An updated dividend drop-off estimate of theta

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Contents

Executive Summary

1.1 Context

1 In the Australian regulatory setting, the regulator requires an estimate of a parameter that reflects the implied market value of dividend imputation tax credits at the time those credits are *created* by the payment of corporate tax. This parameter is known as 'gamma.' Gamma, in turn, is a function of two other parameters. One of these is the implied market value of imputation credits at the time they are *distributed* to shareholders – a parameter known as 'theta.'

2 One method of estimating theta is known as 'dividend drop-off analysis.' This is an econometric (statistical) technique that estimates the value of distributed imputation credits (theta) by observing the change in stock prices around ex-dividend events (days when the dividend and imputation credit separate from the share).

3 Specifically, share prices are expected to drop, on average, by the value of the cash dividend and the attached imputation credit on the ex-dividend date when the dividend and credit separate from the share. By comparing 'with-dividend' share prices against 'ex-dividend' share prices, it is possible to infer the value that the market has placed on dividends and imputation credits.

4 The Australian Competition Tribunal (Tribunal) has twice endorsed the use of dividend drop-off analysis for the purpose of estimating theta. In the *Energex Gamma Case*,[1] the Tribunal rejected methods that were based on counting the proportion of distributed credits that might be redeemed, and instead directed that a 'state of the art' dividend drop-off study should be performed to assist with its deliberations. The resulting study, the SFG (2011) study, concluded that the best estimate of theta was 0.35. The Tribunal endorsed and adopted that estimate.

5 For a number of years, the AER adopted a theta of 0.35. However, in its December 2013 Rate of Return Guideline, the AER proposed to increase its estimate of theta, again on the basis of methods that involve counting the proportion of credits that might be redeemed. In the *PIAC-Ausgrid Case*,[2] the Tribunal again rejected that approach and set theta to 0.35 on the basis of an updated dividend drop-off estimate – the SFG (2013) study.[3]

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[1] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011).

[2] Applications by Public Interest Advocacy Centre and Ausgrid [2016] ACompT1.

[3] The AER has sought a judicial review of the Tribunal's decision, but that review application has not yet been heard.

1.2 The current report

6 This report summarises the results of updating the 2011 and 2013 SFG reports using the most recently available data. As set out below, this report has been prepared by Stephen Gray, Professor of Finance at the UQ Business School at the University of Queensland and Director of Frontier Economics. Professor Gray is also the author of the 2011 and 2013 SFG studies.[4]

7 All of the procedures for compiling the data set and performing the statistical analysis that are set out in this report follow the approach adopted in the 2011 and 2013 SFG reports. This report simply summarises the results that are obtained from applying the same methods to an updated data set through to June 2016.

8 We conclude that the updated data set supports an unchanged estimate of theta of 0.35.

1.3 Author of report

9 This report has been authored by Professor Stephen Gray, Professor of Finance at the UQ Business School, University of Queensland and Director of Frontier Economics, a specialist economics and corporate finance consultancy. I have Honours degrees in Commerce and Law from the University of Queensland and a PhD in Financial Economics from Stanford University. I teach graduate level courses with a focus on cost of capital issues, I have published widely in high-level academic journals, and I have more than 15 years' experience advising regulators, government agencies and regulated businesses on cost of capital issues. I have published several papers on the estimation of gamma, including in the *Journal of Financial Economics*, one of the leading international finance journals. A copy of my curriculum vitae is attached as an appendix to this report.

10 My opinions set out in this report are based on the specialist knowledge acquired from my training and experience set out above. I have been provided with a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines). I have read, understood and complied with the Expert Witness Guidelines.

I was assisted in the preparation of this report by Dr Damien Cannavan of the UQ Business School at the University of Queensland. Dr. Cannavan and I have co-authored a number of papers relating to the valuation of dividend imputation tax credits. He assisted in the compilation of the data sets and with the econometric analysis of the data.

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[4] Professor Gray and Dr Damien Cannavan, also from UQ Business School, are in the process of preparing an updated dividend drop-off analysis for publication in an academic journal. This report summarises the relevant results from that work.

2 Background and context

2.1 The role of gamma in the regulatory process

11 In the Australian regulatory setting, the regulator estimates the return that investors would require to provide equity capital to the firm and then allows the firm to charge prices so that it is able to pay that return to the investors. In the absence of imputation, this process is straightforward.

12 Consider, for example, a firm with $1,000 of equity in its RAB and a required return on equity of 7%. In this case, the equity investors require a return of $70.[5] The regulator will allow the firm to earn a pre-tax profit of $100, from which it will pay $30 corporate tax,[6] leaving $70 to return to shareholders, as required.

13 Now consider the same example with imputation, and where the regulator has determined that gamma should be set to 0.4, as the AER has done in its recent decisions. In this case, the regulator will allow the firm to earn a pre-tax profit of $85.37, from which it will pay $25.61 corporate tax (30%), leaving $59.76 to distribute to shareholders. The $25.61 of corporate tax will create $25.61 of imputation credits that are assumed to have a value of 0.4 × 25.61 = $10.24. Thus, the shareholders receive $59.76 from the firm plus imputation credits that are assumed to have a value of $10.24, providing the total return of $70.00 that is required.

14 In summary, the return that shareholders would otherwise receive from the firm ($70.00) is reduced by the regulator's estimate of the value of imputation credits ($10.24).

15 To illustrate the key point of contention in relation to gamma, suppose that the regulator estimates that 40% of all credits that are created will be redeemed and sets gamma on that basis, whereas imputation credits are only valued (in aggregate by the equity market) at 25% of the face amount. In this case, the regulator will reduce the return that the shareholders would otherwise receive by $10.24, but the credits received by those shareholders would only have a value to them of 0.25 × 25.61 = $6.40. This would result in shareholders being under-compensated as their return is reduced by $10.24 in relation to credits that are only worth $6.40 to them.

2.2 Points of agreement

16 There are a number of points on which there is broad agreement between consultants, regulators and regulated businesses, as set out below.

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[5] 7% × $1,000 = $70.

[6] Assuming a 30% corporate tax rate.

Two parameters to be estimated

17 There is broad agreement that gamma should be estimated as the product of two parameters: $\gamma = F \times \theta$. The first parameter is the distribution rate – the proportion of created imputation credits that are attached to dividends and distributed to shareholders. The second parameter is variously defined as "theta" or "the value of distributed imputation credits" or "the utilisation rate." While there is dispute about how each component of gamma should be interpreted and estimated, there is broad agreement that gamma is to be estimated as the product of these two components.[7] For example, if firms distribute 70% of the imputation credits they create and if those credits are each valued at 35% of face value, then gamma would be:

$$\gamma = F \times \theta = 0.7 \times 0.35 = 0.25.$$

Agreement in relation to theta

18 There is broad agreement that two different interpretations of the second parameter, theta, have been proposed:

a. a *market value* interpretation; and

b. a *redemption proportion* interpretation.[8]

19 There is also broad agreement that:

a. If the *market value* interpretation is adopted, we should use estimation methods that are designed to estimate the market value from the market prices of traded securities; and

b. If the *redemption proportion* interpretation is adopted, we should use estimation methods that are designed to estimate the proportion of credits that are (or are likely to be) redeemed.[9]

2.3 Key point of disagreement: The estimation of theta

20 Over the last six years, the key point of dispute between regulated businesses and the AER has been whether theta, the value of distributed imputation credits, should be estimated with reference to the market prices of traded securities, or whether theta should be estimated as the proportion of credits that might be

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[7] AusNet Draft Decision, Attachment 4, p. 11. Throughout this report we use references to the AusNet Draft Decision as an example of the AER's current approach to gamma. The AusNet decision is among the batch of the AER's most recent final decisions. The AER's approach to, and estimate of, gamma has remained the same for more than two years.

[8] AER Rate of Return Guideline, Explanatory Statement, p. 158. The AER defines gamma in terms of the expected proportion of the credits that are created by the payment of corporate tax that investors are able to redeem or utilise.

[9] AusNet Draft Decision, Attachment 4, p. 35 and following.

available for redemption. We begin this section by providing some background on this issue.

2.3.1 The 2011 Energex Gamma Case

21 Prior to the AER's 2009 WACC Review, the long-standing regulatory precedent was to set gamma to 0.5. However, in its Statement of Regulatory Intent in May 2009, the AER set gamma to 0.65. That estimate was based on:

a. Setting F to 100%. The AER's consultant on this issue proposed that the distribution rate should be set on the basis of theoretical assumption rather than market evidence; and

b. Setting θ to 0.65 as the mid-point of two estimates:

    i. A dividend drop-off estimate of 0.57 whereby one compares the prices of shares immediately before the ex-dividend date with the prices of the same shares immediately after, as a means of inferring the implied value of dividends and the tax credits that are attached to them ; and

    ii. An estimate based on ATO tax statistics about the proportion of imputation credits that are redeemed.

22 The first three businesses to be regulated under the AER's SoRI estimate of 0.65 were ENERGEX, Ergon Energy and ETSA Utilities,[10] all of whom sought a review by the Australian Competition Tribunal (the Tribunal). This review took place under the National Electricity (Distribution) Rules and has become known as the *Energex Gamma Case*.[11]

Issues and Tribunal findings

23 Two techniques for estimating theta were considered by the Tribunal:

a. Tax statistics about the proportion of distributed imputation tax credits that had been redeemed by shareholders, obtained from the Australian Taxation Office (ATO); and

b. Dividend drop-off analysis, whereby the implied value of imputation tax credits is inferred from the price change that occurs over ex-dividend days.

24 The Tribunal held that the ATO tax statistic approach did not produce an estimate of market value and that the AER was wrong to have interpreted tax statistic estimates in that way. In particular, the Tribunal held that the ATO tax statistic approach provides no more than an upper bound check on estimates of theta obtained from the analysis of market prices, and that the AER was wrong

[10] Now called SA Power Networks.

[11] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011).

to have interpreted such an estimate as a point estimate rather than as an upper bound:

> The AER accepted that utilisation rates derived from tax statistics provide an upper bound on possible values of theta. Setting aside the manner in which the AER derived a value from the tax statistics study, it correctly considered that information from a tax statistics study was relevant. However, its relevance could only be related to the fact that it was an upper bound. No estimate that exceeded a genuine upper bound could be correct. Thus the appropriate way to use the tax statistics figure was as a check.[12]

25 This left the Tribunal with dividend drop-off analysis. On this point, the AER had sought to rely entirely on a single study by Beggs and Skeels (2006). The Tribunal held that the AER was wrong to rely on an out-dated and methodologically unsound dividend drop-off study. The Tribunal then directed that a 'state-of-the-art' dividend drop-off study should be conducted to assist the Tribunal. The Tribunal also directed that the dividend drop-off study, to be performed by SFG, "should employ the approach that is agreed upon by SFG and the AER as best in the circumstances."

26 In summary, the Tribunal ruled that:

a. The AER had erred in using tax statistics estimates for any purpose other than as an upper bound;

b. The AER had erred in its reliance on the Beggs and Skeels (2006) dividend drop-off estimate of theta; and

c. SFG should be retained to prepare a "state-of-the-art" dividend drop-off analysis with terms of reference to be agreed with the AER.

The SFG "state-of-the-art" dividend drop-off study

27 After agreement could not be reached between the parties on the terms of reference for the state-of-the-art drop-off study, the Tribunal held another hearing and ruled that:

a. The four variations of the econometric specification of dividend drop-off analysis drawn by SFG from the literature should be used; and

b. The results from the full updated data set compiled by SFG should be used rather than reporting results for various sub-periods.

28 SFG then conducted the dividend drop-off study and circulated a draft report to all parties. The AER and the regulated businesses that were parties to the *Energex Gamma Case* provided detailed comments on the draft report and these were taken into account in a revised report that was provided to all parties and to the Tribunal.

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[12] Application by Energex Limited (No 2) [2010] ACompT 7 (13 October 2010), Paragraph 91.

29 Although the AER submitted that the SFG study had departed from the terms of reference, the Tribunal disagreed and accepted the estimates from the SFG dividend drop-off study:

> The Tribunal is satisfied that the procedures used to select and filter the data were appropriate and do not give rise to any significant bias in the results obtained from the analysis. Nor was that suggested by the AER.
>
> In respect of the model specification and estimation procedure, the Tribunal is persuaded by SFG's reasoning in reaching its conclusions. Indeed, the careful scrutiny to which SFG's report has been subjected, and SFG's comprehensive response, gives the Tribunal confidence in those conclusions.[13]

30 The Tribunal went on to conclude that:

> The Tribunal is satisfied that SFG's March 2011 report is the best dividend drop-off study currently available for the purpose of estimating gamma in terms of the Rules.[14]

and:

> The Tribunal finds itself in a position where it has one estimate of theta before it (the SFG's March 2011 report value of 0.35) in which it has confidence, given the dividend drop-off methodology. No other dividend drop-off study estimate has any claims to be given weight vis-à-vis the SFG report value.[15]

Final estimate of Gamma

31 Having determined that the appropriate distribution rate is 70% and that the best dividend drop-off estimate of theta is 0.35, the Tribunal multiplied these two estimates together to obtain a gamma estimate of 0.25:

> Taking the values of the distribution ratio and of theta that the Tribunal has concluded should be used, viz 0.7 and 0.35, respectively, the Tribunal determines that the value of gamma is 0.25.[16] [17]

2.3.2 The 2013 SFG update

32 In June 2013, SFG provided an update of its dividend drop-off estimate of theta in a report commissioned by the Energy Networks Association (ENA). This involved applying the same econometric methodologies and applying the same statistical, diagnostic and robustness tests as in the 2011 study performed for the Tribunal. In that study, the data set was updated from September 2010 to October 2012.

33 The 2013 study notes that the conclusions from the earlier 2011 study were that:

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[13] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), Paragraph 22.

[14] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), Paragraph 29.

[15] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), Paragraph 38.

[16] Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), Paragraph 42.

[17] As set out in Section 2.3.3 below, the AER has subsequently conducted a conceptual re-evaluation of the estimation of theta and concluded that the Tribunal erred in adopting a market value perspective.

> For the reasons set out in detail in this report, we conclude that the appropriate estimate of theta from the dividend drop-off analysis that we have performed is 0.35 and that this estimate is paired with an estimate of the value of cash dividends in the range of 0.85 to 0.90.[18]

34 The 2013 went on to conclude that:

> …the conclusions from the earlier study remain valid when tested against the updated data set.[19]

2.3.3 The 2016 PIAC-Ausgrid Case[20]

35 In its December 2013 Rate of Return Guideline, the AER announced that it had conducted a "conceptual re-evaluation"[21] of gamma and that it intended to redefine gamma in terms of the proportion of imputation tax credits that might be redeemed. This led the AER to propose an increased gamma of 0.5 in its Rate of Return Guideline.

36 In the first set of regulatory determinations after the Guideline, the AER maintained its approach of relying primarily on the redemption rate evidence, but reduced its proposed gamma to 0.4 after a reconsideration of the relevant redemption rate evidence.

37 The AER's re-evaluation runs counter to the *Energex Gamma* decision, where the Tribunal held that the proportion of redeemed credits cannot be used to estimate theta, but can only serve as an upper bound for theta.

38 This led a number of businesses to seek a merits review of the AER's decision in relation to gamma (and several other issues) – proceedings that have become known as the *PIAC-Ausgrid Case*.

39 In the *PIAC-Ausgrid* case,[22] the Australian Competition Tribunal rejected the AER's "conceptual re-evaluation" and held that gamma must be interpreted as the value of credits to investors and not as the proportion that can be redeemed:

> We consider that, by placing most reliance on the equity ownership approach and effectively defining the utilisation rate as the proportion of distributed imputation credits available for redemption, the AER has adopted a conceptual approach to gamma that redefines it as the value of imputation credits that are available for redemption. This is inconsistent with the concept of gamma in the Officer Framework for the WACC.[23]

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18 SFG (2013), Paragraph 85.

19 SFG (2013), Paragraph 86.

20 Applications by Public Interest Advocacy Centre and Ausgrid [2016] ACompT1.

21 AER, 2013, Rate of Return Guideline, Explanatory Statement, p. 160.

22 Applications by Public Interest Advocacy Service Ltd and Ausgrid Distribution [2016] ACompT 1 (26 February 2016).

23 PIAC-Ausgrid, Paragraph 1100.

> …the Tribunal does not accept the AER's approach that imputation credits are valued at their claimable amount or face value (as it said in the Final Decisions: the measure is what can be claimed). The value is not what can be claimed or utilised.[24]

40 Thus, the Tribunal decided that the AER had estimated the wrong thing – a redemption proportion instead of a value – and directed the AER to re-make its decision with a gamma of 0.25 instead of the 0.4 figure that the AER had proposed. The 0.25 estimate is a value estimate based on market prices, and is the estimate that had been used prior to the AER's "re-evaluation."

41 In its decisions since the *PIAC-Ausgrid* judgment, the AER has continued to estimate theta as the proportion of credits that are available to be redeemed. In doing this, the AER relies primarily on the "equity ownership" approach to estimate the proportion of credits that might be redeemed. This involves simply estimating the proportion of Australian equity that is owned by resident investors. The Tribunal in *PIAC-Ausgrid* found that approach to be in error:

> The AER's equity ownership and tax statistics approaches consequently make no attempt to assess the value of imputation credits to shareholders…The Tribunal considers these approaches to be inconsistent with a proper interpretation of the Officer Framework.[25]

> The Tribunal considers that the equity ownership approach overstates the redemption rate. We agree with the Network Applicants' submission that "even on the AER's own definition of theta (focussing on potential utilisation by eligible investors), equity ownership rates are above the true maximum possible figure for theta".[26]

42 The Tribunal also noted that the AER's approach to estimating theta was inconsistent with the approach to estimating all other WACC parameters. All other parameters are estimated as market values using the prices of traded securities:

> Moreover, the AER's reasoning ignores the fact that other parameters in the WACC calculations are market values.[27]

> …the Tribunal considers the use of market studies to estimate the value of imputation credits is consistent with the methods used to calculate other parameters of the costs of debt and equity from market data.[28]

> Consequently, placing significant weight on market value studies is, in the Tribunal's view, consistent with evidence relied on by the AER to calculate the rate of return on capital.[29]

43 The Tribunal's conclusion is very clear on this point:

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[24] PIAC-Ausgrid, Paragraph 1081.

[25] PIAC-Ausgrid, Paragraph 1095.

[26] PIAC-Ausgrid, Paragraph 1093.

[27] PIAC-Ausgrid, Paragraph 1073.

[28] PIAC-Ausgrid, Paragraph 1097.

[29] PIAC-Ausgrid, Paragraph 1098.

> …the AER has adopted a conceptual approach to gamma that redefines it as the value of imputation credits that are available for redemption. This is inconsistent with the concept of gamma in the Officer Framework for the WACC.[30]

44 The Tribunal is also very clear about the fact that it is not enough to simply look at the *number* of credits that might be redeemed – it is also necessary to determine the *value* to investors of any credits that they redeem:

> …it is necessary to consider both the eligibility of investors to redeem imputation credits and the extent to which investors determine the worth of imputation credits to them.[31]

45 The Tribunal also concluded that the approaches that seek to estimate the proportion of credits that are redeemed produce nothing more than an upper bound, and that it is only market value studies such as dividend drop-off analysis, that produce a point estimate:

> Given that two of the three approaches adopted by the AER are considered no better than upper bounds, it follows that the assessment of theta must rely on market studies. The Tribunal considers that, of the various methodologies for estimating gamma employed by the AER, market value studies are best placed to capture the considerations that investors make in determining the worth of imputation credits to them.[32]

46 Having decided that theta (and consequently gamma) must be estimated as market values from the prices of traded securities, the Tribunal adopted the updated 2013 SFG dividend drop-off estimate of 0.35 in its decision.[33] Accordingly, the Tribunal directed the AER to remake its decision with a gamma of 0.25 – being the product of a 70% distribution rate and a theta of 0.35.[34]

2.4 The 2016 dividend drop-off update

47 The results set out below are based on the following approach:

a. Start with the data set used in the 2013 SFG update;

b. Update the data to June 2016, using the same procedures as used in the 2013 SFG update; and

c. Apply the same econometric methods as used in the 2013 SFG update.

48 The updated data and analysis supports the same conclusion of the 2011 and 2013 SFG studies – that the most appropriate estimate of theta remains at 0.35.

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[30] PIAC-Ausgrid, Paragraph 1100.

[31] PIAC-Ausgrid, Paragraph 1061.

[32] PIAC-Ausgrid, Paragraph 1096.

[33] PIAC-Ausgrid reasons, Paragraph 1103.

[34] The AER has sought a judicial review of the Tribunal's decision, but that review application has not yet been heard.

49 The remainder of this report documents all of the steps and sets out all of the analysis involved in the 2016 updated dividend drop-off analysis.

3 Compilation of data

3.1 Initial data set

50 The current update begins with the same set of ex-dividend events that was used in the 2013 SFG study. That sample consists of 3,642 observations from July 2001 to October 2012. The construction of that sample is explained in detail in Section 3 of the 2013 SFG report.[35]

3.2 Extended sample of ex-dividend events

51 The SFG (2013) data set has now been extended through to June 2016, again following the updating procedures set out in Section 3 of the 2013 SFG report.

Compilation of the updated set of ex-dividend events

52 The first step in updating the set of ex-dividend events involves identifying all ex-dividend events in each of two independent data bases – DatAnalysis and Thompson Reuters Tick History (TRTH). DatAnalysis is operated by Aspect Huntley, which is a wholly-owned subsidiary of Morningstar Inc. It is commonly used as the basis for papers published in the academic and practitioner literature relating to empirical finance. The TRTH database is compiled by Reuters and made available by the Securities Industry Research Centre of Asia-Pacific (SIRCA). This data is also commonly used as the basis for papers published in the academic and practitioner literature relating to empirical finance.

53 The records of all ex-dividend events for all firms listed on the Australian Securities Exchange (ASX) are obtained from each data base. Information obtained includes the following fields:

a. Company name;

b. ASX ticker symbol (three digit code used by the ASX);

c. Dividend amount;

d. Currency in which the dividend was paid;

e. Franking percentage (the proportion of the dividend that was franked);

f. Ex-dividend date; and

g. Type of dividend:

   i. Ordinary (interim, final, quarterly, or monthly);

   ii. Special-cash;

[35] As set out above, Professor Gray and Dr Damien Cannavan are in the process of preparing an updated dividend drop-off analysis for publication in an academic journal. The remainder of this section summarises the approach taken in that work.

iii. Special-scrip; or

iv. Return of capital.

Application of preliminary screens and conversions

54 The next step in the analysis is to apply a number of preliminary screens, as follows:

a. Eliminate observations where the dividend amount is missing (or set to zero) or where the ex-date is missing;

b. Eliminate observations for which the ticker symbol has more than three letters, as this indicates that the security is not an ordinary share;

c. Eliminate dividends that are defined to be a capital return or a special scrip dividend;

d. Eliminate dividends with a currency defined to be "PCT." This indicates "per cent" rather than a currency and is used for in specie distributions rather than cash dividends;

e. Eliminate all duplicate records. The TRTH database in particular contains a number of duplicated observations; and

f. Eliminate all observations for which there was a corporate event/capitalisation change (such as a rights or bonus issue or other issuance or cancellation of shares) within five days of the ex-dividend event identified in the DatAnalysis Corporate Events file.

55 All foreign currency dividends are then converted into Australian dollars using exchange rates provided by the Reserve Bank of Australia.[36] A record of the dividend currency is retained so that the drop-off analysis can be applied to samples that include, and exclude, foreign currency dividends.

56 In cases where a database indicates that the same company paid two different dividends with the same ex-date, those dividends are added to obtain a single record for each ex-date for each company. For example, if a company paid a 15 cent fully franked dividend and a 5 cent unfranked special dividend with the same ex-date, a single record is retained with:

a. Dividend amount set to 20 cents; and

b. Franking percentage set to $\frac{15}{20}\times 100+\frac{5}{20}\times 0=75$.

57 A record of observations that have been summed in this manner is maintained so that the drop-off analysis can be applied to samples that include, and exclude, these summed observations.

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[36] http://www.rba.gov.au/statistics/hist-exchange-rates/index.html?accessed=2013-06-07-12-31-03.

Matching of ex-dividend events across databases

58 The next step is to match ex-dividend events from the two data bases on the following four fields:

a. ASX ticker symbol/company identifier;

b. Ex-dividend date;

c. Australian dollar dividend amount; and

d. Franking percentage.

59 A number of observations match on ASX ticker symbol, ex-dividend date and dividend amount, but not franking percentage. In most of these cases, the franking percentage is missing in one of the databases. In these cases, the ASX web site and company annual reports are checked for franking percentage information. In cases where two independent sources agree on the franking percentage, the observation is treated as a match.

60 Those observations that matched across databases are then allocated to the "Matched" sample. Other observations are allocated to the "Unmatched DatAnalysis" or the "Unmatched TRTH" samples, but only if data is available on the following fields:

a. ASX ticker symbol/company identifier;

b. Ex-dividend date;

c. Australian dollar dividend amount; and

d. Franking percentage,

otherwise they are eliminated from the sample.

Addition of ASX share price data

61 All observations in all three subsamples[37] are then supplemented with additional data sourced from Datastream, which is commonly used as the basis for papers published in the academic and practitioner literature relating to empirical finance. The following data items are added to each observation:

a. The closing cum-dividend day stock price;

b. The closing cum-dividend day trading volume;

c. The closing ex-dividend day stock price;

d. The closing ex-dividend day trading volume;

e. The total return on the All Ordinaries Accumulation Index over the ex-dividend day;

f. The market capitalisation for the firm on the ex-dividend day;

[37] That is, the "Matched," "Unmatched DatAnalysis," and "Unmatched TRTH" samples.

g. The total market capitalisation for the All Ordinaries index on the ex-dividend day;

h. The mean of the daily excess returns (total stock return less All Ordinaries Accumulation Index return) computed over the year ending six trading days before the ex-dividend day; and

i. The standard deviation of the daily excess returns (total stock return less All Ordinaries Accumulation Index return) computed over the year ending six trading days before the ex-dividend day.

62 The mean and standard deviation of daily excess returns are calculated in the same way as in the 2011 and 2013 SFG reports:

a. **Mean excess return**: This is computed over a period of one year, ending six days prior to the ex-dividend date, so that the historical period does not overlap with the ±5 day window around the ex-dividend date. The mean excess stock return is measured over the trading days beginning one year and six days prior to the ex-dividend day and ending six days prior to the ex-dividend day. The excess stock return for each day is defined as the stock return for a particular company *i* less the return on the market index. Formally, the mean excess stock return for company *i* at time *t* is defined as:

$$\overline{er}_{i,t} = \frac{1}{N}\sum_{j=1}^{N} er_{i,t-5-j}$$

where:

$$er_{i,t} = r_{i,t} - r_{m,t},$$

and N represents the number of trading days over the relevant year-long period.

b. **Standard deviation of excess returns**: The volatility of excess stock returns is computed as the standard deviation of the excess stock return, measured over the same period. Formally, the volatility of excess stock returns for company *i* at time *t* is defined as:

$$\sigma_{i,t} = \sqrt{\frac{1}{N}\sum_{j=1}^{N}\left(er_{i,t-5-j} - \overline{er}_{i,t}\right)^2}.$$

Addition of other data fields

63 The final step is to augment each observation with the following fields:

a. An indicator of whether the dividend was an ordinary or special dividend. In cases where a company paid an ordinary and special dividend with the same ex-date, the dividend is classified as special;

b. An indicator of whether the company made any announcement to the ASX on the cum-dividend day or the ex-dividend day that was classified as price sensitive. We obtain information about announcements and the classification of price sensitivity from the SIRCA company announcement file, which is a direct feed from the ASX;

c. A field that indicates whether the ASX classifies the security as:

    i. ordinary shares of company;

    ii. a listed fund;

    iii. a real estate investment trust (REIT); or

    iv. a stapled security; and

d. A field that indicates whether there was any capitalisation change for the firm within five days of the ex-dividend date, sourced from the SIRCA "dilutions" (capitalisation change) file.

Summary

64 In summary, the processes that have been used to update the data through to June 2016, and which underpin the results that are set out below, are identical to those that were applied in the SFG 2013 update.

4 Econometric methods

4.1 Primary data set

65 The primary data set is compiled as follows:

a. Begin with the matched sample – the set of ex-dividend events for which all relevant items are consistent across the two independent data bases;

b. Eliminate observations where the stock did not trade on the cum-dividend day or the ex-dividend day;

c. Eliminate observations where there was a capitalisation change within five days of the ex-dividend date;

d. Eliminate observations where the company made an announcement that was classified as price sensitive on the cum-dividend day or the ex-dividend day;

e. Eliminate observations where the company in question had a market capitalisation that was less than 0.03% of the market capitalisation of the All Ordinaries index at the time of the ex-dividend date; and

f. Eliminate observations where the security in question falls into any one of the following categories: stapled securities; shares whose primary listing is overseas; CHESS depositary interests; CHESS units of foreign securities; or exchange-traded funds.

66 The compilation of the primary data set follows the procedures adopted in the 2011 and 2013 SFG studies. The rationale for compiling the primary data set in this manner is to ensure that the required data exists and is timely and reliable and uncontaminated by material events that are unrelated to the payment of the dividend. The objective of this process is to produce a final estimate of theta that is as statistically reliable and precise as possible.

4.2 Econometric Models

67 As in the 2011 and 2013 SFG studies (and in accordance with Paragraph 12 of the 2011 Terms of Reference) the objective is to estimate the parameters of the following model:

$$\frac{P_{i,t-1} - P^*_{i,t}}{D_i} = \delta + \theta \frac{FC_i}{D_i} + \varepsilon_i \qquad (1)$$

where $P_{i,t-1}$ is the cum-dividend stock price for observation i; $P^*_{i,t} = \dfrac{P_{i,t}}{1+r_{m,t}}$ is the market-adjusted ex-dividend stock price (where $r_{m,t}$ is the return on the All

Ordinaries index on day *t*); D_i is the amount of the dividend for observation i; and FC_i is the amount of franking credits associated with observation *i*.

68 The two parameters to be estimated are δ and θ where:

a. δ represents the estimated market value of cash dividends as a proportion of their face value; and

b. θ represents the estimated market value of distributed franking credits as a proportion of their face value.

69 The econometric model in Equation (1) is estimated using regression analysis applied to the final sample (and subsequently to a number of samples used for the purposes of robustness checks and sensitivity analysis). It is estimated using ordinary least squares, generalised least squares and robust regression methods, as in the 2011 and 2013 SFG studies.

70 Generalised least squares estimation involves multiplying all terms in the original econometric model by the same variable. This would be done if the researcher was concerned about a potential relationship between the variance of the residuals (ε_i) and a particular variable. Suppose, for example, that there is a potential relationship between the variance of the residuals in Equation (1) and dividend yield, $\frac{D_i}{P_{i,t-1}}$, such that the variance of residuals is inversely related to dividend yield. This would be the case if the model in Equation (1) provided a closer fit to the data and generally smaller residuals for observations with a higher dividend yield. If this were actually the case, the coefficient estimates in Equation (1) would be consistent and unbiased, but the usual procedures for conducting statistical inference (e.g., *t*-statistics) may be inaccurate.

71 Generalised least squares estimation is designed to eliminate any relationship between the variance of residuals and the variable in question. This is done by scaling every term in the original model by the variable in question. If, for example, all terms in Equation (1) are multiplied by dividend yield, $\frac{D_i}{P_{i,t-1}}$, then Equation (1) becomes:

$$\frac{P_{i,t-1} - P_{i,t}^*}{D_i} \times \frac{D_i}{P_{i,t-1}} = \delta \times \frac{D_i}{P_{i,t-1}} + \theta \frac{FC_i}{D_i} \times \frac{D_i}{P_{i,t-1}} + \varepsilon_i \times \frac{D_i}{P_{i,t-1}}$$

which is equivalent to:

$$\frac{P_{i,t-1} - P_{i,t}^*}{P_{i,t-1}} = \delta' \frac{D_i}{P_{i,t-1}} + \theta' \frac{FC_i}{P_{i,t-1}} + \varepsilon_i' . \tag{2}$$

72 The idea behind generalised least squares estimation in this example is that if the variance of the original residuals (ε_i) is inversely related to dividend yield, the scaled residuals (ε_i') are not related to the dividend yield, and standard statistical inference can be performed (i.e., the *t*-statistics will be correct).

73 Consequently, Equation (2) can be thought of (equivalently) as GLS estimation of Equation (1), where the scaling variable is dividend yield, or as OLS estimation of a model in which the percentage stock return is regressed on dividend yield and franking credit yield.

74 The prior literature (e.g., Michaely, 1991; Bellamy and Gray, 2004) identifies dividend yield and stock return volatility as variables that might be related to the variance of the residuals in Equation (1) and we are not aware of any dividend drop-off analysis that uses GLS scaling variables other than dividend yield and stock return volatility. Other things equal, the magnitude of the residuals may be greater for high-volatility stocks because stock price changes tend to be greater for these stocks. In this case, the relevant GLS adjustment would be to scale by the inverse of the volatility of stock returns for the company in question. This adjustment produces the following econometric specification:

$$\frac{P_{i,t-1} - P_{i,t}^{*}}{D_i \sigma_i} = \delta'' \frac{1}{\sigma_i} + \theta'' \frac{FC_i}{D_i \sigma_i} + \varepsilon_i'' . \tag{3}$$

75 If both GLS adjustments are applied, the econometric specification is:

$$\frac{P_{i,t-1} - P_{i,t}^{*}}{P_{i,t-1} \sigma_i} = \delta''' \frac{D_i}{P_{i,t-1} \sigma_i} + \theta''' \frac{FC_i}{P_{i,t-1} \sigma_i} + \varepsilon_i''' . \tag{4}$$

76 In accordance with the Terms of Reference for the 2011 SFG study (Paragraphs 12 and 14), and consistent with the 2013 SFG study, the four model specifications set out in Equations (1) to (4) above are estimated using OLS regression analysis, noting that the models in Equations (2) to (4) can be thought of as GLS estimates (with different scaling adjustments) of the basic model in Equation (1). Table 1 summarises the four econometric models that are estimated. Even though the four specifications are referred to as "Models" 1 to 4 for convenience, they are actually just different econometric specifications of the one model in which cash dividends and franking credits are posited as the only systematic factors in driving the ex-dividend day change in stock prices.

Table 1: Econometric models to be estimated

Model	Specification	Interpretation
Model 1	$\frac{P_{i,t-1}-P^*_{i,t}}{D_i}=\delta+\theta\frac{FC_i}{D_i}+\varepsilon_i$	Basic model.
Model 2	$\frac{P_{i,t-1}-P^*_{i,t}}{P_{i,t-1}}=\delta'\frac{D_i}{P_{i,t-1}}+\theta'\frac{FC_i}{P_{i,t-1}}+\varepsilon'_i$	GLS estimation of (1) with weighting variable dividend yield, $\frac{D_i}{P_{i,t-1}}$.
Model 3	$\frac{P_{i,t-1}-P^*_{i,t}}{D_i\sigma_i}=\delta''\frac{1}{\sigma_i}+\theta''\frac{FC_i}{D_i\sigma_i}+\varepsilon''_i$	GLS estimation of (1) with weighting variable inverse stock return volatility, $\frac{1}{\sigma_i}$.
Model 4	$\frac{P_{i,t-1}-P^*_{i,t}}{P_{i,t-1}\sigma_i}=\delta'''\frac{D_i}{P_{i,t-1}\sigma_i}+\theta'''\frac{FC_i}{P_{i,t-1}\sigma_i}+\varepsilon'''_i$	GLS estimation of (1) with weighting variables dividend yield, and inverse stock return volatility.

4.3 Estimation results

77 The results of the estimation of the four econometric models are set out in Table 2 below. The key results are:

a. The point estimate of the value of a dollar of cash dividends ranges from 81 cents to 91 cents;

b. The point estimate of the value of a dollar of imputation credits ranges from 14 cents to 38 cents; and

c. The point estimate of the value of the package of a one dollar cash dividend and the associated 43 cent franking credit ranges from 87 cents to 104 cents.

78 Following the 2011 and 2013 SFG studies, two methods are used to estimate standard errors:

a. The White method for computing heteroscedasticity-consistent standard errors (which allows for unspecified heteroscedasticity in the residuals); and

b. A method that allows for clustering at the firm level (i.e., allows for the variance of residuals to differ by firms).[38]

[38] As noted in the 2013 SFG study, we have reason to believe that standard errors vary systematically with firm characteristics, namely higher standard errors for volatile stocks with low dividend yields. We observe a number of firms appearing multiple times in our examination of outliers. Hence, this is our preferred technique for estimating standard errors but we present White's (1984) adjusted

79 The two methods produce standard error estimates that are similar in magnitude and generally indicate that the estimates of the value of cash dividends are significantly less than one and franking credits are significantly greater than zero. The standard errors for the estimated value of a fully-franked dividend (i.e., the package of cash dividend and the associated franking credit) are considerably lower than the standard errors for the estimated values of cash or franking credits separately, meaning there is reliable evidence that the value of one dollar of a fully-franked dividend is approximately one dollar.

80 The R^2 statistics measure how much of the variation in the dependent variable is explained by variation in the independent variables. For Models (2) and (4), the R^2 statistics are substantial – 61% and 73% (respectively) of the variation in the ex-day percentage price change can be explained by variation in the cash dividend and franking credit.39

81 For Models (1) and (3), however, the explanatory power of the cash dividend is moved from the right-hand side of the regression to the left-hand side – the cash dividend appears only on the left-hand side as part of the dependent variable. For these models, the R^2 statistic must be interpreted as a measure of the extent to which the franking percentage (not the amount of credits) is able to explain the ex-day price change – beyond that which can be explained by the cash dividend.

82 That is, for Models (2) and (4) the R^2 statistic measures the combined explanatory power of the cash dividend and the franking credit. For Models (1) and (3) it measures only the incremental explanatory power of the franking credits – the cash dividend is effectively given full opportunity to explain whatever it can of the ex-day price change and the R^2 statistic measures only what the franking credit can explain beyond this. Consequently, it would be wrong to compare R^2 statistics across models or to use them as a basis for selecting a preferred model.

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standard errors for completeness. For a review of estimation techniques for standard errors refer to Petersen (2009).

[39] We refer to the *R*-squared statistic throughout, rather than the adjusted *R*-squared statistic, because the robust regression analysis considered later only generates an *R*-squared statistic and we seek to present explanatory power on a consistent basis throughout.

Table 2: Estimation results: OLS/GLS estimation

Model	Estimate	Standard error (White)	Standard error (Firm clustering)
Model 1			
Cash	0.8412	0.0565	0.0546
Franking credits	0.1729	0.1503	0.1468
Package	0.9153	0.0266	0.0255
R-squared	0.0004		
N	4,690		
Model 2			
Cash	0.8335	0.0301	0.0282
Franking credits	0.3952	0.0787	0.0776
Package	1.0029	0.0140	0.0167
R-squared	0.6079		
N	4,690		
Model 3			
Cash	0.9085	0.0362	0.0365
Franking credits	0.2391	0.0958	0.0979
Package	1.0110	0.0172	0.0184
R-squared	0.0014		
N	4,690		
Model 4			
Cash	0.9138	0.0188	0.0187
Franking credits	0.3610	0.0535	0.0559
Package	1.0685	0.0120	0.0145
R-squared	0.7320		
N	4,690		

Cash represents the estimated value of a one dollar cash dividend; Franking credits represents the estimated value of a one dollar franking credit; Package represents the estimated combined value of a one dollar cash dividend plus the associated 43 cent franking credit. The package value is estimated as the sum of the cash coefficient and 0.43 times the franking credits coefficient. The standard error for the package estimate is computed as a function of the standard errors of the cash and franking credits coefficients, and the correlation between them.

4.4 Robust regression estimates

83 In accordance with the Terms of Reference (Paragraphs 12 and 14) for the 2011 SFG study, and with the approach adopted in the 2013 SFG study, the four models set out in Equations (1) to (4) above are also estimated using robust regression analysis. Robust regression analysis uses automated statistical adjustments to down-weight the influence of extreme data points or outliers. The SAS[40] procedure ROBUSTREG to implement the MM robust regression method. The MM method was developed by Yohai (1987) and accounts for imprecision in the dependent and independent variables. Of the four alternative techniques available in the ROBUSTREG procedure it provides the most

[40] SAS is a statistical programming language.

comprehensive analysis of outliers. The application of these methods in the SAS package is explained in detail in Chen (2002).

84 When implementing the MM robust regression method in SAS, the user is able to over-ride default values and impose values for certain parameters. For example, the INEST option allows the user to impose a prior expectation for the values of the regression coefficients, rather than using values from a first stage estimation procedure. The results set out below are based on the default (neutral) values for all options.

85 The results of the estimation using the ROBUSTREG-MM procedure are summarised in Table 3 below. The estimates of theta for Models 2 and 4 are similar to those reported in Table 2 above. The robust regression estimates of theta for Models 1 and 3 are higher than the estimates in Table 2, and more consistent with the estimates from Models 2 and 4.

86 The ROBUSTREG procedure available in SAS does not permit the calculation of White heteroscedastic-consistent standard errors or standard errors based on firm clustering. The procedure only allows for estimates of the standard covariance matrix of parameters. The result is that the "regular" standard errors in Table 3 are lower than the heteroscedastic-consistent and firm clustering standard errors reported in Table 2. This should not be seen as an improvement in the precision of estimates, but rather that a different definition of standard error is being reported.

Table 3: Estimation results: Robust regression

Model	Estimate	Standard error
Model 1		
Cash	0.8999	0.0268
Franking credits	0.2863	0.0717
Package	1.0312	0.0140
R-squared	0.0021	
N	4,690	
Model 2		
Cash	0.9066	0.0208
Franking credits	0.3571	0.0561
Package	1.0599	0.0113
R-squared	0.5333	
N	4,690	
Model 3		
Cash	0.9200	0.0196
Franking credits	0.3034	0.0523
Package	1.0131	0.0102
R-squared	0.0035	
N	4,690	
Model 4		
Cash	0.9340	0.0144
Franking credits	0.3952	0.0386
Package	1.1036	0.0077
R-squared	0.6712	
N	4,690	

Cash represents the estimated value of a one dollar cash dividend; Franking credits represents the estimated value of a one dollar franking credit; Package represents the estimated value of a one dollar cash dividend plus the associated 43 cent franking credit.

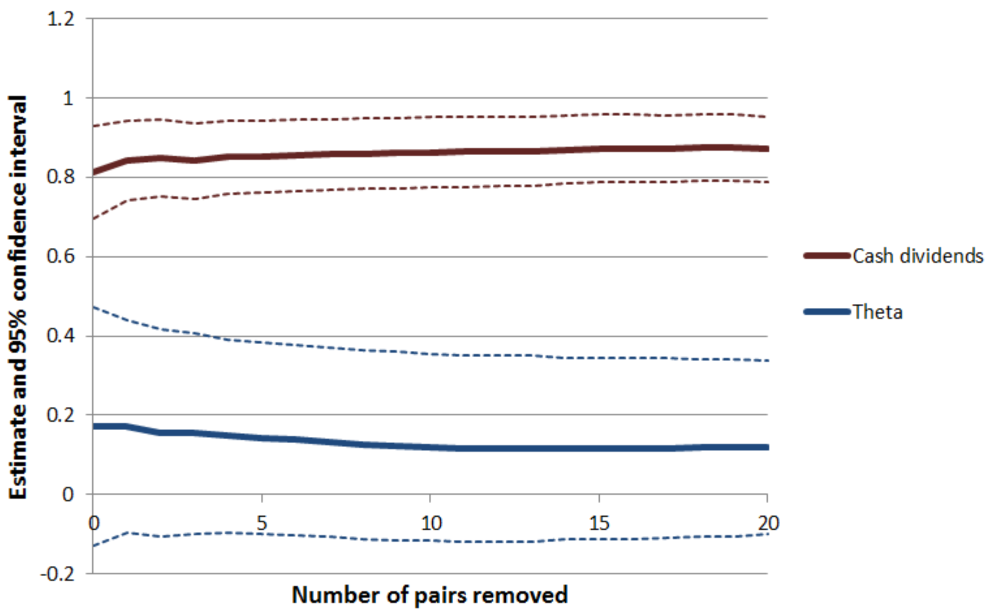
4.5 Stability analysis: Robustness to influential observations

87 The data compilation methods set out above (e.g., eliminating from the sample very small firms or firms that do not trade on the cum-dividend and ex-dividend dates) are designed to eliminate outlier data points that may be erroneous in some respect and which are likely to have a disproportionate influence on the estimate of theta. Even after having performed this screening and checking process, it is inevitable that some of the remaining data points will be more influential than others. Consequently, the 2011 and 2013 SFG studies conduct a stability analysis to quantify the sensitivity of the estimates of theta to influential observations. This is done by first determining which single observation, if removed, would result in the greatest increase in the estimate of theta. The next step is to determine which single observation, if removed, would result in the greatest decrease in the estimate of theta. Then both observations are removed and theta is re-estimated. This process is then repeated by removing another pair

of observations and the process continues until 20 pairs of observations have been removed.[41]

88 The results of applying this stability analysis to Model 1 are summarised in Figure 1. The solid lines represent the estimates of the value of cash dividends and theta, as indicated. In each case, the corresponding dashed lines represent the 95% confidence intervals around the point estimates.

Figure 1: Sensitivity to removal of influential observations: Model 1



89 Figure 1 shows that the original point estimate of theta from Model 1 was 0.17. When the first pair of observations (i.e., one observation that would maximally increase the estimate of theta and one that would maximally decrease the estimate of theta) is removed, there is a negligible change in the point estimate of theta. As further pairs of observations are removed, the point estimate of theta falls marginally before levelling off at approximately 0.12.

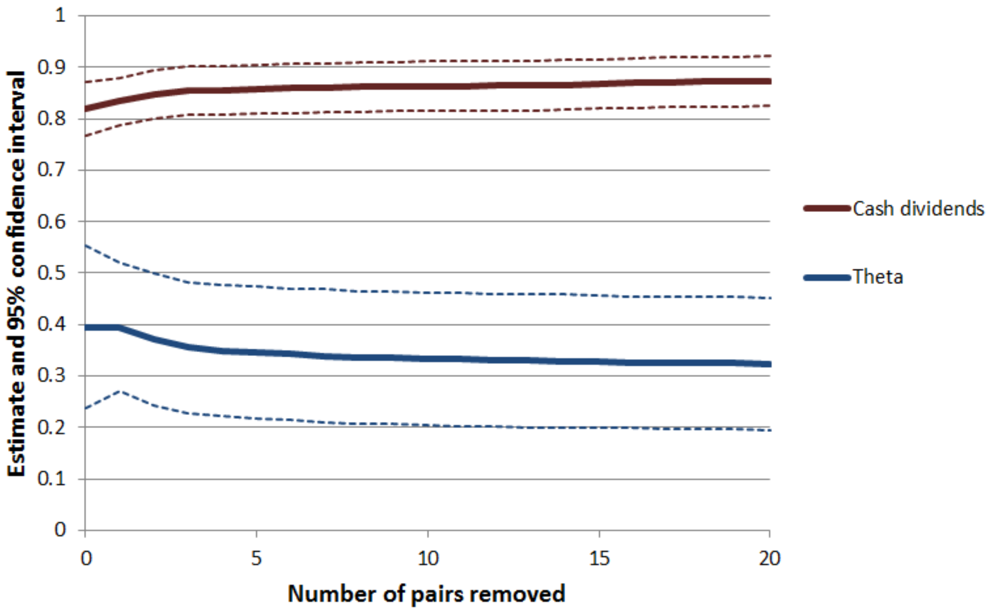
90 The point estimates of the value of cash dividends move in the opposite direction. As pairs of influential observations are removed, the estimate increases slightly before settling at approximately 0.87.

91 The combined value of dividend plus franking credit is stable throughout, taking a constant value (between 0.907 and 0.927) whether the influential observations are included or excluded.

92 The result of applying the same process of removing pairs of influential observations to Model 2 is summarised in Figure 2 below. These results are similar to those for Model 1 above. The point estimate of theta falls slightly as the first pairs of influential observations are removed before stabilising at a constant level – approximately 0.31 in this case.

[41] We remove the observations in pairs to aid in the interpretation of the figures below. If the observations were removed one at a time, the estimate of theta would rise or fall with each data point that is excluded producing a jagged graph making it more difficult to interpret.

Figure 2: Sensitivity to removal of influential observations: Model 2



93 The stability analysis for Models 3 and 4 are set out in Figure 3 and Figure 4 respectively.

Figure 3: Sensitivity to removal of influential observations: Model 3

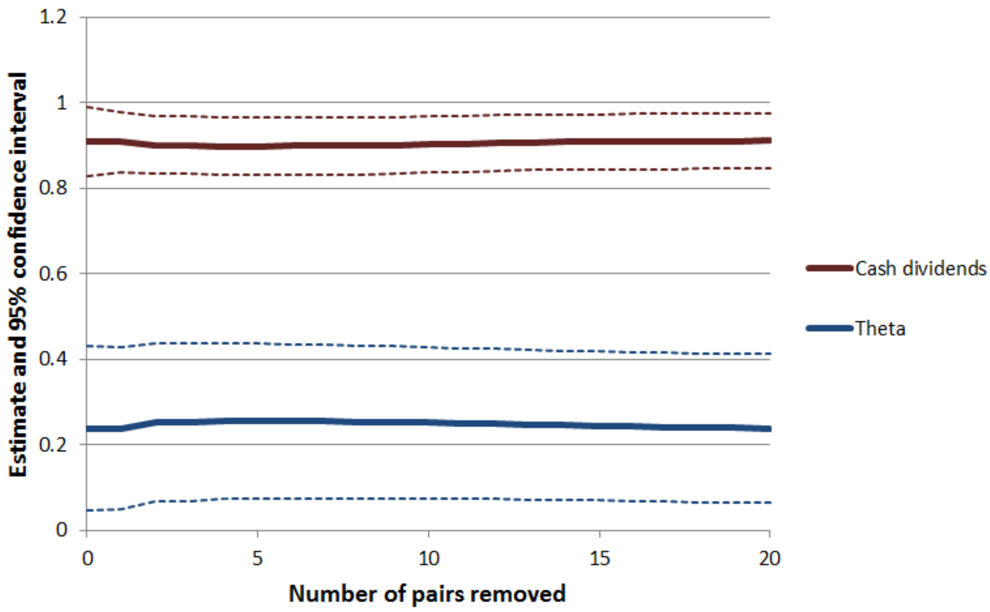
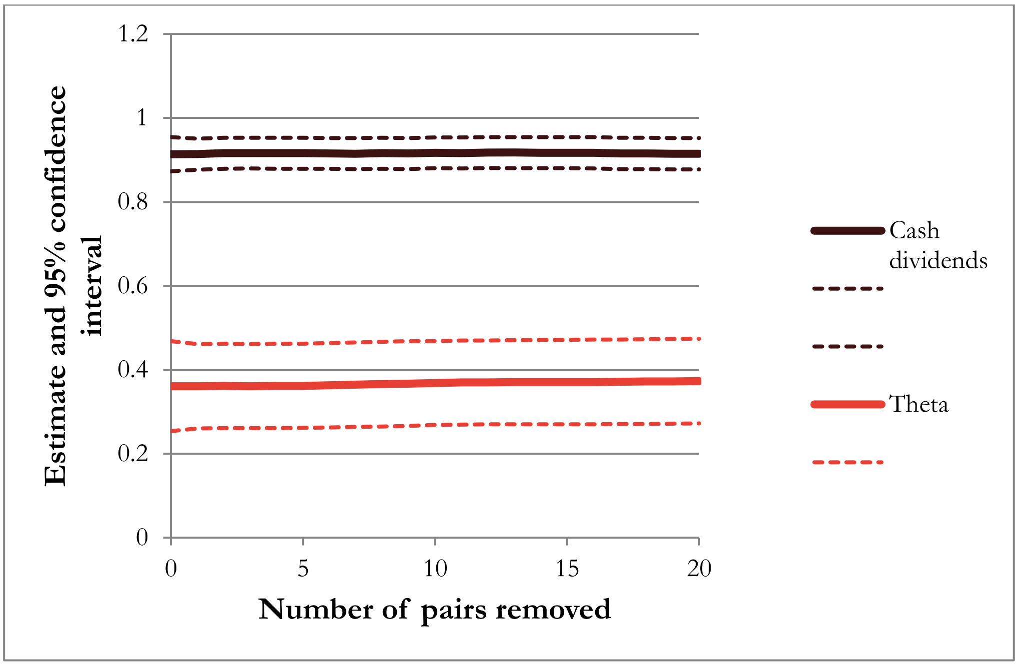


Figure 4: Sensitivity to removal of influential observations: Model 4



94 The stability analysis for Model 4, in Figure 4 above, shows that the estimates of the value of cash dividends, the value of theta, and the value of the combined package are very stable and robust to the removal of pairs of influential data points. That is, the estimates from Model Specification 4 are less sensitive to the effects of influential observations.

95 In summary, the stability analyses demonstrate that the estimates of theta are either maintained or slightly lowered when pairs of influential observations are removed from the data set.

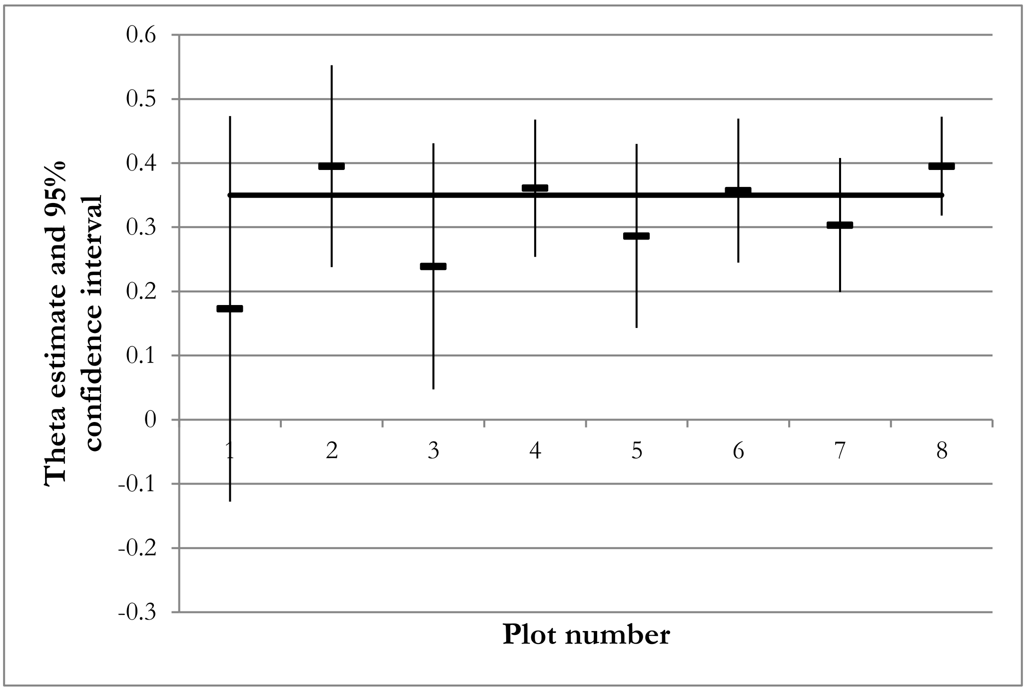
4.6 Sensitivity analysis

96 In this section, the sensitivity of the results to variations in the model specifications and estimation methods is examined. In each case, our preferred estimate of 0.35 from the current study is compared with the point estimates and confidence intervals from the various econometric specifications.

0.35 is consistent with results from different model specifications and estimation techniques

97 We begin by noting that our preferred final estimate of 0.35 lies within the standard statistical 95% confidence interval for all of the specifications. The range of overlap in the confidence intervals is from 0.26 to 0.41, which has a mid-point of 0.34. This is illustrated in Figure 5 below, which plots estimates for Model Specifications 1-4 estimated by OLS/GLS (Plots 1-4 in the figure) and then the corresponding robust regression estimates (Plots 5-8 in the figure). For none of these estimations can the proposed estimate of 0.35 be statistically rejected.

Figure 5: Summary of point estimates and confidence intervals for theta by model specification and estimation technique



For each estimate, the narrow line represents the 95% confidence interval for theta and the solid black marker represents the point estimate. The solid black horizontal line represents the recommended point estimate of 0.35.

Plot 1: Model specification 1, OLS estimation;

Plot 2: Model specification 2, OLS estimation;

Plot 3: Model specification 3, OLS estimation;

Plot 4: Model specification 4, OLS estimation;

Plot 5: Model specification 1, RR estimation;

Plot 6: Model specification 2, RR estimation;

Plot 7: Model specification 3, RR estimation;

Plot 8: Model specification 4, RR estimation.

5 Conclusions

98 This report summarises the results of updating the 2011 and 2013 SFG reports using the most recently available data. All of the procedures for compiling the data set and performing the statistical analysis that are set out in this report follow the approach adopted in the 2011 and 2013 SFG reports. This report simply summarises the results that are obtained from applying the same methods to an updated data set through to June 2016.

99 In our view, the analyses set out above support a point estimate for theta of 0.35. For none of these estimations can the proposed estimate of 0.35 be statistically rejected. Although the estimates from some of the econometric specifications have point estimates well below 0.35, we place more (but not exclusive) weight on the Model 4 specifications that are uniformly very close to 0.35.

6 Declaration

100 I confirm that I have *made all the inquiries that* I *believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld from the Court.*

Professor Stephen Gray

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