

REPORT TO AER

EVIDENCE AND SUBMISSIONS ON GAMMA

MICHAEL MCKENZIE

AND GRAHAM PARTINGTON

ON BEHALF OF

THE SECURITIES INDUSTRY RESEARCH CENTRE OF
ASIA-PACIFIC (SIRCA) LIMITED

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Table of Contents

Executive Summary	3
Background	6
Introduction	7
Conceptual Issues	9
Ex-Dividend Studies and Taxation Studies.....	9
Issues in Ex-Dividend Studies	11
<i>Observability and Allocation</i>	12
<i>Noise in the Data</i>	14
<i>Clean Results</i>	15
<i>Measurement Errors</i>	18
<i>Confounding Events and Tax Changes</i>	20
<i>Partitioning and Filtering</i>	22
<i>Time Clustering</i>	23
The Interpretation of Ex-Dividend Studies.....	24
The Payout Ratio and Undistributed Franking Credits.....	25
Franking Credits and Market Practice	27
The Value of Cash Dividends	29
Econometric Issues	32
Background.....	32
Data Issues.....	33
<i>Accuracy of the Data</i>	33
<i>Issues Related to the Filtering of the Data</i>	34
Estimation Issues.....	43
<i>Heteroscedasticity</i>	43
<i>Multicollinearity</i>	44
<i>Point Estimates</i>	47
<i>Significance of the Parameter Estimates</i>	47
<i>Treatment of Outliers</i>	49
<i>The Regression Intercept</i>	50
Bibliography	51
Curriculum Vitaes	53
Professor Michael McKenzie	53
Associate Professor Graham Partington	59

REPORT TO AER

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EXECUTIVE SUMMARY

In this report, we provide a discussion of the conceptual issues related to the estimation of gamma as well as an overview of the econometric issues that result from the estimation of theta in dividend drop off studies.

The report initially focuses on the two main ways in which gamma has been determined. The first approach is the use of dividend drop off studies. This technique brings with it a host of issues related to the problem of estimating the value of the package of cash dividend and franking credit and splitting the package into its components for the purposes of estimation. In particular the presence of noise in the data and measurement errors present severe problems in generating reliable estimates of the variables of interest. These data problems mean that it is common in ex-dividend studies to engage in some form of data filtering and also to partition the data into various samples, which brings with it many issues related to selection criteria and representativeness of results. The second approach is to estimate gamma using taxation data. Such taxation studies present an entirely different set of measurement problems and their indirect approach to estimating gamma makes them intuitively less appealing.

Given the problems inherent in estimating gamma using either taxation or ex-dividend studies, we argue in favour of a balanced approach. Since the best estimation techniques are beset with problems, the most logical approach is to consider the evidence on balance across all available sources. In this respect the AER's approach of considering both ex-dividend and taxation statistics

has merit, but we would recommend a broader range of studies to triangulate the evidence considered by the AER. Relying on one study, such as that of the Strategic Finance Group (SFG), or one type of study, such as ex-dividend studies, would not be appropriate.

Triangulation of the evidence relating to the value of dividends and credits distributed would suggest that the gamma value supplied by SFG is substantially on the low side while the gamma value determined by the AER tends to the high side, but much more evidence can be adduced to support the AER's gamma value. However, a precise estimate of gamma remains elusive both because of econometric problems and the fundamental problem of splitting the combined value of dividends and franking credits into its component parts.

One way round the econometric problems is to assume a value for the cash component of the dividend and then take the balance left over to be the value of the credit. The problem with this approach is that the value of the cash dividend is an open question. However, the Australian evidence tends to support the view that dividends are valued at less than their face value. A value of about \$0.80 per dollar of face value would be a reasonable reflection of this evidence.

In order to value the credits created it is necessary to estimate the value of undistributed franking credits. This is a very difficult task and there has been a tradition of treating undistributed credits as worthless. Thus, gamma is often estimated by multiplying the value of credits distributed by the actual payout ratio for imputation credits. In our opinion, this approach is incorrect as we believe that undistributed credits are not worthless. Consequently, the payout ratio used should be above the actual payout ratio. The payout ratio should therefore be set to lie between the historical payout of about 70 percent and the upper limit of 100 percent.

The latter part of this report focuses on the econometric issues associated with the estimation of gamma in the context of dividend drop off studies. We reviewed the analysis of SFG, whose data and code we were provided with and we discuss three main problem areas.

The first such area relates to the accuracy of the data. All data will inevitably contain some element of error and we argue that the best dataset available should be chosen for analysis and cross referenced to other known sources for the purposes of validating the accuracy of observations.

The second area of concern for empirical studies relates to the filtering of the data. Specifically, many of the filters are applied in an ad-hoc fashion and while they may be implemented to achieve some goal, they are not achieving this in practice. In particular, we find the issues of zero drop off ratios and the discreteness of stock prices to be two important issues that have been largely overlooked in dividend drop off studies.

The final area of concern for dividend drop off studies relates to the econometric issues surrounding the estimation of the regression equations. In particular, the issue of multicollinearity dominates as there is a perfect linear relationship between the size of the cash dividend and the franking credit. The only reason why singularity is not a problem in the estimation equation, is because of changing tax regimes and the inclusion of unfranked and less than fully franked dividends in the sample. The multicollinearity results in large standard errors, and this severely limits the extent to which it is possible to interpret the estimated regression coefficients.

We conclude that the problems inherent to dividend drop off studies only serve to reinforce our view that a logical approach to estimating gamma is to consider the evidence on balance across all available sources and not rely on any one individual source.

BACKGROUND

We have been asked to evaluate the determination of gamma (the market value of imputation credits created) as used by the AER for the purposes of economic regulation. Specifically, our instructions were to undertake an analysis of the estimation of gamma from dividend drop-off studies and an analysis of the arguments presented by the AER and those raised in the submissions of the following DNSPs:

- The NSW/ACT gas DNSPs of ActewAGL, Country Energy and Jemena Gas Networks.
- The QLD/SA electricity DNSPs of Energex, Ergon Energy and ETSA Utilities.
- The VIC electricity DNSPs of CitiPower, Jemena Electricity Networks, Powercor, SP AusNet and United Energy.

The focus of this report is on gamma in the context of a given valuation model and capital asset pricing model. In the course of this evaluation we have consulted the following documents:

- SFG, Further analysis in response to AER Draft Determination in relation to gamma: Prepared for ETSA Utilities (4 Feb. 2010)
- SFG, Gamma: Further Evidence to Support Departure from the AER's Statement of Regulatory Intent: Report prepared for ENERGEX and Ergon Energy (7 Dec. 2009)
- SFG, The value of imputation credits as implied by the methodology of Beggs and Skeels (2006): Report prepared for ENA, APIA, and Grid Australia (1 Feb. 2009)
- SFG, The impact of franking credits on the cost of capital of Australian companies: Report prepared for ENA, APIA and Grid Australia (16 Sept. 2008)
- SFG, The impact of franking credits on the cost of capital of Australian companies: Supporting evidence submitted to the Australian Energy Regulator. (12 Nov. 2008)

- SFG, Response to AER Draft Determination in relation to gamma: Report prepared for ETSA Utilities (13 Jan. 2010)
- C. Skeels, Response to Australian Energy Regulator Draft Determination (13 Jan. 2010)
- C. Skeels, A Review of the SFG Dividend Drop-Off Study (28 Aug. 2009)
- J. Field, Reliability of data used in dividend drop off study (5 Jan. 2010)

EXPERT WITNESS COMPLIANCE DECLARATION

We have been provided with a copy of *Expert witnesses in proceedings in the Federal Court of Australia* and this report has been prepared in accordance with those guidelines. As required by the guidelines we have made all the inquiries that we believes are desirable and appropriate and that no matters of significance that we regard as relevant have, to our knowledge, been withheld from the Court.

INTRODUCTION

Our starting point for discussion is the observation that the AER is attempting to estimate gamma, the market value of one dollar of franking credits created, or equivalently the ratio of market value to face value. To do this, the AER is utilising the historical evidence on gamma from both taxation statistics and ex-dividend studies. We have been asked to review the AER's approach to the estimation of gamma, particularly the use of ex-dividend studies, and submissions to the AER in relation to that estimate. The most extensive of these submissions in both content and number have been prepared by SFG. We subsequently use the generic term SFG to refer to their collective submissions.

Gamma is commonly taken to be the product of two elements, the proportion of credits created that are distributed and the market value of the credits distributed. This approach is followed by the AER and in the submissions from the DNSPs. The market value of franking credits distributed as a proportion of face value is sometimes referred to as theta and sometimes as the utilisation factor. In

Officer (1994), a paper which is frequently referred to by regulators, the utilisation factor and the market value of imputation credits are defined to be the same. However, as SFG point out the utilisation factor and the market value of imputation credits (θ) are not necessarily the same. It is reasonable to expect that they are positively related. However, the market value of franking credits may be lower, or higher, than the utilisation factor.

The proportion of credits created that are distributed is called the access fraction, or payout ratio. It is important to note that this payout ratio is the imputation credit payout ratio not the dividend payout ratio. The common presumption is that if the payout ratio is less than one hundred percent the undistributed franking credits are worthless. As we discuss later, this presumption causes significant problems in the Officer (1994) framework. We also think that it is unlikely to be true. To understand why, consider two firms which are identical in every respect except that firm A has a franking account balance of zero and firm B has a franking account balance of \$100 million. If undistributed franking credits are worthless then firm B must have the same value as A. It is difficult to believe that firm A and firm B will have the same value because it seems very unlikely that the managers would squander up to \$100 million in value and that arbitrageurs would leave this much potential profit on the table.

In this report, a major focus is on the estimation of θ from ex-dividend studies. The problems in such studies can be simply stated. First, we want to obtain an accurate measurement of the combined package value of dividends and franking credits. This is difficult as there are many confounding effects and the data is extremely noisy. Second, we need to split the value of the package into the value of the franking credit and the value of the dividend. This task is also extraordinarily difficult, and to date has proven to be impossible to accomplish with precision. Both of these are intractable problems and the estimates of θ obtained from ex-dividend regressions should be viewed with a healthy degree of scepticism.

Our report conveniently divides into two main parts. The first part deals with important conceptual matters and some of the major estimation issues that need to be understood. The second part deals with specific econometric matters arising from the documents that we have reviewed and the data that we have analysed.

CONCEPTUAL ISSUES

EX-DIVIDEND STUDIES AND TAXATION STUDIES

One of the key issues to arise in the submissions to the AER is whether or not studies of taxation statistics and ex-dividend studies should be considered jointly in determining gamma, or whether it is preferable to consider ex-dividend studies alone. In particular, whether, as some of the DNSPs argue, gamma should be set with regard to the results of one ex-dividend study, that of SFG. In our judgment both taxation statistics and ex-dividend studies can supply useful evidence on whether the value of gamma is positive. This is a view that is clearly shared with Hathaway and Officer (2004).

Ex-dividend studies and taxation studies however, both have limitations. Ex-dividend studies have substantial measurement and estimation issues and they involve analysis of trades in a restricted window. Taxation studies present results that apply across a broad sweep of investors, but they are subject to measurement problems (this has proven to be less of an issue since the introduction of the simplified tax system). Furthermore, the link between taxation statistics and the market value of imputation credits remains indirect. Therefore, neither type of study is likely to provide an accurate and definitive estimate of gamma on its own. Given the uncertainty surrounding the estimates of gamma, we argue that it is preferable to consider evidence from multiple sources. This means

considering results from both types of study and, where multiple studies of the same type are available, considering the results across these studies.

Consideration of multiple ex-dividend studies will show that, even when using the same or similar data, the estimates of theta can vary considerably, depending on the particular specification of the regression equation and technique used to estimate the regression. Estimates of theta also vary depending on how the data is filtered and how it is partitioned into sub-samples. For example, when Truong and Partington (2006) examine ex-dividend data from 1995 to 2005, they use several regression models with minor differences in specification and include controls for tax changes. They estimate each model using OLS, GLS and robust regression. They also partition the data into subsamples of fully franked, partially franked and unfranked dividends. The resulting estimates of theta range from 0.32 to 1.14. Much less variability is observed for the combined value of the package of dividends and franking credits. For fully franked dividends, the value ranges from 120 percent to 131 percent of the face value of the cash dividend. For unfranked dividends it ranges from 71 percent to 99 percent.

The value of the combined package of dividends and franking credits in Truong and Partington (2006) is higher than in most ex-dividend studies. For fully franked dividends this value tends to cluster around 100% of the face value of the dividends and for unfranked dividends it tends to cluster around 80%. We emphasise, however, that this is not a precise or universal result.

Even given identical estimates of the value of fully franked dividends, estimates of theta may vary substantially depending on how the package of dividends and franking credits is split up into its component values. Indeed, Cannavan, Finn and Gray (2004, p175) conclude: “... *it is unlikely that the traditional ex-dividend day drop-off methodology will be able to separately identify the value of cash dividends and imputation credits.*” A similar conclusion is reached in Bellamy and Gray (2004) who study the problem

of multicollinearity between the value of cash dividends and franking credits. We agree that multicollinearity is a serious problem and we point to a further problem, the allocation problem as identified in Partington (2007) and Dempsey and Partington (2008). We discuss the allocation problem in detail later.

It is clear that a precise and unambiguous valuation of theta is unlikely to be derived from traditional ex-dividend studies. It would be unwise, therefore, to rely on one ex-dividend study to determine theta. Equally, it would be unwise to just rely on combining results across several ex-dividend studies; triangulation with other evidence is desirable. Taxation statistics are one source of such evidence. Extensively canvassing other sources of evidence lies beyond our brief, but we think it worthwhile to observe that the Beggs and Skeels (2006) ex-dividend estimate, used by the AER, is closely triangulated by the estimate of Cummins and Frino (2008). This latter estimate is based on the analysis of the price difference between the ASX index futures and the basket of underlying stocks.

ISSUES IN EX-DIVIDEND STUDIES

The estimation of the market value of the combined package of dividends and franking credits is a prerequisite to determining theta. This estimate is often expressed as the drop-off ratio, which is defined as the change in the share price on the ex-dividend day divided by the dividend. We make considerable reference to the drop-off ratio in the discussion below since calculation of the drop-off ratio is the usual starting point for ex-dividend studies. Note that the drop-off ratios we refer to are computed with reference to the cash dividend, not the dividend grossed up for franking credits.

It is common, in ex-dividend studies, to also derive an estimate of dividend value using regression analysis. SFG refer to the regression estimate as the drop-off ratio. We will call such estimates regression estimates of the drop-off ratio, or regression estimates of market value. These regression estimates of market value can be somewhat different from the simple drop-off ratio (change in the

share price on going ex-dividend divided by the dividend). In a simulation study, Bellamy and Gray (2004) find that the regression estimates, in particular generalized least squares estimates, of the drop-off ratio are more accurate. However, regression suffers from a potentially serious drawback in ex-dividend studies as it is not robust to the presence of outliers in the data. Ex-dividend data, such as the SFG data, contains a high proportion of outliers. We therefore suggest that regression estimates of theta should include estimates derived from robust regression methods, such as MM estimators. Such estimators are robust to the presence of outliers and have the asymptotic properties of maximum likelihood estimators. They also have the advantage that data is not discarded; rather observations are reweighted according to a well defined statistical procedure, so that each data point has approximately the same influence on the fit of the regression.

OBSERVABILITY AND ALLOCATION

Once the market value of the combined package of dividends and franking credits has been obtained, it is then necessary to split that value into the market value of dividends and the market value of franking credits. There are substantial problems in both estimating the value of the package and splitting it into its components. This is of relevance to SFG's arguments about the advantages of *observability* in ex-dividend studies relative to studies of taxation statistics.

SFG make the point that in ex-dividend studies, as opposed to studies of taxation statistics, there is a direct attempt to measure the *market value* of dividends and franking credits. Furthermore, this is based on observable market prices. These are advantages, but we should be careful not to overstate them. As will become evident in the discussion below, in most ex-dividend studies, we cannot clearly observe the combined market value of dividends and franking credits as this measurement is confounded by other effects. We cannot, even in principle, observe the traded value of franking credits, because they are not separately traded. They come in a package with dividends. To split up

the package we must make some assumptions. Depending on which assumptions we make, we will get different values for theta. This is known as the allocation problem.

The market value of a franked dividend on the ex-dividend date consists of a package that embeds the dividend, the franking credit, income taxes, capital gains taxes, discounting for the effect of time, and possibly some transactions costs. This can be seen in simple models of the ex-dividend drop-off ratio as in Elton and Gruber (1970) or more comprehensive models under imputation such as Walker and Partington (1999a). The problem is how to allocate the income taxes, capital gains taxes, and so on between the value of the cash dividend and the value of the credit.

Cannavan, Finn and Gray (2004) address the allocation problem by allocating a dollar to the value of the cash dividend and anything leftover to the value of the franking credit. They estimate that the value of franking credits is zero following the introduction of the 45 day rule. Walker and Partington (1999a) separate out the effect of taxes, transactions costs and discounting, so that they are removed from the estimate of franking credit value. This estimate is in the spirit of the utilisation rate for franking credits as in the Officer (1994) paper.¹ Walker and Partington estimate the franking credits to be worth up to 96% of their face value. Of course the difference between Cannavan, Finn and Gray's estimate of 0% versus 96% for Walker and Partington is not just due to the different methods of allocation, but allocation drives a substantial part of the difference.

Most ex-dividend studies implicitly use the value of unfranked dividends as the benchmark value for the cash component of the dividend. It has to be assumed that the only systematic differences in ex-dividend price changes, between the shares with different levels of franking, are caused by the level of franking. This is not a trivial assumption. For example, if fully franked dividends are more subject

¹ It does not however allow for the impact of the payout ratio.

to dividend arbitrage (as it seems they are), then transactions costs will impact more heavily on the value of franked dividends than on the value of unfranked dividends.

In particular, it must be assumed that the cash component of both franked and unfranked dividends are valued the same. However, franked and unfranked dividends are taxed differently. The consequence for allocation is that income and capital gains tax effects get split between the cash dividend and the franking credit. It is also an open question whether stocks with franked and unfranked dividends attract the same clientele of investors. Different investor clienteles may value the cash component of the dividends quite differently.

The allocation assumptions may be explicit or implicit, either way some model of cash dividend and franking credit valuation underpins the analysis and the assumptions made will affect the estimated value of theta. There is also the choice of regression model to estimate separate market values for dividends and franking credits and this choice will also affect the values obtained. In short, even in an ex-dividend study the value obtained for theta is dependent on the assumptions of a model and choice of estimation method. We are not just relying on observability. The list of assumptions may be smaller and the train of causal logic shorter than when estimating theta from taxations statistics, but both are still present nonetheless.

NOISE IN THE DATA

Clearly it is unreasonable that a dividend should have a market value of zero or less. Under the 36% corporate tax regime, the grossed up value of a dollar of fully franked dividends was \$1.56, so we might take this as an upper bound on the market value of dividends. However, the theoretical upper limit on the market value of one dollar of fully franked dividends is \$2.44, see Chu and Partington

(2001).² We might, therefore, expect that the observations of ex-dividend drop-off ratios should not lie much outside the range 0 to 2.5. The reality is that a range of plus or minus 50, or more, outside of these bounds is common in ex-dividend drop-off studies. For example, in the full SFG data supplied to AER, this range is -60 to 575 and after filtering using their SAS code this range is from -60 to +55.

The outliers reflect the noise in ex-dividend data caused by the overnight price movement, which can easily swamp the value of the dividend.³ Thus, the observation of the value impact of dividends is confounded by the value impact of other, often larger, value changing events. Large price movements on small dividends lead to a low signal to noise ratio and heteroscedasticity.

The noise in the data causes problems in estimating the value of dividends and theta. The standard errors of the estimates are large, particularly for theta, and outliers can bias the results. Much more precise estimates of dividend value can be obtained when there is no overnight price change to cloud the data.

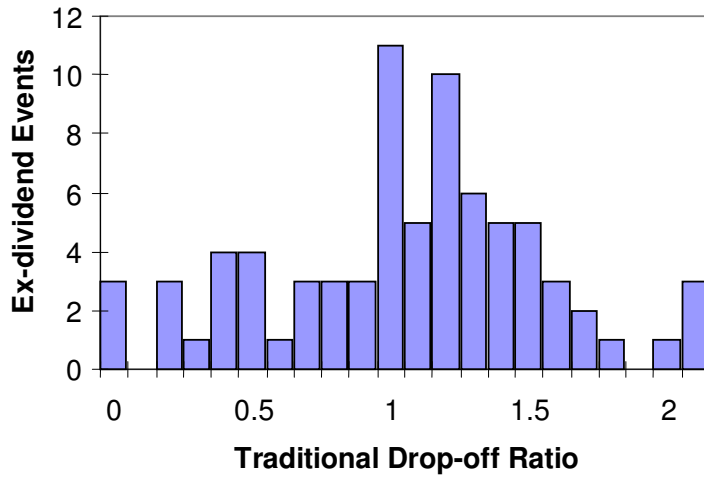
CLEAN RESULTS

Studies that avoid the problem of overnight price changes are Walker and Partington (1999a,b) and Halbert (2003). These authors study stocks trading cum-dividend in the ex-dividend period and they match cum-dividend and ex-dividend trades to no more than one minute apart. Consequently, the prices compared are formed on information sets that differ at most by one minute's content. A particular advantage of this approach is that no adjustment for market movements or information releases is required. Comparing the results with traditional ex-dividend studies the results are much cleaner as can be seen by comparing Figures 1 and 2 from Walker and Partington (1999a).

² While theoretically feasible this value is unlikely in practice.

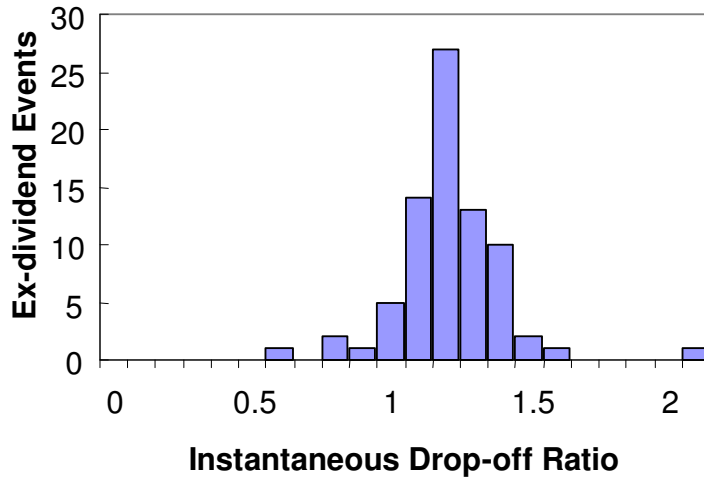
³ Since many studies use close to close prices the time gap is often overnight plus a full day's trading.

Figure 1
Traditional Drop-off Ratio



Source: Walker and Partington (1999a)

Figure 2
Instantaneous Drop-off Ratio



Source: Walker and Partington (1999a)

Figure 2 shows, for fully franked dividends, the drop-off ratio when the cum-dividend and ex-dividend prices are observed only a minute apart. Notice that the overwhelming majority of observations lie between the value of the cash dividend \$1 and the grossed up value of the dividend \$1.56. Figure 1 shows the results for the same ex-dividend events, but using the approach of a traditional ex-dividend study. It is clear that the observations in Figure 1 are considerably more

variable than in Figure 2. Even so, the results for Figure 1 are much cleaner than in most traditional ex-dividend studies. The explanation for this lies in a relatively small sample of mostly large high dividend yield companies and the exclusion of all ex-dividend events where, due to holidays and weekends, the cum-dividend and ex-dividend prices were not observed on successive calendar days. This filter eliminated 17 percent of the sample, which suggests that the effect of holidays and weekends in traditional ex-dividend studies may be substantial.

Comparing Figures 1 and 2, it is clear that the mean drop off ratio is higher in Figure 2 than Figure 1 (1.18 v 0.96). The three studies, Walker and Partington (1999a,b) and Halbert (2003), progressively extend the period observed until coverage extends from 1995 to June 2003. The drop-off ratio is similar across studies at about 1.20. This suggests a substantially higher value for theta than is derived from traditional ex-dividend studies. Indeed, Walker and Partington (1999a) estimate theta to be between 0.88 and 0.96. However, they note that their estimate of theta is a provisional estimate. This is because of the difficulty in splitting up the package of dividends and franking credits and because the value for theta is conditional on the particular allocation method they use. It is clear, however, that the cleanest ex-dividend results available imply a higher franking credit value than that estimated from traditional ex-dividend studies such as the SFG study, or Beggs and Skeels (2006).

The results of Walker and Partington (1999a,b) and Halbert (2003), are based on thousands of trades. Halbert (2003) the most comprehensive of the studies, used 4280 matched pairs of trades, representing 279 ex-dividend events. However, the number of companies involved in these studies is not large (82 companies in the case of Halbert, 2003). These companies tend to be large liquid stocks and whether the results can be generalized to other stocks is an open question.⁴ There is also the question of whether the investors trading are representative of investors in general, as trades seem to

⁴ Hathaway and Officer (2004) favour estimates of theta based on large stocks in their traditional ex-dividend study. This is because the measurement issues are less severe for large stocks.

arise from dividend arbitrage and from option settlement requirements. However, the generalisation of traditional ex-dividend studies is also open to question, on the evidence of abnormal trading across the cum-dividend and ex-dividend dates, reflecting dividend arbitrage.

MEASUREMENT ERRORS

Various types of measurement errors can arise in the use of ex-dividend data. Some of the measurement errors are just noise arising from confounding events, but some measurement errors can lead to bias. For example, stocks simultaneously going ex-bonus and ex-dividend can lead to an upward bias in the drop-off ratio. Careful researchers are well aware of the issues caused by such capitalisation events and two solutions are possible. One is to use capitalisation adjusted prices. The problem here, as Chu and Partington (2001) show in the context of rights issues, is that alternative adjustment procedures are possible and, depending on which is chosen, significantly different results can arise. The other solution is to delete cases with capitalisation changes as SFG do. The issue here is filtering, which we discuss later.

Hathaway and Officer (2004) point to an abnormally high incidence of zero drop-off ratios in their data. This is a common feature in ex-dividend data. Stale prices are an obvious explanation for such zero observations. When no trades are observed on the ex-day the price is unchanged and the apparent return is zero. SFG state that in their study they only consider observations where there is a trade on the ex-dividend day, but we are uncertain whether they also require there to be a trade on the cum-dividend day. If not, stale cum-dividend prices may be a confounding factor in their analysis.

There are an abnormally large number of zero drop-off ratios in the SFG data. In their original set of 5646 observations there are 526 observations of zero, or a little over 9% of the sample. Even after their data filters are applied and the sample is reduced to 3201 observations, 177 zeros remain. We note that such observations are masked by the market adjustment, since no zero price drop-offs are

evident once the adjustment for market movements is applied. Clearly, an abnormally large number of zeros will depress the average drop-off ratio, but this bias may be less of a problem in regression estimates of the drop-off ratio.

An important source of measurement error in ex-dividend studies arises from the bid ask spread. There are two problems, first where the dividend is small, and/or the bid ask spread is wide, movements in price due to the stock going ex-dividend are difficult to distinguish from bid-ask bounce. This adds noise to the data.

The second problem is that bid-ask bounce can create bias. For example, if cum dividend prices are predominately at the ask while ex-dividend prices are predominately at the bid then the drop-off ratio will be biased up and vice versa. Consequently, it is desirable to control for this effect when estimating drop-off ratios. This can be done by forming samples where cum-dividend and ex-dividend trades in a stock are both at the ask, or both at the bid. Alternatively, the mid-point of quotes from the order book may be used instead of trades.

The effects of bid-ask bounce are likely to have affected the data in both the Beggs and Skeels (2006) study and the SFG study. However, the impact on their results is unknown.

Another factor influencing the drop-off ratio can arise from dividend reinvestment plans. Since the purchase price in Dividend Reinvestment Plans (DRPs) is often at a discount to the prevailing market price, this makes the dividend more valuable to investors planning to participate in the DRP. It may therefore be desirable to compute drop-off ratios before and after adjustment for DRPs.

CONFOUNDING EVENTS AND TAX CHANGES

Confounding events can be an important source of measurement problems in ex-dividend studies and, as discussed above, drive a lot of the noise in the data. The AER point to various confounding events, which may affect the measurement of the drop-off ratio, such as the release of price sensitive company announcements about the ex-dividend day. If such announcements are fully impounded into prices at the time of the announcement then, as SFG argue, only announcements on the ex-day should affect the drop-off ratio. However, with the widespread thin trading in the Australian market there may well be a lag, for some stocks, before the announcement is fully reflected in the price.

Price movements caused by company announcements are symptomatic of the many other confounding information events, such as news items affecting a specific company, industry, or the whole market, which cause prices to change between the cum-dividend and ex-dividend dates. Control for such events is not possible and traditional ex-dividend studies must therefore rely on their randomisation. However, dividend announcements across firms tend to be clustered at certain times of the year and consequently ex-dividend dates also tend to be clustered in time. This makes randomisation more difficult. This clustering may also help explain the substantial time series variation observed in the drop-off ratio as documented for example by Eades, Hess and Kim (1994).

The implication of the foregoing, as SFG argue, is that more data obtained over long time series can be desirable in an ex-dividend study. This gives more opportunity to average out measurement error and the annual time series variation in drop-off ratios. However, the use of a long data series is conditional on stationarity in the underlying values of dividends and franking credits. The assumption must therefore be made that the time series variation documented by Eades, Hess and Kim (1994) is not reflective of true variation in the underlying value, but is a consequence of measurement problems.

The AER appropriately question whether the stationarity assumption is violated by a structural break consequent to the introduction of cash refunds for imputation credits from 1 July 2000. There is mixed empirical evidence on the effect of tax changes (the introduction of the 45 day rule, the cut in capital gains tax rates for long term gains, and the refund of excess imputation credits in cash) on the value of franked dividends. For example, Cannavan, Finn and Gray (2004) find that the 45 day rule had a substantial effect on the value of franked dividends, while Walker and Partington (1999b) find no effect on the value of franked dividends.

Ex-dividend studies provide relatively little evidence of tax changes impacting on the drop-off ratio. Beggs and Skeels (2006), only find a significant effect on cash refunds, while Truong and Partington (2006) find no effect from any of the tax changes. Such a result may seem surprising, but it is easily explained if the ex-dividend trading is dominated by dividend arbitrage. Short-term traders will not benefit from capital gains tax cuts that apply to long term gains, and short term trading is likely to be most attractive to traders who could fully utilize their franking credits even before the advent of cash refunds.

It might be suggested that no tax change effect is found because of low power tests resulting from the excessive noise in ex-dividend data. However, studies that use clean data also fail to find an effect. Walker and Partington (1999b) study the announcement of the 45-day rule and find no effect, while Halbert (2003) finds no effect from any of the tax changes.

The conclusion on the tax changes is that they leave very little track in the ex-dividend data. This, however, is not the same as concluding that the tax changes are irrelevant to the valuation of dividends. What it suggests is that the tax changes do not much affect the valuations of the marginal traders about the ex-dividend date. Whether this applies more generally depends on whether they are also the marginal traders in normal trading.

PARTITIONING AND FILTERING

The data problems discussed previously, mean that it is common in traditional ex-dividend studies to filter the data and also to partition the data into various samples. For example, partitioning the data by firm size, dividend yield classes and franking status is common. Such partitions commonly show that the drop-off ratio increases with dividend yield classes, which is a consistent result in the literature from Elton and Gruber (1970) onwards. However the reasons for this are open to debate and, as we discuss later, go to the heart of how we interpret the value of theta derived from ex-dividend studies. Larger firms also tend to have higher drop-off ratios as in Hathaway and Officer (2004), probably because their dividends tend to be larger and these stocks are easier to trade, in particular the bid ask spread is lower. Further, stale prices are less of a problem and dividend arbitrage is a more attractive proposition in these stocks.

Partitions by franking class typically show that fully franked dividends have a higher drop-off ratio than unfranked dividends as in Bellamy (1994) and this effect is apparent in the SFG data. The clear implication is that franking credits have value. Indeed, as Truong and Partington (2006) find, regression estimates of the drop-off ratio decline monotonically across fully franked, partially franked and unfranked dividends.

Filtering is commonly directed to eliminating outliers and may be used to help detect erroneous data. Outliers are a particular problem when regression is used, as we discussed above. There is a Catch 22 with filtering as on the one hand filtering is undertaken to create a cleaner and more stable dividend valuation. On the other hand the result obtained is a joint consequence of the underlying valuation of dividends and the filtering process. Indeed if the filtering does not change the results, there is no point to the filtering. This leaves a study based on filtered data open to the criticism that the result may reflect the filtering rather than the true underlying value of the dividends. Conversely, a study

that uses unfiltered data is open to the criticism that its results are driven by outliers. Robust regression may help here as it does not require outliers to be deleted.

We note that in the SFG ex-dividend study, substantial outliers still remain after filtering with the drop-off ratio ranging from -60 to +55. Since the minimum drop-off ratio before filtering was -60 it appears that the filtering of outliers was on the upside of the distribution.

TIME CLUSTERING

One issue that has received relatively little attention in ex-dividend studies is the issue of independence of the observations. Dividend announcements across firms tend to be clustered at certain times of the year and consequently ex-dividend dates also tend to be clustered in time. This is likely to violate the assumption that the observations are independent and if so standard errors will be understated and consequently statistical significance will be overstated. One solution is to form portfolios of stocks which are observed within a common time period, but whether that period should be a day, or longer is an open question.

Time clustering also has significance for the method of adjusting for overnight movements of the market. Brown and Warner (1980) present evidence that adjustment for market movements should be firm specific where there is time clustering in events. That is, they should reflect the sensitivity of the individual firm to movements in the market. However, Australian ex-dividend studies, as in Beggs and Skeels (2006) and SFG, typically use the movement of the whole market to make the adjustment. In effect, they assume that the sensitivity of stock returns to the market (the equity beta) is one. Unfortunately, in the Australian market the estimated betas for daily price adjustment are frequently so unreliable that using firm specific adjustments is unlikely to be an improvement and may make things worse. The adjustment for market movements of individual stocks is therefore a problem that is not easily resolved in the traditional Australian ex-dividend study. Forming portfolios

might help as portfolio betas are usually measured with less error than is the case for individual stocks.

THE INTERPRETATION OF EX-DIVIDEND STUDIES

Even if we had clean estimates of the value of cash dividends and theta from ex-dividend studies, the interpretation and generalisation of those measurements is open to question. Are we detecting the valuations of long term traders, which reflect the relative taxation of dividends and capital gains as argued by Elton and Gruber (1970), or are we detecting the valuations of dividend arbitrage traders constrained by transactions costs, as argued by Kalay (1982)? Theoretical argument and empirical data can be adduced for both sides of this debate, but no clear resolution has emerged. Unfortunately, the consistent empirical result that drop-off ratios rise with dividend yields is predicted by both schools of thought. The likely reality, as in the model of Boyd and Jaganathan (1994), is that a mixture of transactions by both long term investors and dividend arbitrageurs are to be found in ex-dividend data. In Boyd and Jaganathan's model arbitrageurs tend to dominate trading in high dividend yield stocks and long term traders tend to dominate trading in low dividend yield stocks.

Arbitrageurs are attracted to the high dividend yield stocks because the transaction costs of arbitrage consume a smaller fraction of the dividend. The impact of transactions costs in interpreting the results of ex-dividend studies is substantial, as demonstrated by Partington and Walker (2001). In that paper, they show how consideration of transactions costs can greatly reduce the equilibrium drop-off ratio in dividend arbitrage and can completely change the inferences to be drawn from an ex-dividend study.

In short, even if a clean measure of theta could be obtained from an ex-dividend study, it is not clear how much of the valuation is driven by dividend arbitrage. The extent to which the value of theta has

been affected by transactions costs and other market microstructure effects is also unclear. To the extent that dividend arbitrage is present in fully franked dividends, the value of theta is likely to be downward biased (by the extent of transactions costs) as a measure of the value of franking credits to the traders. In turn the valuations by dividend arbitragers may be a poor reflection of the value to the stock's long term clientele of investors.

THE PAYOUT RATIO AND UNDISTRIBUTED FRANKING CREDITS

It is common when computing the value of gamma to assume that undistributed franking credits have no value, and this is the view of SFG. As explained in the introduction, we do not believe that this is correct. Indeed, the assumption that undistributed franking credits have no value creates significant problems in the application of the Officer (1994) framework to regulatory decisions. Gray and Hall (2006) present an analysis in which they show that under the Officer (1994) framework the parameters used in regulatory decisions are internally inconsistent. In particular, they show that the implied dividend yield on the market is an implausibly high 8.2%. However, as Truong and Partington (2008), show this result hinges critically on the assumption that undistributed franking credits have no value. If it is assumed that retained franking credits have value, then the internal inconsistency can be eliminated.

The view that undistributed franking credits have no value is based on the assumption that the franking credits will never be distributed and that investors therefore apply an infinite discount factor to them. In our opinion this view is too extreme. Clearly, undistributed credits will be discounted relative to distributed credits, but we doubt that the discount factor is infinite.

There is empirical evidence to support the view that retained credits have a positive value. Harris, Hubbard and Kemsley (2001) find that in Australia retained earnings are valued at more than their face value, consistent with additional value arising from undistributed franking credits. Supporting

evidence for this result can be found in Ricketts and Wilkinson (2008). However, assessment of the value of retained earnings is a very difficult task and we would not claim that the evidence from these studies is unassailable.

The AER makes the assumption that there is a 100 percent payout of imputation credits. Taken literally, this is clearly incorrect. However, we view the 100 percent payout assumption as simply a convenient step designed to allow for the value of undistributed franking credits when computing gamma. It is equivalent to saying that undistributed franking credits have the same value as distributed franking credits. In principle, this is likely to overstate the value of the undistributed credits, but it is not clear by how much. Under the assumptions for the distribution of credits that the AER makes, the AER argues that the overstatement is not material.

Whether the AER's distribution assumptions are valid and whether the valuation effect is material is an open question, since the average period that credits remain undistributed is not known and neither is the discount rate that applies to them. The discount rate is the easier of the two parameters to pin down, it lies somewhere between the risk free rate and the firm's cost of equity. The discount rate is below the cost of equity since there is no uncertainty regarding the quantum of the credits, but it lies above the risk free rate because there is uncertainty over the timing of distributions and there is also the risk of changes to the tax regime that may affect the value of franking credits. The AER chose not to discount the value of the undistributed credits as a simplifying assumption. We understand that this particular assumption is balanced by other aspects of the determination where not discounting for the time value of money favours the DNSPs.

One line of argument to support the full valuation of undistributed franking credits is to make the usual assumption of finance theory that the objective of management is to maximise shareholder wealth. If so, the minimum criteria for the retention of credits is that their retention is value neutral.

In other words, no value should be lost by the retention of franking credits and so there is a case for valuing them fully. However, this line of argument implies either a higher cost base, or a higher cost of capital, for investments financed from retained earnings that could otherwise be distributed as franked dividends.

The other line of argument is that firms will not leave their franking credits undistributed for long periods of time. Firms do make efforts to distribute the surplus franking credits that are accumulating in their franking account. This is exemplified in structured buybacks of equity, where a large part of the buy-back price is in the form of a fully franked dividend. The adoption of dividend reinvestment plans has also allowed companies to increase their payouts of both dividends and associated imputation credits. Nevertheless, the taxation statistics show that the tendency has been for the total of franking account balances to rise through time. This reflects the growth in total credits created as company tax payments grow. In order to distribute the accumulated credits companies will have to grow the distribution rate faster than the creation rate. Only time will tell whether this can be achieved.

In short, assuming a payout ratio of 100 percent is likely to overstate the value of undistributed franking credits. If, however, gamma is to be computed as the product of the payout rate and theta, then it is necessary to use a payout ratio which is greater than the actual payout ratio of about 70% in order to allow for some value in undistributed credits. An appropriate value for the payout therefore lies between 70% and 100%.

FRANKING CREDITS AND MARKET PRACTICE

SFG make the case that ignoring franking credits is standard practice in valuations and in project analysis and their implication is that franking credits are worthless. We believe it probably is the case that ignoring franking credits in valuations is widespread, but the practice is not universal. Neither

does ignoring franking credits in valuations necessarily imply that practitioners believe that franking credits have no value. The Truong, Partington and Peat (2008) study cited by SFG provides direct evidence on this issue, as those firms who did not account for imputation credits in project evaluations were asked to explain why. We reproduce the firm's reasons in Table 1 ranked by number of responses. There were 60 firms that responded to the question, but because multiple responses were possible 89 responses are reported. The most cited reason for ignoring franking credits was the difficulty in setting an appropriate value for them and the least cited reason was that franking credits had zero value.

It is possible, as the AER argue, to undertake valuations which correctly account for franking credits without explicit consideration of their value. Dempsey and Partington (2008) show how this can be done, provided the value of the package of dividend and franking credits is known. While this approach was known to some practitioners well in advance of its publication, we doubt that it had extensive use. There are also other ways that imputation might have been allowed for. It is not uncommon in valuations to add a bit extra, a fudge factor, to the discount rate to allow for various contingencies. Lower fudge factors, post imputation, would be one way to implicitly allow for the value of franking credits. Whether fudge factors are lower post imputation is, however, unknown.

Table 1
Reasons for not accounting for imputation credits in project evaluations

	Number of Responses
It's difficult to set an appropriate tax credit value for all investors	22
Imputation credit should have a very small impact on evaluation result	15
The market already adjusts stock prices, therefore imputation credit is taken into account in cost of capital estimate already	14
It is too complicated	11
Other	11
Imputation credits are irrelevant to overseas shareholders	10
Credits have zero market value	6

Source: Truong, Partington and Peat (2008)

THE VALUE OF CASH DIVIDENDS

SFG strongly argue that the cash component of dividends is fully valued. In our opinion they overstate the case and, if anything, the evidence that cash dividends are worth less than their face value is stronger. Whether or not cash dividends are fully valued is a question that has been debated for over fifty years and there is still no agreed consensus.

SFG refer to the evidence of dividend yield studies as supporting the case for full valuation of cash dividends. We presume that by dividend yield studies, SFG refer to tests of the significance of a dividend yield term in an asset pricing model. Some studies find the coefficient on dividend yields to be insignificantly different from zero, but there is plenty of evidence from such studies that dividends are valued at less than their face value. Indeed this latter is where the weight of evidence lies. This point is clearly made in the internationally renowned textbook of Brealey and Myers. We quote from the Australian Edition, Brealey Myers, Partington and Robinson (2000) and reproduce their Table 16.2 as Table 2 below:

“Given these difficulties in measuring the relationship between the expected dividend yield and return, it is not surprising that different researchers have come up with different results. Table 16.2 summarises some of these findings. Notice that in each of these tests the estimated tax rate was positive. In other words higher yielding shares appeared to have lower prices and to offer higher returns. Notice, however, that in several cases the standard error is so large that the estimated tax rate is not significantly different from zero. So, while the dividends are bad school can claim some weight of evidence on its side, the contest is by no means over.”

We should explain that a positive estimate for the tax rate implies a tax disadvantage for dividends, so that dividends are valued at less than their face value and investors demand higher returns from stocks with higher dividend yields

Table 2
Some tests of the effect of yield on returns

A positive implied tax rate on dividends means that investors require a higher pre-tax return from high-dividend shares.

Test	Test period	Implied tax rate (%)	Standard error of tax rate
Brennan	1946–65	34	12
Black & Scholes (1974)	1936–66	22	24
Litzenberger & Ramaswamy (1979)	1936–77	24	3
Litzenberger & Ramaswamy (1982)	1940–80	14–23	2–3
Rosenberg & Marathe (1979)	1931–66	40	21
Bradford & Gordon (1980)	1926–78	18	2
Blume (1980)	1936–76	52	25
Miller & Scholes (1982)	1940–78	4	3
Stone & Bartter (1979)	1947–70	56	28
Morgan (1982)	1946–77	21	2
Ang & Peterson (1985)	1973–83	57	27

Source: Brealey Myers, Partington and Robinson (2000)

While these studies consistently suggest that dividends are valued at less than their face value, in our opinion, they should be accorded relatively little weight. There are some significant question marks over the research method. Miller and Scholes(1982), for example, showed how the dividend yield measure could be confounded with information effects. More importantly, there are questions about the adequacy of the asset pricing models used in such studies and whether they provide adequate controls for risk. In relation to Australian data, Ball, Brown, Finn and Officer (1979) found a large positive coefficient on the dividend yield term that implied a tax rate far too large to be sensible. They suggested that the dividend yield was proxying for risk factors omitted from the CAPM. In the USA, Naranjo, Nimalendra and Ryngaert (1998), used the Fama and French three factor model, rather than the CAPM, to control for risk, but they also found an implausibly high implied tax rate and suggested the same risk proxy explanation as Ball, Brown, Finn and Officer (1979).

With regard to the evidence from ex-dividend studies, the evidence is that cash dividends are valued at less than or equal to their face value. However, the weight of the evidence favours a market valuation at less than face value and a great deal of literature has been devoted to trying to explain

this discount. In the Australian context the valuation of unfranked dividends shows a consistent trend to valuations less than face value. Consequently, if a value is to be ascribed to the cash component of dividends a value of about 80 cents in the dollar, rather than full valuation, would better reflect the Australian evidence (see for example, Brown and Walter (1986), Brown and Clarke (1993), Hathaway and Officer (2004))

ECONOMETRIC ISSUES

BACKGROUND

In undertaking a review of econometric issues associated with the estimation of gamma in the context of dividend drop-off studies, we have been provided with the following datasets and SAS code from SFG:

- **Beggs and Skeels replication 20100201.sas**: SAS program code that performs the analysis.
- **dataset_20090821.sas7bat**: The main dataset of 5646 observations.
- **specials.sas7bat**: A dataset that identifies special dividends.
- **market.sas7bat**: A dataset that contains stock market returns.
- **additional2.sas7bat**: A dataset that contains additional observations⁵

Using this dataset and code, we have been able to replicate the results of the SFG study in SAS. It is our understanding that the AER have achieved the same feat using STATA. We do note however, that our attempts to replicate the output in Eviews were unsuccessful. More specifically, the weighted least squares equation results were different. We mention this point to highlight the issue that care must be taken when undertaking this type of research, as differences in results may result from the choice of software.

This report has comprehensively examined the SFG data and found it to be somewhat error prone. Many of these errors have been documented in previous reports. Due to their proprietary nature, we have not had access to the data used in either the Handley and Maheswaran (2008) or Beggs and

⁵ We note that while the SFG Report (4 Feb. 2010, point 19) states, “we have added 14 observations to our data set and have made one correction”, the additional2.sas7bat dataset only contains 12 observations, of which the ICT dividend is a replacement for an observation already in the sample. Thus, it would appear that a total of only 11 observations is included in this dataset.

Skeels (2006) study and so therefore are unable to assess whether the data used in these studies is any more, or less, error prone. We suspect that, due to the nature of the data and the task at hand, if subject to the same level of scrutiny as the SFG study, the studies of Handley and Maheswaran (2008) or Beggs and Skeels (2006) would yield a list of questions and clarifications.

DATA ISSUES

We note that a number of data related issues have been raised, some of which have been resolved (for example, the appropriate window in which to apply different company tax rates) and some of which are ongoing. Specifically, the following issues have generated considerable discussion and merit individual attention here:

ACCURACY OF THE DATA

- (i) Missing observations – the SFG analysis excludes all ex-dividend events where a complete sample of data could not be obtained. This is a reasonable data filtering step for this type of study and is more likely to impact on the early part of the sample period and the data for small stocks.

- (ii) Incorrect observations – the presence of incorrect observations is a problem for any empirical study and care should always be taken to ensure that the data is of the highest quality available. Having said that, most data will typically contain some element of error and most analysis typically proceeds on the assumption that any errors will not significantly bias the estimation results.

Auditing a random sample of observations only serves to verify what we already know – data of this type inevitably contains errors. Thus, auditing and fixing the found errors does not really serve any useful purpose. That is not to say that some form of checking is not appropriate. It is desirable to cross check one data source against another and to investigate as many errors as

possible. For example, in a dividend drop off study, SIRCA provide what is most likely the cleanest data available but it would be appropriate to cross validate the SIRCA data using another data source such as Datastream.

(iii) Stock splits and bonus issues – such events change the basis of quotation for a company and so the historical data must be adjusted to reflect the same basis for quotation. Nowadays, this transformation is typically undertaken by the data vendor as a part of its data verification and cleaning service. For example, SIRCA and Datastream data have such adjustments already made.

If the adjustments to the data are performed correctly, then the dividend drop-off around the ex-dividend date would be proportionately the same comparing across adjusted and unadjusted data. The only time the use of adjusted data is essential, would be in the event that the ex-dividend date occurred simultaneously to the date on which the basis for quotation changed. The estimation results for a dividend drop-off study across a sample of data however, may be different as high-dividend, high-share price observations are more likely to have a significant influence on the results (this is less of a problem where robust regression techniques are specified).

ISSUES RELATED TO THE FILTERING OF DATA

Ideally, a study should include as many observations as possible to minimise the sampling error. The caveat to this rule is that the data sample period should only include those observations which are relevant to the current period of estimation. With this in mind, a number of issues have arisen in terms of what observations to include in a dividend drop-off study.

(i) Excluding Small Firms – the Beggs and Skeels (2006) study excludes all firms with a market capitalisation of less than 0.03%. Other studies, such as SFG, have used a similar filter.

The main problem with a small firm filter is that it is entirely arbitrary and possesses no economic rationale. Presumably, the point of filtering is to remove those companies that suffer from some characteristic such as thin trading. If so, then the choice of filter size should be set so as to ensure that thin traded stocks, however defined, are excluded from the sample. Alternatively, the decision may be made so as to ensure that the stocks included in the sample are representative. Again, the filter should be set so as to achieve that goal and not be so arbitrary.

- (ii) Inclusion of Special Dividends – Beggs and Skeels (2006, p. 252) argue that, “(s)pecial dividends are an irregular distribution of excess cash reserves, and for this reason it is expected that prices may behave inconsistently around special dividend payments.”

While the first part of the Beggs and Skeels argument is certainly true, the latter part is not necessarily so. Indeed, this is an empirical issue and given the need to maximise the sample size (see below), observations should not be dismissed without due consideration. Irrespective, Beggs and Skeels do omit special dividends.

SFG is very much of the opinion that special dividends should be treated no differently to any other dividend for the purposes of a drop off study (SFG, 13 January 2010, Para. 38-41). They argue that, “there is no reason at all to exclude special dividends from a dividend drop-off analysis. There is no reason why the stock price change over the ex-dividend date would differ for special dividends relative to ordinary dividends. Special dividends may have a different announcement effect than ordinary dividends (i.e., the stock price reaction may be different at the time of announcement) but this pre-dates the cum-dividend price and is of no relevance to the price change over the ex-dividend date (which is some weeks after the announcement)” (13 January, 2010, p. 9). SFG’s argument is also based on opinion rather than any apparent verifiable analysis.

SFG (13 January, 2010, p. 10) do make the point that “special dividends should only be omitted from this analysis if there were some reason why the value of franking credits attached to special dividends differed from the value of franking credits attached to ordinary dividends.”

We believe that the choice of whether or not to exclude special dividends should be based on an empirical and/or theoretical justification as to what differences may exist in comparison to regular dividends. Having undertaken such an analysis, it would then be possible to determine what controls need to be put in place to account for the distinguishing characteristics of special dividends, or indeed, even whether they should be excluded as truly erroneous.

(iii) Contemporaneous price sensitive announcements – firms often release price sensitive information to the market and this may occur around the time of the dividend ex-date. The presence of such announcements may not necessarily bias the estimation results. Where good and bad news announcements are equally as likely, they will cancel out in the estimation process.

Regardless, it is common practice for empirical researchers to exclude such observations. This is a difficult task however, as firms release many news items each year and it is not clear exactly what constitutes price sensitive information. Ideally, we should only exclude those ex-dividend dates that occur contemporaneously with the release of price sensitive information.

It is also unclear how close to the ex-dividend date the announcement needs to be in order to qualify for exclusion. While SFG argue that only announcements on the ex-dividend date are relevant (SFG 13 January, 2010, p. 11), this depends on the rate of information dissemination and a case can be made for a wider window.

(iv) Unusual Market conditions - Beggs and Skeels (2006) exclude “data from the extremely volatile month of October 1987” on the basis that “price volatility in that month was the highest measured over the past 100 years” which “could distort interpretation of results.”

In a similar vein, arguments have been raised by the AER to suggest that SFG should exclude observations from the Black Friday period. SFG in turn argue that no reason exists to exclude observations from the analysis due to unusual market events over the post-July 1997 period.

In a similar spirit to the previous small firm filter discussion, to follow the logic of excluding unusually volatile trading periods would mean establishing a valid cutoff for periods to exclude. For example, market volatility since the outbreak of the Financial Crisis in August, 2007 has been unusually high. Would it be appropriate therefore to exclude this entire period? What about the pre-2007 period where unusually low market volatility was experienced, would we be prepared to accept a similar argument for this period as not being ‘normal’. Further, why only consider unusual market volatility, what about other market metrics, such as trading volume. Indeed, we may even extend this concept beyond market activity to the individual stock level.

We argue that while it is a reasonable form of robustness analysis to consider whether ‘unusual’ market conditions impact on any results, an appropriate form of analysis would be to include these observations and then to undertake additional analysis to establish the impact of excluding any observations drawn from an anomalous period.

(v) Use of Raw Data vs. Market Adjusted Data - while the earlier SFG report uses raw prices to calculate the price adjustment over the ex-dividend date, this was not consistent with the Beggs and Skeels approach (see Beggs and Skeels, 2006, footnote 6). Later SFG work adjusted prices in the manner of Beggs and Skeels (2006) and found the results were not significantly altered.

While we accept that accounting for market movements around the ex-dividend date is valid, the use of adjusted data does bring with it a potentially important issue. Specifically, the choice of adjustment is important. The Beggs and Skeels (2006) approach is to adjust by the movement in the market index. The problem with this is that it assumes that the $\beta=1$ for all stocks and this is inappropriate. Industry level, or ideally individual firm, adjustments should be made, however, this brings with it a range of technical issues that are beyond the scope of this report.

(vi) Drop Off Ratio (DOR) values – the theory of ex-dividend stock price behaviour suggests that the stock price should fall by some amount on the ex-dividend date after adjusting for market movements. As such, zero and negative market adjusted DORs are implausible.

It is interesting to note that in the SFG market adjusted data, there are 489 negative observations and 2712 positive DORs. Further, where the raw price change data is considered, 177 DOR are zero and 433 DOR are negative. While some zero and negative DOR values are to be expected in the raw price data, this number is higher than would be expected (almost 20% of the sample). The extent of these zero DOR observations is masked by the market adjustment as even where the stock price does not change, the market adjustment will ensure that some price movement is recorded generating a non-zero DOR. This should not be taken as a unique criticism of the SFG study as other similar studies will also exhibit such characteristics.

Where the sample accorded to its theoretical ideal, there would be no negative or zero market adjusted price movements in the data. While we accept that it is unavoidable that there would be some zero and/or negative values in the data, their presence may act to bias the sample estimates downwards.

(vii) Thin Trading – the previous discussion raises the issue of thin trading as one possibility is that these zero raw price DOR can be attributed to a lack of trading and the use of stale price information.

It is important for any dividend drop off study to accurately record stock prices on the cum and ex-dates. Thin trading in stocks does raise the possibility that prices are unchanged over the measurement period.

SFG address this issue by limiting their analysis to only include observations “in which we can identify a trade as having occurred on the ex-dividend date.” (SFG February, 2010, p. 4). While not going into details, we presume they used positive trading volume on the ex-dividend date to apply this filter.

We do note however, that SFG do not mention whether they took any steps to ensure that their cum-dividend date price observation was current. Where a cum-price is stale, this means that the change in price observed on the ex-dividend date could potentially be a mix of new information and the dividend drop off. This may dilute any estimation results.

(viii) Discreteness of Stock Prices – one important issue which is not addressed by either Beggs and Skeels (2006) or SFG relates to the ability of the market to adjust to the ex-dividend drop off event.

Where the spread is large and the dividend relatively small, then the theoretical drop off in the share price may be close to or even less than the spread in the stock. Obviously, the ability of the market to change to fully reflect the change in the value of the stock is limited in such circumstances. The minimum tick is a further complication to this issue.

By way of example, consider Newcrest Mining, which is a blue chip top 20 stock. On 31/8/2007, Newcrest paid a 0.05 cent dividend, yet its closing spread on the ex-dividend date was 31.4 cents per share. The wide spread for this stock relative to the small dividend, means that it would be impossible for a dividend drop off study to clearly pick up the change in the value of Newcrest's equity as a result of the share going ex-dividend. On the other hand, consider the \$1.70 dividend of NAB on 4/6/2009. The recorded closing spread on the ex-dividend date was only 1 cent per share and so the spread provides little impediment to the market adjusting to the ex-dividend date event.

To provide some insights into this issue, we have undertaken a preliminary study using ex-dividend date closing spreads sourced from Datastream. While we acknowledge these data are not ideal, they will suffice for the sake of exposition.

We consider all dividends paid by ASX listed companies whose market capitalisation constitutes greater than 0.03% of total market capitalisation. Closing bid and ask prices as well as dividend values are sourced from Datastream on each ex-dividend date. After filtering the data for missing and erroneous observations, we ended up with a sample of 2,810 dividend events sampled over the period 19/6/2001 (the earliest that spread data is available in Datastream) to 5/3/2010.

Some descriptive statistics for the data are presented in Table 3. Panel A presents a summary of the data across the whole sample and the average dividend is ten times the size of the spread although the distribution of this data is positively skewed as evidenced by the lower median ratio value of 5.50. The standard deviation is quite high relative to the two measures of central tendency, highlighting how disperse these data are. The majority of the data are between 2.22 and

11.75, however, the extreme values are well outside these bounds, with a maximum value of 170.00 and a minimum value of 0.07.

Table 3
Descriptive Statistics for the Dividend to Spread Ratio

	Mean	Median	St. Dev.	75 th Percentile	25 th Percentile	Max	Min
Panel A:							
Full Sample	10.24	5.50	15.83	11.75	2.22	170.00	0.07
Panel B:							
Size Decile 1	27.83	17.67	33.55	31.75	6.97	170.00	0.16
Size Decile 2	13.49	9.00	14.24	17.75	4.36	95.00	0.19
Size Decile 3	13.57	9.47	13.78	18.00	5.00	92.00	0.46
Size Decile 4	7.55	5.00	7.59	9.25	2.50	41.00	0.30
Size Decile 5	7.72	4.40	9.68	9.00	1.85	63.00	0.18
Size Decile 6	8.35	5.56	11.00	10.00	2.73	140.00	0.10
Size Decile 7	8.07	5.25	12.24	10.69	2.11	148.40	0.07
Size Decile 8	7.14	4.33	9.11	9.00	2.00	65.00	0.15
Size Decile 9	5.12	3.33	6.18	6.33	1.67	67.00	0.10
Size Decile 10	3.53	2.00	4.12	4.00	1.00	30.00	0.15

As a general observation, the data does indicate that the larger the company, the less likely the size of the spread is to be an issue. To highlight this point, Table 3 presents descriptive statistics for the average dividend to spread ratio for each decile of announcements. Size decile 1 (10) summarises the dividend to spread ratio for the top (bottom) 281 observations ranked by the size of the parent company. The average dividend to spread ratio for the first decile is 27.83. This ratio declines as the ex-dividend event is associated with smaller companies and the 10% smallest firms have a dividend to spread ratio of only 3.53.

While the mean value of the ratio does decline, it is interesting to note that each decile exhibits a large degree of variability as evidenced by the maximum and minimum values in each decile. As expected, there are some small stocks that have a dividend value much smaller than the spread. Similarly, there are some large stocks whose dividends are quite small relative to the spread. Indeed, some of these large stocks with a small dividend relative to the spread are well known

companies such as CSL, Newcrest Mining, Computershare, Bluescope Steel, Flightcentre, AMP and Adelaide Brighton. We find that 31 of the top 100 appear in the list of companies that have a dividend to spread ratio of less than or equal to unity.

In total, 269 observations (ie. ~9.5% of the sample) have a dividend that is equal to or less than the ex-dividend date spread. While this study is only preliminary, it does suggest that the ability of the market to fully adjust for the dividend as the share trades ex-dividend is frequently limited by the spread and the tick size of the market.

(ix) Clustering of Event Dates - the nature of the reporting cycle for listed companies means that there is a great deal of clustering of observations in a sample. This violates the assumption of independent and identically distributed errors and so introduces a bias to the estimation process. This is more a criticism of dividend drop off studies in general and does not relate directly to Beggs and Skeels (2006) nor the SFG work.

(x) Structural Breaks and Tax Rates – cognisant of the need to include as many observations in the sample as possible, the structural breaks that occur as a result of changes to the tax regime provide a possible division of the data into three different regimes. These were used by Beggs and Skeels (2006) and the SFG reports and extremely high variability of the estimated coefficients and their standard errors was observed across these regimes. This is more a reflection of the nature of the data and the type of study being undertaken than the influence of the regime changes. In theory, a clear case cannot be made for estimating across regimes.

(xi) Holidays and Weekends – where a dividend event is impacted by the occurrence of a holiday or weekend, this means that the return is not measured across successive calendar days. This may potentially impact a number of observations in the sample and so the return incorporates a greater amount of news, which has accumulated over the longer interval. As such,

a case may be made to exclude these observations. Neither SFG nor Beggs and Skeels (2006) make such an adjustment.

ESTIMATION ISSUES

In addition to issues with the data itself, there are also a number of important issues that relate to the estimation technique. These issues impact on the confidence with which the researcher may interpret the results and draw sensible conclusions.

The most significant issues relate to the impact of heteroscedasticity and multicollinearity on the parameter estimates and their robustness. We shall consider these first as many of the remaining issues stem from these two problems.

HETEROSCEDASTICITY

Beggs and Skeels (2006, p.6) correctly point out that dividend drop off models, “are typically troubled by the presence of heteroscedasticity”. Rather than specify a standard White (1980) type adjustment to the standard errors, they opt for the more complex method of specifying a functional form for the variance of the errors and use a feasible generalised least squares estimator (FGLS), which is asymptotically more efficient .

While the use of FGLS is a reasonable adjustment to account for the problem of heteroscedasticity, it does mean that both Beggs and Skeels (2006) and SFG run their regressions using the data in levels. It is worth noting that since Boyd and Jaganathan (1994), the standard practice has been to run ex-dividend regressions with the variables scaled by the cum-dividend price and one of the reasons for this adjustment is to reduce the impact of heteroscedasticity on the estimated output. This is potentially an important point of distinction as substantially different coefficient estimates can result where ex-dividend regressions specify scaled variables as opposed to variables in levels.

MULTICOLINEARITY

The AER (South Australian Draft Determination, p. 263) recognises that “dividend drop-off studies are likely to suffer from multicollinearity as it is difficult to separate the value investors imply from cash dividends and the imputation credits attached to those cash dividends.”

Multicollinearity refers to a problem that occurs when two, or more, independent variable are closely related to each other. In the context of dividend drop off studies, this relationship is the result of the manner by which franking credits are determined: a fully franked dividend has a franking credit of $D(\tau/1-\tau)$, where τ represents the corporate tax rate. Thus, the franking credit is a monotonic transformation of the dividend, giving perfect multicollinearity and rendering any equation inestimable due to singularity. If we consider the SFG data, we can readily find evidence of a near singular relationship - 2,052 of the 5,646 observations have a 100% franking rate, and the correlation between the cash dividend and the estimated franking credit is 0.9899 (it is only the change in tax regime that prevents the correlation coefficient from being unity, in which case any model would suffer from singularity).

Beggs and Skeels (2006) argue that the presence of observations at different company tax rates and dividends with less than 100% franking could mitigate the colinearity problem. That is to say, if we add in to the sample a mix of tax rate changes and unfranked and partially franked dividends, the singularity problem is overcome to the extent that the equations will estimate. This is true as across the full SFG sample of 5,646 observations, the correlation between the cash dividend and the estimated franking credit is 0.23. Where the 0.03% size filter is employed, the correlation across the 3,201 observations is 0.70. The pooling of fully, partially and unfranked dividends together in this fashion is an important issue and it may be preferable to separately estimate the value of unfranked

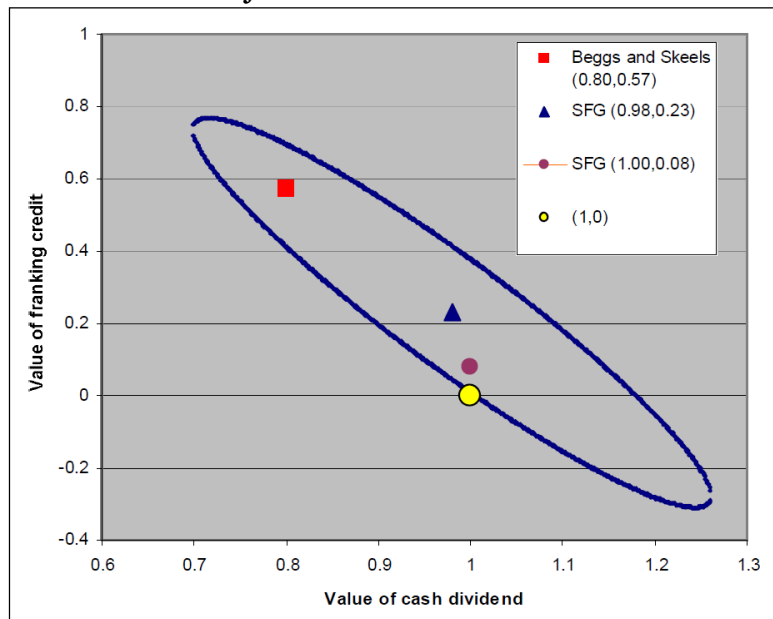
and fully franked dividends. This would require consideration of the tax regime changes since the changes do not affect franked and unfranked dividends to the same degree and in some cases they do not affect unfranked dividends at all.

Researchers typically proceed in the presence of multicollinearity on the basis that the point estimates of the independent variables are unbiased and consistent. There is a drawback however, as the estimated standard error for each estimate is quite large as it is difficult to decompose the partial effect of each variable. Therefore, the t-statistics will be quite low and any form of significance testing is unlikely to be able to distinguish the estimated coefficient from the null (or any other number). Alternative symptoms of the multicollinearity problem include regression estimates that are sensitive to sample changes or model specification.

These symptoms of multicollinearity are exactly what we see in the data as the standard errors of the estimated coefficients are quite large and moreover, the estimates for the franking credit are typically statistically insignificant. This is not obvious from reading the SFG and Beggs and Skeels (2006) results however, as in either study the t-statistics are not given and significant coefficients are not highlighted in the usual way.

SFG (13 January, 2010, p. 7) highlights the impact of multicollinearity on the estimation process by introducing the concept of a joint confidence region (reproduced here as Figure 3) and showing that their results are entirely consistent with those derived from other attempts at estimating gamma.

Figure 3
Joint Confidence Interval



When faced with the issue of multicollinearity, the researcher may attempt to obtain more and better quality sample data. This is unlikely to prove helpful in the current context however, since a longer time series of data may suffer from the same collinear relationships and provide little new information. Alternatively, the researcher may place restrictions on the parameters although such restrictions may bias the least squares estimator unless it is true. A third option is the use of an instrumental variables approach, although this is most likely unfeasible in this context. The final option is to pursue an alternative approach to the traditional ex-dividend study.

Multicollinearity is a serious problem that greatly restricts the ability of a researcher to draw any conclusions from their empirical testing. We believe that multicollinearity is a serious problem for dividend drop off studies and the results of SFG and Beggs and Skeels (2006) cannot be reliably interpreted in the presence of multicollinearity. Further, until serious consideration is given to this

issue, reliable decomposition of the partial effect of cash dividends and franking credits will remain elusive.

POINT ESTIMATES

In light of the previous discussion on multicollinearity, the point must be made that the parameter estimates of SFG and Beggs and Skeels (2006) are not upper and lower bounds. They are in fact, point estimates with confidence intervals and they have proven to be highly unstable with large standard errors.

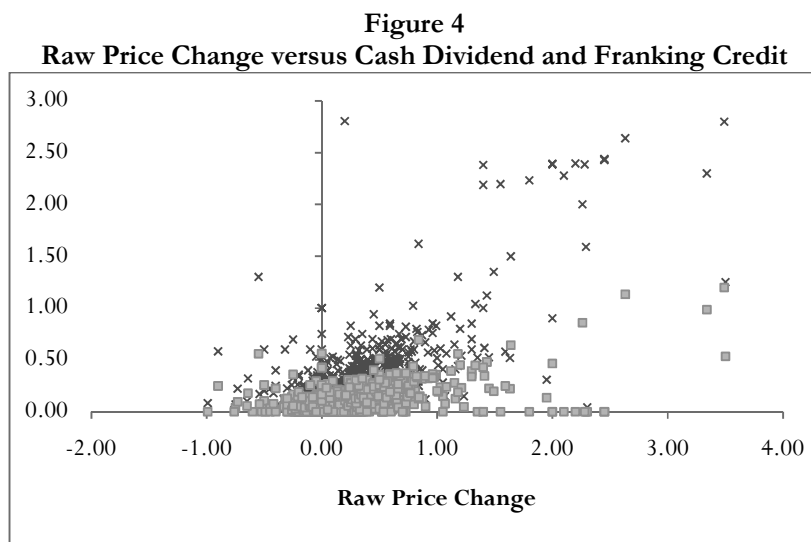
This point is exemplified by SFG (13 January, 2010, p. 7), who provide the joint confidence region, which is reproduced as Figure 3. SFG use this figure to make the point that all of the estimates of the value of the cash dividend and the franking credit, “fit the data just as well as any other combination” (p. 2).

While this figure does serve to highlight the impact of the multicollinearity on the reliability of the estimates, we take a slightly different view of the implications of this figure. Rather than arguing that the estimates of Beggs and Skeels cannot be favoured over SFG or vice versa, we argue that the results of these dividend drop off studies are so severely impacted by multicollinearity as to render any interpretation of the results almost meaningless. As pointed out by SFG, the only thing that is known is that theoretically implausible values (such as negative values) can be excluded (even though the standard errors of the regression equation deem them to be possible).

SIGNIFICANCE OF PARAMETER ESTIMATES

The majority of the discussion around the SFG and Beggs and Skeels (2006) results has focused on the values of the point estimates in their regression equation. Overall, there has been little discussion of the reliability with which they can be interpreted. In particular, while the cash dividends do

produce some significant coefficients, the franking credits do not. Skeels (2009a) uses this observation to argue that since multicollinearity increases the standard errors, any significant coefficient is an achievement. We take a slightly different view of this. Figure 4 presents a scatter plot of the raw price change on the ex-dividend day against the cash dividend (indicated using a cross) and the franking credit (indicated using a box). The figure clearly shows that with only a small standard error, it will be difficult to distinguish any franking credit from zero since the majority are clustered close to the x-axis. The cash dividends also exhibit a similar type of clustering, albeit less severe combined with the presence of a number of outliers. Altogether, these patterns in the data means that the line of best fit for the franking credits is going to have a flat slope and with anything other than small standard errors will be indistinguishable from a zero slope line of best fit. The cash dividend data however, depending on the treatment of outliers, does exhibit a positive slope. Given the inability of the estimation technique to reliably decompose the partial effect of cash dividends and franking credits due to multicollinearity, it is not surprising that the cash dividend dominates in the estimation process.



Source: Authors own calculations using SFG SAS file dataset_20090821.sas7bat.

TREATMENT OF OUTLIERS

For any empirical analysis, it is a valid form of robustness test to consider whether the results are unduly influenced by only a small number of outlier observations. An ‘influential’ observation in this context is an observation that has a disproportionate impact on the regression estimates.

A number of different techniques exist by which such outliers may be taken into account. For example, robust regression analysis may be specified. This approach offers the advantage of not excluding the observations but simply reweighting them to lessen their influence. As such, the estimation results are still based on the complete sample of data, however the influence of the outlier observations is lessened producing more reliable estimates.

An alternative approach is the removal altogether of outlier observations. The validity of removing these influential observations needs to be well justified before its application however. Further, where outliers are a feature of the dataset then the omission of outliers may be viewed as little more than data mining. In this case, important information about the inadequacy of the model is being omitted. As Skeels (2009a, p. 13) puts it, ‘not all influential observations are unreliable’ and ‘not all unreliable observations are influential’.

Skeels (2009a) considered that ‘any influential observations that are unreliable should be removed from the analysis’ (p. 13). However, what constitutes an ‘unreliable’ observation differs between Beggs and Skeels (2006) and the SFG study.

Beggs and Skeels (2006) applied a criteria up-front to the determination of economically unreliable observations. In contrast, the SFG study uses the Cook D-statistic to identify and exclude the most influential 1% of observations. SFG (2009, p. 11) argue that “filtering out a small number of

influential outlier observations dramatically improves the stability of estimates across sub-periods, the way the data fits the model, and the reliability of the resulting estimates.”

Cook’s D-statistic is a useful technique to detect influential observations, however, it does have limitations in the area of a group of observations being jointly significant. Further, it is entirely arbitrary as to what percentage of observations are excluded from the analysis (SFG’s choice of 1% could just have easily been 0.5% or 10%). Further, only one of the 3,201 observations that they filtered, had a Cook D-statistic of greater than unity (which is generally regarded as the cutoff point).

In our opinion, where the decision is made to eliminate outliers, it is appropriate that those outliers be identified *ex-ante* using an economic criteria. In attempting to account for one potential form of bias, the arbitrary application of techniques, such as Cook’s, may have the unintended consequence of introducing another form of bias to the analysis.

THE REGRESSION INTERCEPT

In theory, the regression equation intercept term in a dividend drop off study may be zero or negative depending on the extent of arbitrage and the nature of transaction costs. Beggs and Skeels (2006) report that all of their intercept coefficients are statistically insignificant. SFG do not report their intercept coefficients in their output tables. The replication of their results, however, provides clear evidence that the intercept coefficients are statistically significant and vary in sign. The presence of positive and significant intercepts is unexpected based on *a-priori* theory since it suggests a fixed positive component to the value of dividends. Taken literally this would imply that the slope coefficient underestimates the value of the package of dividends and credits. Our interpretation is that that the presence of positive intercepts and the variation in sign of the intercept term reinforces the argument that caution is required in interpreting the results of ex-dividend studies.

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CURRICULUM VITAE

PROFESSOR MICHAEL MCKENZIE

Chair of the Discipline of Finance
Faculty of Economics and Business
The University of Sydney

Contact Details :

Address: Discipline of Finance
Economics and Business Building (H69),
University of Sydney
New South Wales, 2006.
Telephone: + 61 (0)2 9114 0578
Fax: + 61 (0)2 9351 6461
Email: michael.mckenzie@sydney.edu.au

Qualifications :

B.B.S. (Economics) - Massey University (New Zealand)
M.Ec. (Economics) - Monash University (Australia)
Ph.D. (Finance) - RMIT University (Australia)

PROFESSIONAL

Professor McKenzie worked as a Treasury Analyst for the Australian Treasury Group at Deloitte Touche Tohmatsu before leaving to complete his PhD at RMIT in 1995.

In 1997, Professor McKenzie became an associate of the Midwine Consulting, which is a Sydney based company that specialises in financial risk management consulting and business process re-engineering. This appointment is current and ongoing.

ACADEMIC

Dr. Michael McKenzie is a Professor of Finance and also the Chair of Discipline of Finance in the Faculty of Economics and Business at The University of Sydney (Australia) and a Research Associate at the Centre for Financial Analysis and Policy (CFAP), Cambridge University (UK).

Professor McKenzie has published numerous books and journal articles on a wide range of topics. His main research interests, encompass the areas of corporate finance, risk management, market volatility, price discovery and market microstructure analysis.

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56. Daniel Spring, Jiri Baum, Michael D. McKenzie, Ralph MacNally, A. Sanchez-Azofeifa, James Thomson (2009) "Building a Regionally Connected Reserve Network in a Changing and Uncertain World" Forthcoming in *Conservation Biology*

RESEARCH AWARDS

Recipient of the E. Yetton Award for paper of the year by the Editors of the *Australian Journal of Management* for the paper "Time-Varying Beta Risk of Australian Industry Portfolios: A comparison of modelling techniques", 1998.

Runner-up for the E. Yetton Award for paper of the year by the Editors of the *Australian Journal of Management* for the paper "International Evidence on the Determinants of the Decision to List", 2007.

ASSOCIATE PROFESSOR GRAHAM PARTINGTON

Faculty of Economics and Business
The University of Sydney

PERSONAL

Name: Associate Professor Graham Harold PARTINGTON
Academic Qualifications: B.Sc. (Hons) Economics/Forestry, University of Wales, 1971
Awards: MEd. (Hons), by thesis, Macquarie University, 1983.
1985: Butterworths Travelling Fellowship
2000: Peter Brownell Manuscript Award. Awarded by the Accounting Association of Australia and New Zealand for the best paper in *Accounting and Finance*, 1999
2001: Manuscript award for the best paper: Education Notes, *Accounting Research Journal*, 2000.
2009 Bangor University Senate conferred the title: Honorary Visiting Senior Research Fellow (2009-2012.)
2009 Chartered Financial Analyst (CFA) best paper prize (Asian Investments) at the Asian Finance Association Conference.
Address: Economics and Business Building (H69),
Finance Discipline
University of Sydney
NSW 2006
Telephone: 61 (0)2 9036-9429
Fax: 61 (0)2 9351-6461
Email: G.Partington@econ.usyd.edu.au

CURRENT POSITION

**University of Sydney
Faculty of Economics
and Business** Sept 2002–to date: Associate Professor, Finance Discipline (Head of Postgraduate Research 2002-2007, 2009 to date)
Education Director Capital Markets Co-operative Research Centre 2002-2008

PUBLICATIONS

BOOKS

Brealey, R., S. Myers, G. Partington and D. Robinson, *Principles of Corporate Finance*, Australian Edition, McGraw-Hill 2000 (1st printing 2000, 2nd printing 2000.)

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CONFERENCE PAPERS

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Juan Yao, Graham Partington, Max Stevenson, *Predicting the Directional Change in Consumer Sentiment*, The 28th Annual Symposium on Forecasting, Nice 2008.

Maria Kim and Graham Partington, *The Dynamic Prediction of Corporate Failure*, Australasian Finance and Banking Conference, 2008.

M. Dempsey and G. Partington, *Cost of Capital and Valuation Equations that Work for Any Tax System: Their Application under the Australian Imputation Tax System*, Multinational Finance Association Conference, Thessalonica, 2007.

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G. Hobbes, G. Partington and M.J. Stevenson, *Earnings Dividends and Returns: A Theoretical Model*, Asia-Pacific Finance Association Conference, Hong Kong, 1995.

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G. Partington, *Miller Modigliani and Ohlson: A Note on Old Models in New Clothes*, 1993.

SUBMISSIONS TO GOVERNMENT INQUIRIES AND THE ACCOUNTING RESEARCH FOUNDATION

G. Partington, *Pricing and Capital Adequacy: Are the Banks Getting it Wrong?* a submission to The Australian Banking Inquiry, May 1991.

G. Partington, *Accounting in Higher Education*, a submission to The Review of The Accounting Discipline in Higher Education. July 1989.

J. McKinnon and G. Partington, *Statement of Sources and Applications of Funds - A Comment on the Exposure Draft*, a submission to the Australian Accounting Research Foundation, 1980.

C. Le Gras and G. Partington, *Commission Rates - Sheep and Cattle Sales*, a submission to the Prices Justification Tribunal, October 1979.

R. Chenhall and G. Partington, *Financial Effects of Corporate Taxation*, an invited submission, Australian Financial System Inquiry, July 1979.

R. Chenhall and G. Partington, *Submission on Corporate Sector Finance*, a submission to the Australian Financial System Inquiry, May 1979.

RESEARCH INTERESTS

My main research interests are in corporate finance. A major part of my research is concerned with dividend policy and the cost of capital. In particular, the market value of dividends and associated franking credits in Australia and overseas.

MEMBERSHIPS

Accounting and Finance Association of Australia and New Zealand (1978–to date)

American Accounting Association (1978–1992)

European Accounting Association (1984–1987)

American Finance Association (1988–1990)

Australian Institute of Bankers (1993–1997)

CAREER ACTIVITIES 1976–TO DATE

My current position is Associate Professor of Finance at the University of Sydney, where I am head of the postgraduate research program in finance. Until recently I was also the Education Director for the Capital Markets Co-operative Research Centre.

In a career stretching back more than thirty years I have held Associate Professorships in finance at The University of Technology Sydney and The University of British Columbia. I have also held academic positions at Macquarie University and the University of Wales (Bangor)

I have had extensive teaching and research responsibilities in finance and accounting as well as being head, or deputy head of University Departments and Schools. I have been a major force in the design of several undergraduate and postgraduate degrees and majors in finance. I also supervise Honours, Master's, and PhD theses. I act as a referee for academic journals, as an

assessor for ARC grants and as an examiner of PhD theses. I have also been a member of Higher Education Board and VTAB accreditation committees for degree and diploma accreditation.

CONSULTANCY

From time to time I undertake consulting assignments and also provide informal advice to companies and professional associations. My consultancy is mostly in relation to the cost of capital, valuation, imputation credits and capital budgeting. Most recently this has involved the valuation of NSW State forests and in coal compensation cases, work on both the cost of capital and the value of imputation tax credits.