Using market data to estimate the equilibrium value of distributed imputation tax credits

Report for the Energy Networks Association

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Contents

1. Background and conclusions

Instructions

1. SFG Consulting (**SFG**) has been retained by the Energy Networks Association (**ENA**) to:

   a) Summarise the methodology of Cannavan, Finn and Gray (2004)[1];

   b) Document the peer-review process and the standing of the Journal of Financial Economics, in which that study was published; and

   c) Update the results of that study, applying the same methodology and using the same data source, but using data after July 2000.

2. A copy of our instructions is attached as an appendix to this report.

Declarations

3. This report has been prepared by Professor Stephen Gray, Professor of Finance at the University of Queensland Business School and Director of SFG Consulting. I have been assisted by Dr Damien Cannavan. We acknowledge that we have read, understood and complied with the Federal Court of Australia's Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia. Professor Gray and Dr Cannavan provide advice on cost of capital issues for a number of entities but have no current or future potential conflicts.

Summary of conclusions

Methodology

4. Cannavan, Finn and Gray (2004) estimate the market value of distributed imputation credits (theta) by comparing the simultaneous prices of ordinary shares (which entitle the holder to dividends and imputation credits) and futures contracts (which involve no such entitlement).

5. For futures contracts there is a well-known "cost of carry" or "fair value" relationship that stems from the fact that the futures payoff can be exactly replicated by a dynamic strategy of borrowing money to buy the physical shares. This relationship does not require any assumptions other than the absence of easy arbitrage opportunities – the most fundamental assumption that is required before market prices can be used for *any* purpose. It does not require any model or any assumption about investor behaviour. It requires nothing more than the absence of "free lunches" or "money trees" in financial markets. Cannavan, Finn and Gray (2004) show that this pricing relation holds to within a fraction of a per cent for the data in their sample.[2]

[1] Cannavan, D., F. Finn and S. Gray, 2004, "The value of dividend imputation tax credits in Australia," *Journal of Financial Economics*, 73, 167-197.
[2] Cannavan, Finn and Gray (2004), Figure 2.

6. Cannavan, Finn and Gray (2004) then use this no arbitrage condition to estimate the implied value of dividends and imputation credits using a sample of firms that paid a dividend prior to the maturity of the futures contract.

The *Journal of Financial Economics*

7. Cannavan, Finn and Gray (2004) is published in the prestigious *Journal of Financial Economics* (**JFE**). This journal is one of four finance journals ranked as an A-star journal (the highest possible rating) by the Australian Business Deans Council.[3] The Australian Research Council (ARC) no longer provides journal rankings but awarded the JFE its highest rating for all the years that it did provide rankings (the latest being 2010).[4] The JFE is the highest-ranked finance journal worldwide in the IDEAS/RePEc Simple Impact Factors for Journals rating.[5] It is commonly ranked as being in the top two or three finance journals worldwide.[6]

8. The JFE applies a rigorous peer-review process. Only leading academics act as reviewers for the JFE and only senior members of the profession serve on its editorial board. Authors must pay a submission fee of USD 600 to have their paper considered at the JFE. More than 90% of submitted papers are rejected.[7]

Updated results

9. This report has been prepared by two of the authors of the Cannavan, Finn and Gray (2004) study. We have used the same data source and applied the same methodology to data from July 2000 to February 2013. The data set consists of 52,041 observations. The simultaneous prices of ordinary shares and matching futures contracts imply that:

    a) The combined value of a $1 cash dividend and the associated imputation credit is $0.99;

    b) Cash dividends are valued at 94% of face value; and

    c) Imputation credits are valued at 12% of face value.

[3] See http://www.abdc.edu.au/journalreview.html.
[4] See http://www.arc.gov.au.
[5] See http://ideas.repec.org/top/top.journals.simple.html.
[6] See for example, Currie, R. and Pandher, G., "Finance journal rankings and tiers: An Active Scholar Assessment methodology," *Journal of Banking and Finance*, 35, 7-20.
[7] http://jfe.rochester.edu/.

2. Background and context

Estimating the value of distributed credits

10. The value of imputation tax credits, gamma (γ), is widely considered to be the product of two components:

    a) the proportion of credits that are distributed to shareholders (the distribution rate, *F*); and

    b) the market value of those credits that are distributed (θ or "theta").

11. That is, $\gamma = F \times \theta$, where the distribution rate (*F*) recognizes that imputation tax credits can only be of value to shareholders if they are distributed, and theta (θ) is an estimate of the value of the tax credits once distributed to the representative investor.

12. Two empirical approaches have been developed to estimate the market value of distributed imputation credits, θ. The first approach is the dividend drop-off method, whereby stock price changes over the ex-dividend day are compared with the associated cash dividend and any imputation tax credit that is attached to it. The second approach is the simultaneous pricing method, whereby the implied value of cash dividends and imputation credits is extracted from the simultaneous prices of two traded securities, one of which entitles the holder to receive the dividend and tax credit, and one of which does not.

Cannavan, Finn and Gray (2004)

13. The study of Cannavan, Finn and Gray (2004) (**CFG**), uses the simultaneous pricing method to estimate the market value of distributed imputation credits, θ. In particular, the authors construct a sample of simultaneous traded prices of ordinary shares (which entitle the holder to cash dividends and imputation credits) and individual share futures contracts (which provide no such entitlement). They then infer the value of cash dividends and imputation credits from the difference between the prices of the two securities.

14. The CFG study was published in the highly-ranked *Journal of Financial Economics* (**JFE**), but has received no weight in recent regulatory determinations as it employs data that pre-dates changes to the operation of the Australian dividend imputation system that took effect in July 2000.

The *Journal of Financial Economics*

15. The CFG study is published in the prestigious *Journal of Financial Economics*. This leading journal is ranked as an A-star journal (the highest possible rating) by the Australian Business Deans Council.[8] The Australian Research Council no longer provides journal rankings but awarded the JFE its highest rating for all the years that it did provide rankings (the latest being 2010).[9] The JFE is the highest

[8] See http://www.abdc.edu.au/journalreview.html.
[9] See http://www.arc.gov.au.

ranked finance journal worldwide in the IDEAS/RePEc Simple Impact Factors for Journals rating.[10] It is commonly ranked as being in the top two or three finance journals worldwide.[11]

16. The JFE applies a rigorous peer-review process. Only leading academics act as reviewers for the JFE and only senior members of the profession serve on its editorial board. Authors must pay a submission fee of USD 600 to have their paper considered at the JFE. More than 90% of submitted papers are rejected.[12]

[10] See http://ideas.repec.org/top/top.journals.simple.html.

[11] See for example, Currie, R. and Pandher, G., "Finance journal rankings and tiers: An Active Scholar Assessment methodology," *Journal of Banking and Finance*, 35, 7-20.

[12] http://jfe.rochester.edu/.

3. Methodology of Cannavan, Finn and Gray (2004)

Data description and valuation framework

ISFs/LEPOs

17. Individual share futures contracts (**ISF**s) were traded on the Sydney Futures Exchange (**SFE**) between May 1994 and November 2008. They are based on Australia's largest and most actively traded stocks and are typically written with 1,000 shares of an individual company as the underlying asset. Initially, the contracts were settled in cash, although over time most contracts switched to physical delivery, beginning in March 1996 (Lien and Yang, 2004). ISFs are not protected against dividend payments, but adjustments are made for all other capital reconstructions (e.g., share splits and bonus issues). ISFs trade on a quarterly maturity cycle, with at least two delivery contracts on each stock quoted at any one time.

18. Low exercise price options (**LEPO**s) are effectively identical to ISFs. They were introduced by, and have traded on, the Australian Securities Exchange (**ASX**) since 1995. Technically, LEPOs are exchange-traded call options that give the holder the right to purchase 1,000 shares in a company at a predetermined exercise price and impose an obligation on the writer of the LEPO to sell those shares at the exercise price if the holder elects to exercise. LEPOs differ from standard call options in that they have a nominal exercise price of one cent and the option premium is paid when the contract matures. These two features mean that the option is certain to be exercised and the buyer will pay the option premium to the seller at maturity. Note that this feature is the same as a futures contract – the underlying asset is exchanged for the agreed-upon price at maturity. The ASX also arranges a margining and marking-to-market system that makes the cash flows between the parties for a LEPO contract identical to the cash flows under an ISF, but for the one cent exercise price to be paid at maturity. LEPOs currently trade on 47 stocks.

Contract Valuation

19. To derive a valuation formula for ISFs and LEPOs CFG rely on the standard cost-of-carry no-arbitrage framework. They begin by considering a representative investor who faces the same marginal tax rate τ_p on dividend income, income from futures trading, and short-term capital gains on stocks. They also make the standard assumptions required to consider a futures contract to have the same value as an otherwise identical forward contract as outlined in Cox, Ingersoll and Ross (1981).

20. The contract maturing at time T is to be valued at time t. CFG define $F_{ij}(t,T)$ to be the futures price at time t for a contract over stock i that matures at time T where the index j denotes any dividend that is paid by stock i between times t and T; $S_i(t)$ is the spot price of the underlying stock i at time t; and $D_{ij}(s)$ and $IC_{ij}(s)$ are the dividend and the associated imputation credit, respectively, for stock i and dividend j at the ex-dividend date s, where $(t < s < T)$ which is assumed to be known at time t. CFG define X to be the exercise price, so $X=0$ for the ISF contracts in the sample and $X=0.01$ for the LEPO contracts. CFG denote the continuously-compounded risk-free rate of interest between times t and T as $r_{t,T}$, with an analogous definition for other time periods.

21. The no-arbitrage cost-of-carry framework is based on the notion that there are two equivalent methods for obtaining ownership of one share at time T, where each method requires a single net cash flow at time T. Since both methods require a single net cash flow to be made at the same time, and they both result in the acquisition of an identical share in the same company, the two cash flows must be equal in a standard no-arbitrage setting.

Method 1: forward contract

22. Under this method, the investor purchases a forward contract at time t, which involves locking-in a price for future delivery at time T, but requires no payment until then. The purchaser of the forward contract does not receive the dividend or the imputation credit at time *s* because they do not own the physical shares at that time. When the contract matures at time T, the purchaser pays the agreed-upon price of $F_{ij}(t,T)$, and the strike price $X = 0.01$ if the contract is a LEPO, and receives one share in the underlying company, which is worth $S_i(T)$ at that time. CFG denote transactions costs as c_F (in time T dollars). All short-term trading profits are taxed at the rate of τ_p. Consequently, the net cash flow at maturity for the buyer of the forward contract is:

$$\left(S_i(T) - \left[F_{ij}(t,T) + X + c_F\right]\right)\left(1 - \tau_p\right) \quad (3)$$

Method 2: physical replication

23. Under this method, the investor borrows $S_i(t)$ and uses these funds to purchase one share at time *t*. This means at time *s* the investor receives a cash dividend $D_{ij}(s)$ and the associated imputation credit $IC_{ij}(s)$. If the cash dividend is placed in a risk-free interest-bearing account, it will have accumulated to $D_{ij}(s)e^{r_{s,T}(T-s)}$ at time T. This dividend and accumulated interest is taxed at τ_p meaning that the investor is left with $D_{ij}(s)e^{r_{s,T}(T-s)}(1-\tau_p)$ after-tax.

24. Let θ denote the value of one dollar (face value) of imputation credits paid to the investor. The receipt of imputation credits does not result in an immediate cash benefit to the investor – rather, it enables a resident investor to reduce their personal tax obligations (or receive a cash rebate for those credits in excess of those needed to do so) when filing their next personal tax return. CFG assume that this coincides with the maturity date of the forward contract. CFG also note that imputation credits are taxable in the hands of resident investors in that the investor's taxable income is increased by the amount of the credit.[13] Consequently, net of taxes the time T value of the imputation credit is $\theta IC_{ij}(s)(1-\tau_p)$.[14]

[13] For example, consider an investor with a marginal personal tax rate of 40% who receives a $100 imputation credit. This investor would have to increase their taxable income by $100, but can then reduce their personal tax bill by $100, producing a net benefit of $60. The receipt of an imputation credit is, therefore, the same as the receipt of a dividend or any other income – in this case, the investor effectively receives $100, pays tax of $40, and is left with $60.

[14] Each investor will either be able to redeem all imputation credits or none of them. That is, there are no investors who are able to redeem some of the imputation credits that are distributed to them. In this context, θ does not represent the value of

25. At time T the investor must repay the original loan along with the interest, which totals $S_i(t)e^{r_{t,T}(T-t)}$. Since the interest on the loan is tax-deductible, the after-tax payment required to repay the loan is $S_i(t)\left[e^{r_{t,T}(T-t)} - \tau_p(e^{r_{t,T}(T-t)} - 1)\right]$. Lastly, the investor can sell the share for $S_i(T)$ at time T and pay capital gains tax of $[S_i(T) - S_i(t)]\tau_p$ since capital gains are taxed at the same rate as ordinary income over short horizons.[15] CFG denote transactions costs as c_S (in time T dollars). This means that the net after-tax payoff at time T is:

$$\left(S_i(T) - \left[S_i(t)e^{r_{t,T}(T-t)} - D_{ij}(s)e^{r_{s,T}(T-s)} - \theta IC_{ij}(s) + c_S\right]\right)\left(1 - \tau_p\right). \tag{4}$$

26. As the net payoff from Method 1 must equal the net payoff from Method 2 to prevent arbitrage, it must be the case that:

$$F_{ij}(t,T) + X + c_F = S_i(t)e^{r_{t,T}(T-t)} - D_{ij}(s)e^{r_{s,T}(T-s)} - \theta IC_{ij}(s) + c_S \tag{5}$$

which defines the valuation formula for the forward contract:

$$F_{ij}(t,T) = S_i(t)e^{r_{t,T}(T-t)} - D_{ij}(s)e^{r_{s,T}(T-s)} - \theta IC_{ij}(s) - X + (c_S - c_F). \tag{6}$$

27. Of course, the analysis for a seller rather than a buyer leads to the same result except with the reverse sign on the transactions cost term. This produces an expression, bounded by transaction costs, for the value of the futures contract in terms of the spot price of the underlying stock, cash dividends and imputation credits:

$$\begin{aligned} &S_i(t)e^{r_{t,T}(T-t)} - D_{ij}(s)e^{r_{s,T}(T-s)} - \theta IC_{ij}(s) - X - (c_S - c_F) \\ &\leq F_{ij}(t,T) \leq \\ &S_i(t)e^{r_{t,T}(T-t)} - D_{ij}(s)e^{r_{s,T}(T-s)} - \theta IC_{ij}(s) - X + (c_S - c_F) \end{aligned} \tag{6a}$$

28. Crucially, these no-arbitrage relationships do not require knowledge of, and are unaffected by, the size of the ex-dividend drop-off. A disparity between the expected drop-off and the value of the cash dividend and imputation credit to an investor may motivate trading in the stock (e.g., short-term dividend capture strategies) but it does not affect the no-arbitrage futures price for that investor. Regardless of whether the investor buys a futures contract or the stock itself, the terminal payoff involves the same ex-dividend stock price, meaning the price of the futures contract (relative to the current stock price) is independent of the size of the drop-off. CFG exploit this fact in their valuation framework and set the cost of obtaining the ex-dividend stock to be the same under both methods, thereby eliminating arbitrage possibilities.

credits to any particular type of investor. Rather, θ is the equilibrium outcome of trading between all investors – it represents the extent to which a distributed imputation credit is reflected in the equilibrium stock price.

[15] Equivalently, assuming that investors are traders and such returns will be treated as trading income.

29. CFG also note that these no-arbitrage relationships are independent of the risk preferences of investors, the volatility of the underlying stock, and the stochastic process that governs the evolution of stock prices. All that is required is the assumption that riskless arbitrage opportunities are not easily available in financial markets.

Data description

30. The CFG sample consists of all trades in all ISF and LEPO contracts that occurred during the period May 1994 to December 1999. Trades in the derivative contracts and the underlying stocks were obtained from Securities Industry Research Centre of Asia-Pacific (SIRCA). The majority of trades occur in the contract that is nearest to maturity. Consequently, observations with no ex-dividend date between the trade date and maturity of the contract are relatively common and are useful in testing the pricing accuracy of the cost-of-carry no-arbitrage pricing model. Conversely, trades where more than one ex-dividend event occurs between the trade date and contract maturity are infrequent and are excluded from the sample.

31. Trades in the derivative contracts are matched with the closest trades in the underlying shares and the sample is restricted to those trades occurring within a four minute window.

Econometric method

32. CFG begin by testing the accuracy of the cost-of-carry no-arbitrage pricing model in the absence of dividends. To do this, they form a sub-sample of all observations for which there is no dividend event between the trade date and the maturity of the contract. From Equation (6) we know that in the absence of dividends and transactions costs:

$$F_i(t,T) = S_i(t)e^{r_{t,T}(T-t)} - X \quad . \tag{7}$$

33. They then compute the relative pricing error which, in the absence of dividends and transactions costs, defined as:

$$RPE_i(t) = \frac{S_i(t)e^{r_{t,T}(T-t)} - X - F_i(t,T)}{S_i(t)} . \tag{8}$$

34. CFG show that the pricing model performs very well empirically, consistent with no-arbitrage pricing of the LEPO and ISF contracts, validating its ability to measure the value of dividends and imputation credits.

35. Substituting the definition of relative pricing error from Equation (8) into the no-arbitrage valuation framework in Equation (6) and scaling appropriately produces the following equation:

$$RPE_i(t) = \beta_0 + \delta \frac{D_i(s)e^{r_{t,T}(T-s)}}{S_i(t)} + \theta \frac{IC_i(s)}{S_i(t)} \tag{9}$$

with β_0 representing an equilibrium transactions cost differential

36. The regression form of this equation is:

$$RPE_{ij}(t) = \beta_0 + \beta_1 \frac{D_{ij}(s)e^{r_{s,T}(T-s)}}{S_i(t)} + \beta_2 \frac{IC_{ij}(s)}{S_i(t)} + \varepsilon_{ij}(t) \tag{10}$$

where β_1 measures the value of one dollar of cash dividends relative to the value of one dollar of futures payoff. It is important to remember that this differs from the interpretation in dividend drop-off studies, which measure the value of cash dividends relative to the value of capital gains. The coefficient β_2 is an estimate of the value that the representative investor obtains from receiving one dollar of imputation credits.

4. Updated results

Data

37. We have updated the CFG study using data from July 2000 to March 2013. From July 2000, resident individual taxpayers and superannuation funds became entitled to a cash refund of all imputation credits that were in excess of what was needed to reduce their tax obligations to zero. Prior to this change, all unused imputation credits expired and were worthless. No major tax law changes have occurred in this area since July 2000, so we use a sample period from that date through to the present year. Our results show that:

    a) The combined value of a one dollar cash dividend and the associated imputation credit is $0.99;

    b) The value of cash dividends is approximately 94% of their face value; and

    c) The value of imputation credits is approximately 12% of their face value.

38. We also show that the value of cash dividends and the value of imputation credits are estimated jointly and that it is important that they are interpreted as a pair of values.

39. Our sample consists of all trades in all ISF and LEPO contracts that occurred during the period 1 July 2000 to 31 March 2013. Trades in the derivative contracts and the underlying stocks were obtained from Securities Industry Research Centre of Asia-Pacific (SIRCA). The majority of trades occur in the contract that is nearest to maturity. Consequently, observations with no ex-dividend date between the trade date and maturity of the contract are relatively common and are useful in confirming the pricing accuracy of the cost-of-carry no-arbitrage pricing model. Conversely, trades where more than one ex-dividend event occurs between the trade date and contract maturity are infrequent and are excluded from the sample.

40. Every futures trade must be matched with the contemporaneous stock price. We do this, by taking a volume-weighted average of the prices of the five stock trades immediately before and the five stock trades immediately after the futures trade, conditional on those stock trades occurring within five minutes of the futures trade. Where any of these ten stock trades fall outside the +/- five minute window, they are omitted from consideration and the average is taken over those trades within the window. Where less than four stock trades occur within the window, the observation is deleted from our sample. We use the volume weighted-average prices to smooth short-term stock price volatility and to dampen the effects of bid-ask bounce.

41. Our data consists of a total of 52,041 matched stock-futures observations over 98 different companies.

42. Table 1 shows that approximately 75% of the observations related to companies that paid fully-franked dividends, with the remaining 25% relating to unfranked and partially-franked dividends. The median time between the matched observation and the ex-dividend date is approximately three months.

43. The Appendix contains a summary of the firms in the sample set and the number of observations relating to each firm. These companies in our sample span over 77% of the ASX 200 index based on market capitalization as at July 2013.[16]

44. Table 2 shows that the matches trades in the sample are distributed across all months of the year.

45. The data on dividend amounts, franking and ex-dividend dates are sourced from Capital IQ. Our primary analysis assumes that all information about dividends is known at the time of the futures contract trades. Given that ex-dividend dates (Kalay and Lowenstein, 1985), dividend amounts (Brav, Graham, Harvey and Michaely, 2005; Leary and Michaely, 2011) and franking percentages (CFG) are relatively predictable, this is not a strong assumption. As a robustness check, we also restrict our analysis to futures contract trades occurring fewer than 21 days before the ex-dividend date to ensure the dividend information is known and find that the results are immaterially different. We also examine a sub-sample of observations within 10 days of the ex-dividend date and again find no material difference in the results.

46. We obtain proxies for the risk-free rate of interest from the Reserve Bank of Australia (RBA). Specifically, we obtain daily values of the RBA 11 a.m. Cash Rate, the RBA 30-day Dealers' Bill Rate, the RBA 90-day Dealers' Bill Rate, and the RBA 180-day Dealers' Bill Rate for the sample period. We use interest rates that match as closely as possible the time between the trade or the dividend payment and contract maturity. The cash rate is used if the relevant number of days is 15 or less; the 30-day rate if the number is between 16 and 60; the 90-day rate if the number is between 61 and 120; and the 180-day rate if the number is greater than 120.

Table 1. Sample characteristics

	Number of observations			Days between observation and ex-dividend date		
Year	**Fully-franked**	**Others**	**Total**	**10th percentile**	**Median**	**90th percentile**
2,000	956	670	1,626	17	115	175
2,001	1,898	818	2,716	19	91	172
2002	3,541	2,141	5,682	18	89	160
2003	4,748	1,940	6,688	18	98	179
2004	4,914	973	5,887	20	90	169
2005	4,754	1,362	6,116	20	100	177
2006	2,197	732	2,929	19	107	182
2007	2,576	684	3,260	23	109	178
2008	1,854	433	2,287	24	87	180
2009	4,833	894	5,727	6	98	179
2010	2,599	1,253	3,852	18	98.5	176
2011	2,139	587	2,726	14	89	165
2012	1,927	460	2,387	32	84	171
2013	123	35	158	32	42	53

[16] See http://www.asx200list.com/ for market capitalizations as at 11 July 2013.

Total	39,059	12,982	52,041	18	96	174

Table 2. Distribution of trade dates

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3,576	3,586	4,468	3,397	5,212	5,058	4,541	5,180	5,090	4,324	4,199	3,410	52,041

Results

47. The results of the updated study are set out in Table 3 below. We estimate the value of cash dividends to be 94% of face value and the value of distributed imputation credits (theta) to be 12% of face value. These results imply that the combined value of a one dollar dividend and the associated imputation credit is $0.9916 (0.94+0.12×0.43). This average value of cash dividends and imputation credits explains approximately 80% of the difference between share and futures prices over the sample.

Table 3. Updated sample coefficient estimates

This table reports coefficient estimates from the OLS regression model:

$$RPE_i(t) = \beta_0 + \beta_1 \frac{D_{ij}(s)e^{r_{s,T}(T-s)}}{S_i(t)} + \beta_2 \frac{IC_{ij}(s)}{S_i(t)} + \varepsilon_i(t)$$

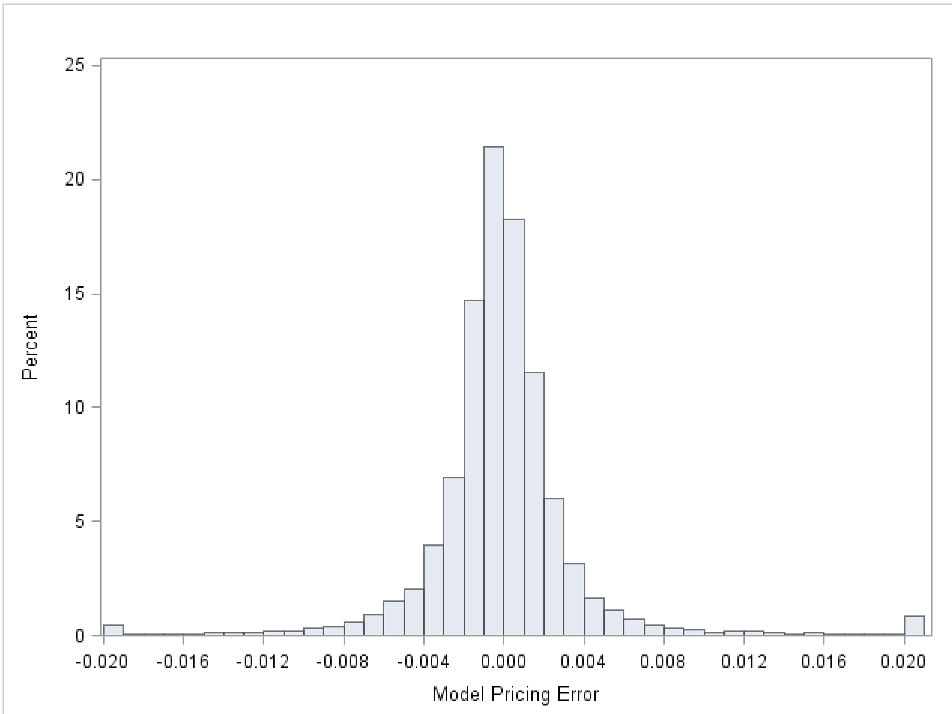
where $RPE_i(t)$ is the relative pricing error at time t for observation i and is defined as $RPE_i(t) = (S_i(t)e^{r_{t,T}(T-t)} - X_i - F_i(t,T)) / S_i(t)$. The intercept β_0 measures the average transaction cost differential, β_{1t} measures the relative value of one dollar of cash dividends, and β_{2t} measures the relative value of value of one dollar of imputation tax credits. The data are obtained from the prices of individual share futures contracts traded on the SFE and the prices of low exercise price options traded on the ASX over the period 1 July 2000 to 31 March 2013.

Coefficient	Estimate
Intercept	
β_0	0.0006***
(std. error)	(0.0000)
Value of Cash Dividends	
β_{10}	0.9382***
(std. error)	(0.0092)
Value of imputation credits	
β_{20}	0.1243***
(std. error)	(0.0219)
F	101,079***
Adjusted R^2	0.795
N	52,041

***Significant at 0.01 level. Significance for β_1 is tested against 1.0.

48. To further test the reliability of the results set out above, we examine the extent to which the fitted values from the regression analysis match the actual data. Figure 1 below shows that the difference between the fitted value and the actual futures price is less than 0.5% for the vast majority of observations and less than 1% for almost all observations.

Figure 1. Distribution of difference between fitted values and observed futures prices



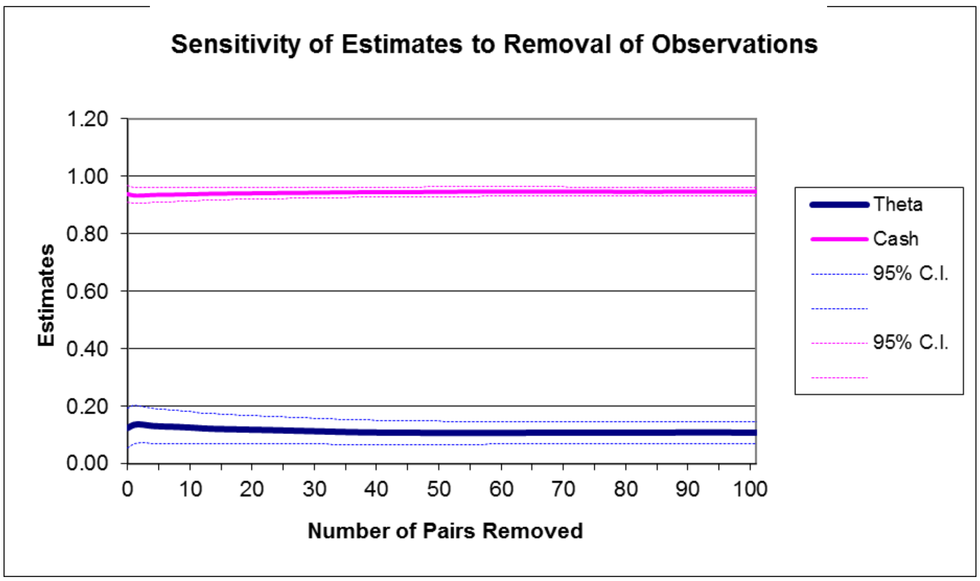
49. As a further check of the robustness of our results, we perform a stability analysis to examine the sensitivity of our estimates to the most influential observations in the sample. We do this by first determining which single observation, if removed, would result in the greatest increase in our estimate of theta. We then determine which single observation, if removed, would result in the greatest decrease in our estimate of theta. We then remove both observations and re-estimate theta. We then repeat this process by removing another pair of observations. We continue in this manner, removing pairs of observations, until 100 pairs have been removed.

50. The results of applying this process are summarised in Figure 2. The solid lines represent the estimates of the value of cash dividends, the value of theta, and the value of the combined package, as indicated. In each case, the corresponding dashed lines represent the 95% confidence interval around the point estimate.

51. It is clear from Figure 2 that our results are not driven by a small number of influential data points. The point estimates and 95% confidence intervals are stable and largely insensitive to the removal of

up to 100 pairs of the most influential observations. If anything, the estimated value of cash dividends increases and the estimate of theta decreases as a small number of the most influential data points are removed from the sample.

Figure 2. Stability analysis



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Appendix: Companies in sample

Ticker Symbol	Frequency	Percentage of sample	Ticker Symbol	Frequency	Percentage of sample
AGK.AX	89	0.17	MAP.AX	2	0.00
AIO.AX	141	0.27	MAY.AX	119	0.23
ALL.AX	18	0.03	MBL.AX	176	0.34
AMC.AX	313	0.60	MIG.AX	10	0.02
AMP.AX	1,324	2.54	MIM.AX	137	0.26
ANN.AX	77	0.15	MQG.AX	931	1.79
ANZ.AX	2,921	5.61	MYR.AX	16	0.03
ARI.AX	4	0.01	NAB.AX	4,534	8.71
ASX.AX	117	0.22	NCM.AX	1,909	3.67
AWC.AX	300	0.58	NCP.AX	4,586	8.81
AXA.AX	85	0.16	NCPDP.	50	0.10
BBG.AX	46	0.09	NWS.AX	443	0.85
BBI.AX	13	0.02	NWSLV.	2	0.00
BHP.AX	6,521	12.53	ORG.AX	109	0.21
BIL.AX	478	0.92	ORI.AX	141	0.27
BLD.AX	348	0.67	OSH.AX	152	0.29
BNB.AX	232	0.45	OST.AX	35	0.07
BSL.AX	240	0.46	OZL.AX	30	0.06
BXB.AX	48	0.09	PBG.AX	2	0.00
CBA.AX	4,526	8.70	PBL.AX	266	0.51
CCL.AX	130	0.25	PDP.AX	16	0.03
CFX.AX	5	0.01	PPX.AX	7	0.01
CGJ.AX	92	0.18	PRK.AX	12	0.02
CML.AX	482	0.93	QAN.AX	356	0.68
COH.AX	16	0.03	QBE.AX	468	0.9
CPU.AX	56	0.11	QRN.AX	18	0.03
CSL.AX	347	0.67	RIN.AX	12	0.02
CSR.AX	10	0.02	RIO.AX	4,602	8.84
DJS.AX	177	0.34	SEV.AX	5	0.01
DXS.AX	2	0.00	SGB.AX	733	1.41
EGP.AX	1	0.00	SGP.AX	50	0.10
FBG.AX	37	0.07	SIP.AX	11	0.02
FGL.AX	159	0.31	SRP.AX	45	0.09
FMG.AX	220	0.42	STO.AX	233	0.45
FXJ.AX	125	0.24	SUN.AX	482	0.93
HVN.AX	29	0.06	SYD.AX	4	0.01
IAG.AX	199	0.38	TAH.AX	230	0.44
ILU.AX	7	0.01	TCL.AX	7	0.01
IPL.AX	72	0.14	TIM.AX	1	0.00
JBH.AX	2	0.00	TLS.AX	2,933	5.64
JHX.AX	56	0.11	TLSCA.	254	0.49
LEI.AX	70	0.13	TOL.AX	157	0.3
LGL.AX	101	0.19	TTS.AX	12	0.02
LHG.AX	200	0.38	TWE.AX	2	0.00
LLC.AX	399	0.77	WBC.AX	2,471	4.75

Ticker Symbol	Frequency	Percentage of sample
WDC.AX	231	0.44
WES.AX	1,042	2.00
WMC.AX	425	0.82
WOR.AX	13	0.02
WOW.AX	1,193	2.29
WPL.AX	1,499	2.88
WRT.AX	5	0.01
ZFX.AX	27	0.05