. Of course, as A' starts falling towards A the expected return for foreign investors in the Australian asset falls below its original level (ie, below A). This is because foreign investors do not benefit from imputation so any increase in the Australian asset price due to imputation necessarily reduces their rate of return.[64]

Figure D.1: Investment efficiency frontiers for resident and non-resident investors



Source: Hird and Quach (2003, p.10)

179. The increase in demand for Australian stocks, and the increase in their price, would push both frontiers downward as illustrated in the figure above. This is equivalent to noting that expected returns are lower if one has to pay a higher price to buy the stock. That is, an increase in the price of Australian stocks would lead to lower expected returns for all investors – residents and non-residents. Gamma should then be interpreted in terms of the extent to which these expected returns decline, or (equivalently) the extent to which franking credits are capitalised into Australian stock prices. If gamma is 1, the full value of franking credits is capitalised into the stock price, the "resident frontier" (A') falls all the way down to the pre-imputation frontier (A), Australian residents end up with the same expected return as they faced prior to imputation, and non-residents will receive a lower return than they were receiving prior to imputation. If gamma is 0, the frontiers do not fall, non-residents have the same expected return as prior to imputation, and resident investors receive higher expected returns due to their receipt of franking credits.

180. In this regard, Hird and Quach (2003) note that:

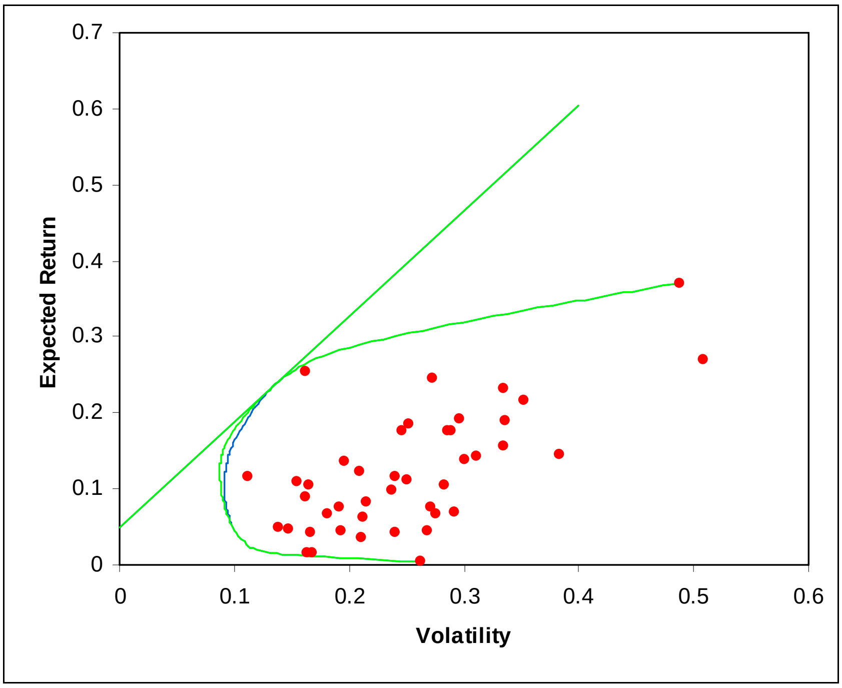
[64] p. 11.

> …a γ of 1 suggests that the full face value of imputation credits is capitalised into current equity prices and that foreign investors have been willing to accept a corresponding reduction in their expected rate of return by this same amount. Alternatively, a γ of 0 suggests that none of the value of imputation credits has been capitalised into equity prices and that, what amounts to the same thing, foreign investors refuse to lower their required rate of return following the introduction of imputation credits.[65]

181. That is, setting gamma above zero requires an assumption that foreign investors have been willing to accept a reduction in their expected rate of return. In my view, foreign investors are unlikely to behave in this way – they will be price sensitive and find substitute investments in other markets if expected returns on Australian investments are suddenly reduced.

182. To see why it might be that foreign investors are likely to be more sensitive to an increase in the price of Australian stocks (i.e., more likely to go elsewhere to find substitutes), one might consider the unique benefits that Australian stocks provide to such investors. In this regard, Costello, Gray, Hall and McCrystal (2008)[66] examine the extent to which Australia expands the risk-return frontier available to foreign investors. They do this by comparing the efficient frontier available to foreign investors with and without the Australian market. Figure D.2 below summarises the results.

Figure D.2: Risk-return efficient frontier with and without Australia



The efficient frontier comprising all 43 national equity indices examined and including Australia is presented in green. The efficient frontier excluding the Australian index is presented in blue. Data points appearing below the efficient frontier represent individual index returns.
Source: Costello, Gray, Hall and McCrystal (2008), Figure 1, p. 5.

[65] p. 11.
[66] Costello, D., S. Gray, J. Hall, and A. McCrystal, "The unique diversification benefits of investing in Australia," forthcoming in JASSA, the Journal of the Finsia professional body.

183. This figure shows that there are no unique benefits available to foreign investors from investing in Australia. They are able to obtain almost identical risk-return properties from portfolios of countries other than Australia. Consequently, if the price of Australian stocks were to rise due to franking credits (that they cannot access) being capitalised into stock prices, there is likely to be a high degree of price sensitivity – these investors are likely to go elsewhere to find substitutes. This is much less so for Australian investors, who hold Australian stocks for reasons other than risk-return-diversification.

184. Consequently, it is likely that foreign investors are more likely to go elsewhere to find substitutes than are Australian investors, in which case gamma must be less than 0.5 – even though all of the Australian investors value franking credits.

185. In this regard, Hird and Quach (2003) conclude that:

> …it is not unreasonable to believe that the rest of the world's demand for Australian equities will be more elastic than Australian residents demand for Australian equities. This reflects the fact that Australian equity constitutes a very small proportion of world equity (around 1 percent) and that foreign equity investors have ample close substitutes to Australian equity with similar diversity value. That is, there are many good substitutes for Australian assets in terms of their diversity value to a foreign investor, however, there are fewer good substitutes for foreign assets in a domestic resident's portfolio.[67]

186. Based on the reasoning in this appendix, it is my view that gamma should be interpreted as the proportion of the face value of imputation credits that is capitalised into current equity prices. This in turn depends upon the relative sensitivity of Australian vs. foreign investors to the prices of Australian stocks. It is my view that foreign investors are likely to be more sensitive to an increase in the price of Australian stocks (i.e., more likely to go elsewhere to find substitutes). This is because there are no unique benefits available to foreign investors from investing in Australia. They are able to obtain almost identical risk-return properties from portfolios of countries other than Australia. Consequently, if the price of Australian stocks were to rise due to franking credits (that they cannot access) being capitalised into stock prices, there is likely to be a high degree of price sensitivity – these investors are likely to go elsewhere to find substitutes. The implication of this is a value of gamma less than 0.5.

[67] p. 12.

Appendix E: Summary of results from SFG (2007)

187. This appendix presents the updated empirical results from the SFG (2007) study conducted as part of the recent Victorian gas distribution determination. The data required for the dividend drop-off method is readily available and the computer processing requirements are not great. We are presently also updating the Cannavan, Finn and Gray (2004) study, although this is a much larger task as the data requirements (matching stock and futures trades to within a couple of minutes) are much more onerous.

Data and empirical methods

188. SFG has obtained the necessary data for the period 1998 – 2006 and applied the empirical procedures of:

a. Hathaway and Officer;

b. Beggs and Skeels; and

c. ACG

and the results of this analysis are reported in the remainder of this section. In all cases, stock price data and dividend information is obtained from SIRCA and is cross-checked against FinAnalysis.

189. Consistent with Beggs and Skeels, we have split our sample into various sub-periods. Specifically we examine Tax Regimes 5, 6, and 7 that are referred to in Beggs and Skeels Tables 4 and 5 as follows:

Table 1
Beggs-Skeels Tax regimes

Tax Regime	Period	Number of Observations
5	1998-1999	1,149
6	2000	576
7	2001-2006	3,921

We note that the Beggs and Skeels sample ends on 10 May 2004. Our sample ends on 31 December 2006. Consequently, we have a substantially greater number of observations for Regime 7.

190. Summary statistics for our data are reported in Table 2. We report summary statistics for each tax regime and separately for unfranked and fully-franked dividends.[68] Dividend yields are reported on a dividend event basis and have not been annualised. The vast majority of firms pay dividends twice per year, so the mean firm in our sample (of dividend-paying stocks) has a yield of about 5% per annum. There is a wide range of yields in our sample. Very small dividends can have a pronounced influence on the results under some methods, as the ex-day stock price change can be many times larger than the dividend – and this produces a large drop-off ratio. Conversely, there are some very large dividends that are clearly more than a return of profits

[68] Our sample also includes a relatively small number of partially franked dividends that are not reported in this summary table.

from the previous six months. This small number of very large dividends can also have a pronounced effect on results under some methods.

191. The drop-off ratio is defined as the change in stock price on the ex-dividend day dividend by the dividend amount. For fully-franked dividends, the median drop-off ratio is around 1.00 (exactly 1.00 in Regime 7). This suggests that the market values a one dollar dividend and the associated franking credit at around one dollar. But there is extreme variation around this median. In some cases, the stock price increases on the day the dividend separates from the shares and the drop-off is negative. In other cases, the stock price falls by orders of magnitude more than the dividend and the drop-off is large and positive. The final results can vary dramatically, depending on the weight given to these extreme observations and whether they are screened out of the sample.

Table 2
Summary statistics for updated data set

Tax Regime	**Regime 5 1998-1999**		**Regime 6 2000**		**Regime 7 2001-2006**	
Dividend type	**Unfranked**	**Fully franked**	**Unfranked**	**Fully franked**	**Unfranked**	**Fully franked**
Number of observations	324	717	153	375	763	2,845
Dividend yield						
Mean	0.025	0.025	0.027	0.027	0.024	0.025
Median	0.022	0.022	0.023	0.024	0.021	0.022
Minimum	0.001	0.001	0.001	0.001	0.001	0.001
10th percentile	0.010	0.012	0.008	0.011	0.006	0.010
25th percentile	0..017	0.017	0.015	0.017	0.012	0.016
75th percentile	0.032	0.030	0.035	0.034	0.031	0.029
90th percentile	0.043	0.038	0.048	0.045	0.044	0.039
Maximum	0.098	0.180	0.083	0.146	0.190	0.420
Drop-off ratio						
Mean	0.54	1.70	0.90	0.87	0.90	0.87
Median	0.67	0.93	0.80	0.92	0.81	1.00
Minimum	-4.42	-6.50	-21.79	-31.2	-54.72	-33.33
10th percentile	-0.46	-0.36	-0.11	-0.40	-1.00	-0.40
25th percentile	0.00	0.20	0.00	0.00	0.00	0.33
75th percentile	1.20	1.43	1.25	1.50	1.40	1.50
90th percentile	1.83	2.17	2.27	2.50	2.60	2.00
Maximum	17.75	575	21.28	13.00	63.16	55.71

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

192. For each tax regime, we apply the three empirical methodologies listed above. We apply these methods to each tax regime separately. This allows us to conduct tests for the statistical significance of any differences in estimates across tax regimes. We also examine a number of reduced samples as follows:

a. Large firms only (using the same definition of large as employed by Beggs and Skeels – greater than 0.03% of the All Ordinaries index at the time);

b. Large firms, excluding those with drop-off ratios in the top or bottom 1% of the sample;

c. Large firms, excluding those with drop-off ratios in the top or bottom 1% of the sample and gross dividends in the top 1% of the sample.

193. For each of these sub-samples, we also re-estimate the results after excluding the top 1% of influential observations assessed using Cook's D-statistic. The reason for examining these various sub-samples is to explore the stability of the estimates and to determine whether the estimate is being driven by a small number of extremely influential observations.

Results for Beggs and Skeels methodology

194. We apply the Beggs and Skeels methodology to the various sub-sets of data in our sample and obtain the results in Table 3 below. In each case the results should be interpreted as follows:

a. **Gross drop-off:** This is the estimate of the average stock price change on the ex-dividend day for a fully-franked dividend. It is an estimate of the combined value of the cash dividend plus the associated franking credit.

b. **Cash dividend:** This is an estimate of the value to the market of one dollar of cash dividends – relative to one dollar of capital gains.

c. **Franking credit:** This is an estimate of the value to the market of one dollar of franking credits – relative to one dollar of capital gains.

Table 3
Estimates using Beggs-Skeels methodology –
No restrictions on influential observations

Tax Regime	**Regime 5 1998-1999**	**Regime 6 2000**	**Regime 7 2001-2006**
Full sample			
Gross drop-off	0.98	0.93	1.00
Cash dividend	0.74	0.10	0.94
Franking credit	0.43	1.47	0.13
P-value, R5 vs R7	*0.50*		
Large firms			
Gross drop-off	0.98	0.91	1.08
Cash dividend	0.76	0.10	0.91
Franking credit	0.44	1.44	0.37
P-value, R5 vs R7	*0.92*		
Large firms without extreme drop-offs			
Gross drop-off	0.91	0.95	1.00
Cash dividend	0.82	0.13	0.76
Franking credit	0.16	1.45	0.30
P-value, R5 vs R7	*0.46*		
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	0.94	0.94	1.03
Cash dividend	0.83	0.76	0.88
Franking credit	0.19	0.32	0.33
P-value, R5 vs R7	*0.44*		

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

195. There are three key results in Table 3:

a. **Stability of combined value of dividends and franking credits.** The gross-drop-off ratio should be interpreted as the combined value of a one dollar dividend and the associated franking credit. In all of the cells in Table 3, this value is close to one – in fact, it is uniformly between 0.9 and 1.1. Regardless of the sub-sample of data, period of time, or any restriction imposed, the results suggest that a one dollar dividend plus the associated franking credit is valued by the market at around one dollar.

b. **Great variation in estimates of separate components.** Although there is stability in the estimate of the combined value of dividend plus franking credit, the estimates of the two components varies greatly. Depending on which sub-sample of data, time period, or restriction is imposed, the results suggest that a dollar of cash dividends can be worth anything between 10 cents and 94 cents. The results also suggest that a dollar of franking credits can be worth anywhere between 13 cents and $1.47. We note that more stable and sensible results appear to be achieved as more restrictions are placed on the data. The results for these cases are reported toward the bottom of Table 3.[69]

c. **The value of franking credits has NOT changed over time.** The last row of each panel contains a *p*-value for a statistical test of the equality of the estimated values of franking credits in Regimes 5 and 7. We conduct this test because the results for Regime 6 are particularly unstable (likely due to the fact that this regime covers a short period and consequently involves a smaller sample size) and because the key tax law change discussed in the Draft Decision occurred half way through 2000 (Regime 6). A p-value less than 0.05 would be a standard benchmark for concluding that the difference in estimates is statistically significant. In no case are the results even close to being statistically significant. This implies that the market value of franking credits does not change significantly after the 2000 rebate provision was introduced.

196. We note that the estimates of the market value of franking credits must be interpreted as being *conditional* on the estimated value of cash dividends. That is, the estimated value of franking credits is essentially a balancing item – the difference between the combined value and the separate value of cash dividends. In particular, positive estimates of the market value of franking credits are conditional on a dollar of cash dividends being worth less than a dollar.

197. We repeat this same analysis after eliminating the top 1% most influential observations from each sub-sample. Those results are reported in Table 4 below.

[69] In this regard, we note that Beggs and Skeels also report highly unstable results for the 2000 year. However, in contrast to our result, they report that cash dividends were valued above their face value and that franking credits had a very small value that year. Our analysis of the data indicates that the results for the relatively small 2000 sample are sensitive to whether a small number of influential observations are screened in or out. For this reason, we prefer to rely more on the results in the bottom panels of Table 3 and in Table 4. Those results indicate that the 2000 year is not at all remarkable – in terms of the estimated value of cash dividends or franking credits.

Table 4
Estimates using Beggs-Skeels methodology –
Most influential 1% of observations removed

Tax Regime	Regime 5 1998-1999	Regime 6 2000	Regime 7 2001-2006
Full sample			
Gross drop-off	0.96	0.94	1.01
Cash dividend	0.75	0.72	0.94
Franking credit	0.38	0.39	0.14
P-value, R5 vs R7	*0.15*		
Large firms			
Gross drop-off	0.98	0.92	1.03
Cash dividend	0.84	0.80	0.92
Franking credit	0.25	0.22	0.24
P-value, R5 vs R7	*0.96*		
Large firms without extreme drop-offs			
Gross drop-off	0.97	0.89	1.03
Cash dividend	0.81	0.77	0.92
Franking credit	0.29	0.21	0.24
P-value, R5 vs R7	*0.81*		
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	0.97	0.90	1.04
Cash dividend	0.80	0.82	0.88
Franking credit	0.31	0.14	0.33
P-value, R5 vs R7	*0.90*		

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

198. The results in Table 4 are more stable across sub-samples, time periods, and data restrictions than are those in Table 3. Eliminating a small number (1%) of highly influential observations has served to reduce the wide range of franking credit values that are reported in Table 3. Table 4 suggests that the market value of a dollar of franking credits is between 14 cents and 39 cents. In all other respects, the results in Table 4 corroborate those in Table 3 above:

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

   b. There is no statistically significant change in the value of franking credits after the 2000 rebate provision was introduced.

Results for Hathaway-Officer methodology

199. We apply the Hathaway-Officer methodology to the various sub-sets of data in our sample and obtain the results in Table 5 below.

Table 5
Estimates using Hathaway-Officer methodology –
No restrictions on influential observations

Tax Regime	Regime 5 1998-1999	Regime 6 2000	Regime 7 2001-2006
Full sample			
Gross drop-off	1.04	1.00	0.98
Cash dividend	0.67	0.80	0.90
Franking credit	0.67	0.35	0.17
P-value, R5 vs R7	*0.00*		
Large firms			
Gross drop-off	0.95	1.02	1.10
Cash dividend	0.83	0.77	0.91
Franking credit	0.22	0.44	0.40
P-value, R5 vs R7	*0.41*		
Large firms without extreme drop-offs			
Gross drop-off	1.00	1.06	1.15
Cash dividend	0.87	0.83	0.97
Franking credit	0.23	0.42	0.38
P-value, R5 vs R7	*0.26*		
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	1.00	1.06	1.15
Cash dividend	0.87	0.94	0.97
Franking credit	0.23	0.40	0.38
P-value, R5 vs R7	*0.28*		

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

200. The results of Table 5 indicate that:

- The combined value of a dollar dividend and the associated franking credit is around one dollar;
- Cash dividends are worth less than capital gains (i.e., the reported value of cash dividends is less than one); and
- there is no statistically significant change in the value of franking credits after the 2000 rebate provision was introduced (except for the results from the full sample, which indicate a significant *decrease*).

201. We note that when the sample is restricted to large firms only, when the time period is restricted to Tax Regime 7, and when the Hathaway-Officer methodology is used, the results suggest that cash dividends and capital gains are almost equally valued. That is, if one were to focus on this result at the exclusion of all others, there is no material inconsistency with the use of the CAPM. The corresponding result from this analysis is an estimate for theta of 0.4. These results are based on a grossed-up dividend value (dividend plus franking credit) of 1.17. In almost every

other study, and in our analysis of other methodologies, the grossed-up dividend value is consistently estimated to be close to 1.0. In this respect, an estimate of 1.17 is somewhat anomalous. However, we draw attention to it because the estimated value of cash dividends is also somewhat anomalous in being not materially inconsistent with the CAPM

202. We repeat this same analysis after eliminating the top 1% most influential observations from each sub-sample. Those results are reported in Table 6 below:

Table 6
Estimates using Hathaway-Officer methodology –
Most influential 1% of observations removed

Tax Regime	Regime 5 1998-1999	Regime 6 2000	Regime 7 2001-2006
Full sample			
Gross drop-off	1.03	0.98	1.03
Cash dividend	0.70	0.88	0.91
Franking credit	0.59	0.18	0.27
P-value, R5 vs R7	*0.02*		
Large firms			
Gross drop-off	1.07	1.05	1.17
Cash dividend	0.93	0.97	0.97
Franking credit	0.25	0.16	0.43
P-value, R5 vs R7	*0.21*		
Large firms without extreme drop-offs			
Gross drop-off	1.11	1.07	1.17
Cash dividend	0.92	0.97	0.98
Franking credit	0.34	0.17	0.41
P-value, R5 vs R7	*0.60*		
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	1.11	1.07	1.17
Cash dividend	0.92	0.99	0.98
Franking credit	0.34	0.14	0.41
P-value, R5 vs R7	*0.63*		

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

203. The results in Table 6 corroborate those of Table 5. The removal of the 1% most influential observations has a relatively lower impact on the results of Hathaway and Officer.

Results for ACG methodology

204. We apply the ACG methodology to the same sub-sets of data and report the results in Tables 7 and 8 below. Table 7 contains results for the full sample and Table 8 omits the 1% most influential observations.

Table 7
Estimates using ACG methodology –
No restrictions on influential observations

Tax Regime	Regime 5 1998-1999	Regime 6 2000	Regime 7 2001-2006
Full sample			
Gross drop-off	1.70	0.87	0.87
Cash dividend	0.54	0.90	0.90
Franking credit	2.06	-0.05	-0.07
Large firms			
Gross drop-off	2.25	0.74	0.89
Cash dividend	0.47	1.01	0.85
Franking credit	3.15	-0.49	0.09
Large firms without extreme drop-offs			
Gross drop-off	0.85	0.88	0.91
Cash dividend	0.72	0.96	0.82
Franking credit	0.24	-0.15	0.20
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	0.85	0.88	0.91
Cash dividend	0.71	0.97	0.83
Franking credit	0.25	-0.16	0.19

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

205. The results in Table 7 are quite unstable. Different cells of the table contain substantially different estimates of the value of dividends, franking credits, and their combined value. This is particularly the case in the first two panels of Table 7, where few restrictions are imposed on the data. The results become more stable and somewhat more sensible in the bottom two panels of Table 7, after observations with extreme drop-offs or extreme dividend yields are omitted. These bottom two panels suggest that:

   a. The combined value of a dollar dividend and the associated franking credit (the Gross drop-off rows) is close to, but a little less than one dollar (85-91 cents);

   b. A one dollar cash dividend has a market value of 71 to 97 cents; and

   c. A one dollar franking credit has a market value of -16 to 28 cents.

206. As for the other two methodologies above, the estimates of the market value of franking credits from the ACG methodology must be interpreted as being *conditional* on the estimated value of cash dividends. In particular, positive estimates of the market value of franking credits are conditional on a dollar of cash dividends being worth less than a dollar.

Table 8
Estimates using ACG methodology –
Most influential 1% of observations removed

Tax Regime	Regime 5 1998-1999	Regime 6 2000	Regime 7 2001-2006
Full sample			
Gross drop-off	0.90	0.87	0.87
Cash dividend	0.53	0.90	0.90
Franking credit	0.66	-0.05	-0.06
Large firms			
Gross drop-off	0.88	0.74	0.89
Cash dividend	0.46	1.02	0.85
Franking credit	0.74	-0.50	0.08
Large firms without extreme drop-offs			
Gross drop-off	0.85	0.88	0.91
Cash dividend	0.71	0.97	0.82
Franking credit	0.25	-0.16	0.19
Large firms without extreme drop-offs or extreme dividends			
Gross drop-off	0.86	0.88	0.91
Cash dividend	0.70	0.95	0.82
Franking credit	0.28	-0.12	0.20

Source: Data is from SIRCA and FinAnalysis. SFG Calculations.

207. The results in Table 8, which eliminates the 1% most extreme influential observations corroborates the results from the bottom panels of Table 7. In general:

a. The combined value of a dollar dividend and the associated franking credit (the Gross drop-off rows) is close to, but a little less than one dollar;

b. A one dollar cash dividend has a market value in the range of about 75 to 90 cents; and

c. Conditional on this estimated value of cash dividends, franking credits have a market value up to about 30 cents.

Appendix F: Curriculum Vitae of Stephen Gray

Stephen F. Gray

University of Queensland
Business School
Brisbane 4072
AUSTRALIA
Office: +61-7-3365 6586
Home: +61-7-3890 1030
Fax: +61-7-3365 6788
Email: s.gray@business.uq.edu.au

Academic Qualifications

1995 Ph.D. (Finance), Graduate School of Business, Stanford University.
Dissertation Title: Essays in Empirical Finance
Committee Chairman: Ken Singleton
1989 LL.B. (Hons), Bachelor of Laws with Honours, University of Queensland.
1986 B.Com. (Hons), Bachelor of Commerce with Honours, University of Queensland.

Employment History

2000-Present	Professor of Finance, UQ Business School, University of Queensland.
1997-2000	Associate Professor of Finance, Department of Commerce, University of Queensland and Research Associate Professor of Finance, Fuqua School of Business, Duke University.
1994-1997	Assistant Professor of Finance, Fuqua School of Business, Duke University.
1990-1993	Research Assistant, Graduate School of Business, Stanford University.
1988-1990	Assistant Professor of Finance, Department of Commerce, University of Queensland.
1987	Specialist Tutor in Finance, Queensland University of Technology.
1986	Teaching Assistant in Finance, Department of Commerce, University of Queensland.

Academic Awards

2006	Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.
2002	Journal of Financial Economics, All-Star Paper Award, for Modeling the Conditional Distribution of Interest Rates as a Regime-Switching Process, JFE, 1996, 42, 27-62.
2002	Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).
2000	University of Queensland Award for Excellence in Teaching (a University-wide award).
1999	Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.
1999	KPMG Teaching Prize, Department of Commerce, University of Queensland.
1998	Faculty Teaching Prize (Business, Economics, and Law), University of Queensland.
1991	Jaedicke Fellow in Finance, Doctoral Program, Graduate School of Business, Stanford University.
1989	Touche Ross Teaching Prize, Department of Commerce, University of Queensland.
1986	University Medal in Commerce, University of Queensland.

Large Grants (over $100, 000)

- Australian Research Council Linkage Grant, 2008—2010, Managing Asymmetry Risk ($320,000), with T. Brailsford, J.Alcock, and Tactical Global Management.
- Intelligent Grid Cluster, Distributed Energy – CSIRO Energy Transformed Flagship Collaboration Cluster Grant, 2008-2010 ($552,000)
- Australian Research Council Research Infrastructure Block Grant, 2007—2008, Australian Financial Information Database ($279,754).
- Australian Research Council Discovery Grant, 2006—2008, Capital Management in a Stochastic Earnings Environment ($270,000).

- Australian Research Council Discovery Grant, 2005—2007, Australian Cost of Equity.
- Australian Research Council Discovery Grant, 2002—2004, Quantification Issues in Corporate Valuation, the Cost of Capital, and Optimal Capital Structure.
- Australian Research Council Strategic Partnership Grant, 1997—2000, Electricity Contracts and Securities in a Deregulated Market: Valuation and Risk Management for Market Participants.

Current Research Interests

Benchmark returns and the cost of capital. Corporate Finance. Capital structure. Real and strategic options and corporate valuation. Financial and credit risk management. Empirical finance and asset pricing.

Publications

Gray, S., & Hall, J. (2008) The Relationship Between Franking Credits and the Market Risk Premium: A Reply. Accounting and Finance, 48, 133-142.

Feuerherdt, C., Gray, S., & Hall, J.(2008) The Value of Imputation Tax Credits on Australian Hybrid Securities. International Review of Finance, forthcoming.

Gray, S., Mirkovic, A., & Ragunathan, V. (2006). The Determinants of Credit Ratings: Australian Evidence. Australian Journal of Management, 31(2), 333-354.

Choy, E., Gray, S., & Ragunathan, V. (2006) The Effect of Credit Rating Changes on Australian Stock Returns. Accounting and Finance, 46(5), 755-769.

Gray, S., & Hall, J. (2006) The Relationship Between Franking Credits and the Market Risk Premium. Accounting and Finance,.46(3), 405-428.

Gray, S., & Treepongkaruna, S. (2006). Are there non-linearities in short-term interest rates? Accounting and Finance, 46(1), 149-167.

Gray, P. K., Gray, S., & Roche, T. (2005). A Note on the Efficiency in Football Betting Markets: The Economic Significance of Trading Strategies. Accounting and Finance, 45(2) 269-281.

Duffie, D., Gray, S., & Hoang, P. (2004). Volatility in Energy Prices. In V. Kaminski (Ed.), Managing Energy Price Risk: The New Challenges and Solutions (3rd ed.). London: Risk Books.

Cannavan, D., Finn, F., & Gray, S. (2004). The Value of Dividend Imputation Tax Credits in Australia. Journal of Financial Economics, 73, 167-197.

Gray, S., & Treepongkaruna, S. (2003). Valuing Interest Rate Derivatives Using a Monte-Carlo Approach. Accounting and Finance, 43(2), 231-259.

Gray, S., Smith, T., & Whaley, R. (2003). Stock Splits: Implications for Investor Trading Costs. Journal of Empirical Finance, 10, 271-303.

Gray, S., & Treepongkaruna, S. (2003). On the Robustness of Short-term Interest Rate Models. Accounting and Finance, 43(1), 87-121.

Gray, S., & Treepongkaruna, S. (2002). How to Value Interest Rate Derivatives in a No-Arbitrage Setting. Accounting Research Journal (15), 1.

Gray, P. K., & Gray, S. (2001). A Framework for Valuing Derivative Securities. Financial Markets Institutions & Instruments, 10(5), 253-276.

Gray, P. K., & Gray, S. (2001). Option Pricing: A Synthesis of Alternate Approaches. Accounting Research Journal, 14(1), 75-83.

Dahlquist, M., & Gray, S. (2000). Regime-Switching and Interest Rates in the European Monetary System. Journal of International Economics, 50(2), 399-419.

Bollen, N. P., Gray, S., & Whaley, R. (2000). Regime-Switching in Foreign Exchange Rates: Evidence from Currency Options. Journal of Econometrics, 94, 239-276.

Duffie, D., Gray, S., & Hoang, P. (1999). Volatility in Energy Prices. In R. Jameson (Ed.), Managing Energy Price Risk (2nd ed.). London: Risk Publications.

Gray, S., & Whaley, R. (1999). Reset Put Options: Valuation, Risk Characteristics, and an Example. Australian Journal of Management, 24(1), 1-21.

Bekaert, G., & Gray, S. (1998). Target Zones and Exchange Rates: An Empirical Investigation. Journal of International Economics, 45(1), 1-35.

Gray, S., & Whaley, R. (1997). Valuing S&P 500 Bear Market Warrants with a Periodic Reset. Journal of Derivatives, 5(1), 99-106.

Gray, S., & Gray, P. K. (1997). Testing Market Efficiency: Evidence from the NFL Sports Betting Market. The Journal of Finance, 52(4), 1725-1737.

Gray, S. (1996). Modeling the Conditional Distribution of Interest Rates as a Regime- Switching Process. Journal of Financial Economics, 42, 27-62.

Gray, S. (1996). Regime-Switching in Australian Interest Rates. Accounting and Finance, 36(1), 65-88.

Brailsford, T., Easton, S. E., Gray, P. K., & Gray, S. (1995). The Efficiency of Australian Football Betting Markets. Australian Journal of Management, 20(2), 167-196.

Duffie, D., & Gray, S. (1995). Volatility in Energy Prices. In R. Jameson (Ed.), Managing Energy Price Risk. London: Risk Publications.

Gray, S., & Lynch, A. W. (1990). An Alternative Explanation of the January Anomaly. Accounting Research Journal, 3(1), 19-27.

Gray, S. (1989). Put Call Parity: An Extension of Boundary Conditions. Australian Journal of Management, 14(2), 151-170.

Gray, S. (1988). The Straddle and the Efficiency of the Australian Exchange Traded Options Market. Accounting Research Journal, 1(2), 15-27.

Teaching

Fuqua School of Business, Duke University, Student Evaluations (0-7 scale):

- Financial Management (MBA Core): Average 6.5 over 7 years.
- Advanced Derivatives: Average 6.6 over 4 years.
- Empirical Issues in Asset Pricing: Ph.D. Class

1999, 2006 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.

UQ Business School, University of Queensland, Student Evaluations (0-7 scale):

- Finance (MBA Core): Average 6.6 over 8 years.
- Corporate Finance Honours: Average 6.9 over 8 years.

2002 Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).
2000 University of Queensland Award for Excellence in Teaching.
1999 Department of Commerce KPMG Teaching Prize, University of Queensland.

1998 Faculty Teaching Prize, Faculty of Business Economics and Law, University of Queensland.
1998 Commendation for Excellence in Teaching, University-wide Teaching Awards, University of Queensland.
1989 Touche Ross Teaching Prize, Department of Commerce, University of Queensland.

Board Positions

2002 - Present: Director, Financial Management Association of Australia Ltd.
2003 - Present: Director, Moreton Bay Boys College Ltd. (Chairman since 2007).
2002 - 2007: External Risk Advisor to Board of Enertrade (Queensland Power Trading Corporation Ltd.)

Consulting

Managing Director, Strategic Finance Group: www.sfgconsulting.com.au.

Consulting interests and specialties, with recent examples, include:

- **Corporate finance**
  - ⇒ **Listed multi-business corporation:** Detailed financial modeling of each business unit, analysis of corporate strategy, estimation of effects of alternate strategies, development of capital allocation framework.

- **Capital management and optimal capital structure**
  - ⇒ **State-owned electricity generator:** Built detailed financial model to analyze effects of increased leverage on cost of capital, entity value, credit rating, and stability of dividends. Debt of $500 million issued.

- **Cost of capital**
  - ⇒ **Cost of Capital in the Public Sector:** Provided advice to a government enterprise on how to estimate an appropriate cost of capital and benchmark return for Government-owned enterprises. Appearance as **expert witness** in legal proceedings that followed a regulatory determination.
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony on issues relating to the cost of capital of a cable TV business.
  - ⇒ **Regulatory Cost of Capital:** Extensive work for regulators and regulated entities on all matters relating to estimation of weighted-average cost of capital.

- **Valuation**
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony. The issue was whether, during a takeover offer, the shares of the bidding firm were affected by a liquidity premium due to its incorporation in the major stock market index.
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony in relation to valuation issues involving an integrated mine and refinery.

- **Capital Raising**
  - ⇒ Produced comprehensive valuation models in the context of capital raisings for a range of businesses in a range of industries including manufacturing, film production, and biotechnology.

- **Asset pricing and empirical finance**
  - ⇒ **Expert Witness:** Produced a written report on whether the client's arbitrage-driven trading strategy caused undue movements in the prices of certain shares.

- **Application of econometric techniques to applied problems in finance**
  - ⇒ **Debt Structure Review:** Provided advice to a large City Council on restructuring their debt portfolio. The issues involved optimisation of a range of performance measures for each business unit in the Council while simultaneously minimizing the volatility of the Council's equity in each business unit.

⇒ **Superannuation Fund Performance Benchmarking:** Conducted an analysis of the techniques used by a large superannuation fund to benchmark its performance against competing funds.

- **Valuation of derivative securities**
  - ⇒ **Stochastic Volatility Models in Interest Rate Futures Markets:** Estimated and implemented a number of models designed to predict volatility in interest rate futures markets.

- **Application of option-pricing techniques to real project evaluation**
  - ⇒ **Real Option Valuation:** Developed a framework for valuing an option on a large office building. Acted as arbitrator between the various parties involved and reached a consensus valuation.
  - ⇒ **Real Option Valuation:** Used real options framework in the valuation of a bio-tech company in the context of an M&A transaction.

Last revised: October 25, 2007