What Determines Early Exercise of Employee Stock Options?

Summary Report of Honours Research Project

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Abstract

Employee stock options (ESOs) have become an increasingly popular way of remunerating employees. This paper analyses factors at the firm and option level that may affect the decision to exercise ESOs prior to maturity. ESO early exercise has not previously been empirically investigated in Australia. Exercises over the period 1998-2004 are analysed using cross-sectional regression. The key factor that influences the early-exercise decision is dividends. Exercises frequently occur well prior to maturity, but in most cases little time value is sacrificed. The findings have implications for ‘fair’ valuation of ESOs in accounting statements, as required by AASB 2.
What Determines Early Exercise of Employee Stock Options?

1. Aims and significance of research

Employee stock options (ESOs) have become an increasingly popular way of remunerating employees both in Australia and overseas. From 1 January 2005 accounting standard AASB 2 Share-based Payment (AASB2), which is equivalent to IFRS 2, issued by the International Accounting Standards Board, applies to financial reporting in Australia.¹ The new standard requires the ‘fair value’ of ESOs, as measured at the grant date, to be recognised in financial statements and written off over the ESO’s life.

Although ESOs are not listed securities and cannot be sold by employees, they can be exercised early, i.e. prior to the maturity date. The ability to exercise early is a critical feature that can have a significant effect on ESO valuation, as a large proportion of ESOs are exercised early. This is acknowledged in AASB 2, and the effect of expected early exercise is required to be taken into account when applying an option pricing model to determine the ‘fair value’ of ESOs (see paragraph B9 of AASB 2). The objective of this thesis is to analyse potential factors at the firm and option level that may affect the early exercise decision and hence the appropriate pricing of ESOs. The aim is to develop a greater understanding of why so many ESOs granted in Australia are exercised early and how early exercise varies across different firms and ESO series. Although it can have a significant impact on option valuation, the issue of early exercise has not previously been empirically investigated in Australia. The research will provide out of sample evidence which can be compared to US empirical findings (see, for example, Bettis et al. (2005))).

Risk assessment and management of derivative products issued by companies is a very important area. There are a number of well publicised cases of substantial losses caused by inappropriate risk management of derivatives. ESOs are a good example to investigate the risks a company faces when issuing or using derivatives. ESOs are

¹ See Australia Accounting Standards Board 2004, Accounting Standard AASB 2 Share-based Payment, July.
What Determines Early Exercise of Employee Stock Options?

American call options written by a firm on its common stock and granted to employees as a form of incentive-based compensation. ESOs are predominantly granted at-the-money, and have long lives compared to exchange traded options (typically five years in Australia). ESOs have a number of unusual or ‘exotic’ features compared to ordinary traded options, such as non-transferability and performance-based vesting criteria. These attributes result in complex valuation and hedging issues that companies need to be aware of.

A crucial feature of ESOs is that they are non-transferable, which means they cannot be sold. Otherwise, this would be an easy way for an employee to stop the ESO component of their compensation from being tied to the value of the firm. The only way an employee can convert their long option position into cash is to exercise vested ESOs and sell the acquired stock. It is difficult for the employee to hedge their option position to reduce risk exposure and generate a low risk return. Such a hedge would require short-selling the firm’s stock or entering into an offsetting derivative transaction with a third party. The inability of employees to hedge or sell their options puts them in an unusual position identified by Meulbroek (2001). Unlike diversified outside investors, employees are subject to all of the stock price volatility when holding ESOs, not just the systematic part of the firm’s risk. This could be argued as a desirable feature of incentive-based compensation, but it does have implications for early exercise.

Executives, who receive the majority of ESOs, are typically far less diversified than outside investors. Holding ESOs further increases exposure to firm-specific risk, which may be undesirable for a risk-averse executive. Sacrificing the option’s remaining time value by exercising early and selling the acquired stock is often a rational approach to improve the executive’s own individual utility. This transaction improves the executive’s level of diversification and was referred to by Chance (2004) as a form of ‘synthetic liquidity’.
What Determines Early Exercise of Employee Stock Options?

Early exercise is highly relevant for the valuation of ESOs. Empirical evidence indicates employees are prepared to sacrifice a significant amount of the option’s life to supposedly achieve the benefits of diversification and liquidity. Prior studies have begun to identify specific factors possibly relevant to the early exercise decision. However, André et al. (2002) (page 2) note that “research on the motives for early exercise is relatively sparse and fairly recent”.

2. Data and methodology

This thesis considers Australian public firms listed on the Connect 4 Annual Report database in 2005. All firms in the S&P/ASX 300 index\(^2\) were investigated and firms with sufficient employee stock option data available were considered. The following data on specific series was collected: strike price, grant date, vesting date(s) and criteria, exercise date(s), maturity date, the number that were exercised or lapsed and the type of employee the options were issued to. ESO series are classified according to whether they were granted to executives, directors or employees.

Practically all firms from the index have ESO plans, but in the majority of cases the data required for this study was unavailable. Typically until either 2002 or 2003, the information provided about specific ESO series in annual reports is limited. Figures provided are usually aggregates of all ESO series the firm has issued. This makes it difficult to identify series for the tracking of exercise behaviour, given the long-lived nature of ESOs.

The final sample has ESO series from 49 S&P/ASX 300 firms, 35 of which are part of the S&P/ASX 200. ESO data from five other smaller firms, identified for a related study on ESOs, was also included. Data from these firms does not contain outliers that would significantly alter the results. From the 54 firms, 138 ESO series are identified

\(^2\) According to the Australian Stock Exchange website, [http://www.asx.com.au](http://www.asx.com.au), “The S&P/ASX 200 index is recognised as the investable benchmark for the Australian equity market.” The S&P/ASX 300 index “provides additional depth and coverage to the S&P/ASX 200. It provides up to an additional 100 small-cap stocks to the S&P/ASX 200.” Considering firms from this index ensures the analysis is not restricted to ESOs granted by large firms.
What Determines Early Exercise of Employee Stock Options?

and tracked completely, i.e. all exercise dates can be identified. In the 138 series there are 445 exercise ‘months’. Any exercises in the same month for the same series are aggregated following Huddart & Lang (1996). This is appropriate given that exercise activity is analysed on a monthly basis. It is also an approximate method of ensuring individual exercises can be considered independent events in the analysis.

The overall aim is to get a broad range of firms, even if only one series per firm is available. The total sample of firms comes from a broad cross-section of industries. All ten of the Global Industry Classification Standard (GICS) sectors are represented, and there are firms from 20 of the 23 industry groups.

In separate regressions, four different types of dependent variable are analysed. This summary report focuses on the two most important dependent variables. The first is the elapsed time in months after the grant month to the exercise month (MAG). This is the actual life of the ESO, or the time it remains outstanding. The second is the ‘RATIO’ variable used in Bettis et al. (2005). This is defined as the intrinsic value of the ESO when exercised (i.e. the stock price minus the strike price) divided by the value of an American call option. The maturity of this option is equal to the time remaining until the ESO’s maturity and the initial stock price is the price on the exercise date. This variable is bounded by 0 and 1: the smaller the ‘RATIO’, the greater the amount of time value sacrificed by exercising. As the exact exercise date cannot be determined with precision, the stock price used is the average price in the month where exercise occurs. American option prices are calculated using the Barone-Adesi & Whaley (1987) model.

The following independent variables are tested for each ESO series: firm dividend yield, stock price volatility, firm size, firm liquidity (using free cash flow as a proxy), and option moneyness. Option moneyness reflects intrinsic value and is defined as the stock price divided by the strike price. Dependent and independent variables are defined in Table 1.
What Determines Early Exercise of Employee Stock Options?

Early exercise behaviour is principally analysed using cross-sectional regression equations. Two types of regression models are considered: ordinary least squares (OLS) and weighted least squares (WLS). When there are 445 data points, it is quite possible that the small exercises will sometimes be driving the results and potentially causing inferences that may be erroneous. For WLS, weights are chosen to reflect the size (dollar values) of the exercises. Each exercise is weighted by the natural logarithm of the number of ESOs exercised multiplied by the strike price. The larger exercises therefore have a stronger influence when fitting the model. However, the regressions are not excessively driven by the largest exercises. The weighting measure therefore seems like a reasonable alternative to standard OLS. Encouragingly, there are no persistent significant differences between the OLS and WLS results.

In the regression analysis all observations, i.e. values for independent variables, are normalised. With normalised independent variables, each regression coefficient explains how a one standard deviation change in the independent variable affects the dependent variable. The dependent variable is not normalised. This procedure does not affect inferences based on significance levels, but makes the coefficient values easier to interpret. The regression constant becomes the mean value for the dependent variable. The RATIO dependent variable is a fraction. As its values are bounded by 0 and 1, the residuals in the regression are similarly bounded, which is inappropriate. A logistic transformation is appropriate, however, there are some dependent variable values equal to 1. Therefore, a trimmed logistic transformation is used, so that all values are strictly between 0 and 1. The first step is to ‘trim’ the values using the following equation:

$$T_{i,j} = c \times R_{i,j} + 0.5 \times (1 - c)$$

Where:

- $$T_{i,j}$$ = Trimmed value of observation i for dependent variable j
- $$R_{i,j}$$ = Raw value of observation i for dependent variable j
- $$c$$ = A multiplier set to 0.99
What Determines Early Exercise of Employee Stock Options?

The second step transforms the trimmed values using the following equation:

\[ L_{i,j} = \ln \left( \frac{T_{i,j}}{1 - T_{i,j}} \right) \]

Where: \( L_{i,j} = \) Transformed (logistic) value of observation \( i \) for dependent variable \( j \);
\( T_{i,j} = \) Raw value of observation \( i \) for dependent variable \( j \);
\( \ln = \) The natural logarithm function

The adjusted values obtained from the trimmed logistic transformation are then used in the RATIO regression model.

The first regression equation uses the dependent variable MAG and is specified as follows:

\[ MAG_i = \alpha_0 + \alpha_1 DIV_i + \alpha_2 VOLEX_i + \alpha_3 SIZE_i + \alpha_4 FCF_i + \alpha_5 S_{AVGEX}/K_i + \alpha_6 S_G/K_i + \epsilon_i \quad (1) \]

The coefficients \( \alpha_1, \alpha_2, \alpha_5 \) and \( \alpha_6 \) are predicted to be negative, while \( \alpha_3 \) and \( \alpha_4 \) are predicted to be positive.\(^3\) ESOs are not dividend protected, and dividends can significantly decrease an ESO’s intrinsic value because of the long time to maturity. It is expected that the higher the firm’s dividend yield, the earlier employees will exercise. As firm-specific risk increases, there will be a stronger desire to diversify, so it is predicted that the higher the firm-specific risk, the earlier employees will exercise.

Although early exercise sacrifices the ESO’s remaining time value, it allows the employee to make a real gain of the current intrinsic value. This is an offsetting effect which can only be immediately exploited by exercising. An option which is deep-in-the-money has far less time value as a proportion of its total value. A higher stock price relative to the strike price is required to induce exercise at an earlier point in

\[^3\] Variables are defined in Table 1.
What Determines Early Exercise of Employee Stock Options?

time. The initial moneyness ratio could be related to early exercise in a similar fashion.

Bettis et al. (2000) found that executives at smaller firms are subject to less internal regulation with regard to the sale of their employer’s stock. Analyst and investor scrutiny is also likely to be less for stock sales by executives in smaller firms. Executives at smaller firms may have a greater desire for liquidity because their overall compensation is lower compared to executives at larger firms. Finally, there is empirical evidence of a significant size premium in the Australian stock market; see Durack et al. (2004). Small firms earn higher raw returns than big firms, so their ESOs are more likely to move deep-into-the-money earlier, thereby inducing exercise.

The conventional reason for granting ESOs is to more closely align the interests of employees and shareholders by providing a form of incentive-based compensation to employees. Bettis et al. (2005) assert that ESOs could also be granted as a substitute for cash compensation in firms that are suffering from liquidity constraints. Employees in these firms will receive more options and less cash. As individual wealth will be more illiquid, there will be a stronger desire for liquidity.

The RATIO regression is specified as follows:

\[
\text{RATIO}_i = \alpha_0 + \alpha_1 \text{DIV}_i + \alpha_2 \text{VOLEX}_i + \alpha_3 \text{FCF}_i + \epsilon_i
\]  

(2)

The coefficients \(\alpha_1\) and \(\alpha_3\) are predicted to be positive, while \(\alpha_2\) is predicted to be negative. When the stock underlying the ESO has a higher dividend yield the option will have less time value. This is because the longer the ESO is held, the greater the total dividends which lower the intrinsic value. Although exercise is anticipated to be earlier the higher the dividend yield, the opportunity cost of early exercise is expected to be lower.
What Determines Early Exercise of Employee Stock Options?

Employees will be prepared to sacrifice more option time value to achieve the benefit of diversification as firm-specific risk increases. There is also a positive relationship between risk and time value because of an option’s asymmetric payoff. Employees will also be prepared to sacrifice more option time value to achieve the benefit of liquidity when individual wealth is more illiquid. This will occur for firms which are suffering from greater liquidity constraints.

The most common time to maturity is five years which occurs 109 times (79% of the sample of 138 grants). Only 39 exercises (8.8% of the sample of 445 exercises) occur in the maturity month, while 324 exercises (73%) occur more than 6 months prior to maturity. ESOs are exercised on average 3.34 years after grant. This implies that on average there is still over 18 months until maturity, but when exercise occurs there is practically no time value sacrificed as the mean RATIO is 0.92. This is because by the time ESOs are exercised they are deep-in-the-money, and not exercising will lead to a decrease in intrinsic value in the future because of dividends.

Of the 138 ESO series, 20 were granted to directors, 21 were granted to lower level employees and 97 were granted to executives. As hypothesised, directors appear to exercise the latest, on average less than six months prior to maturity. They also appear to sacrifice slightly less time value, although all three groups predominantly exercise when ESOs are deep-in-the-money. The interesting result is that exercise patterns for executives and lower level employees appear to be quite similar. Both exercise on average approximately 21 months prior to maturity, and the average RATIO at exercise for both groups is close to 0.90. It is suspected that the ‘lower level’ employees who receive ESOs actually occupy relatively high positions in the firm, and are therefore in a similar position to executives.
3. Results

Table 2 presents the results for the MAG regression. The adjusted $R^2$ for the OLS regression is rather low, but similar to Bettis et al. (2005), reflecting a lot of noise in the data. The unweighted WLS adjusted $R^2$ is almost exactly the same as the OLS adjusted $R^2$. As hypothesised, the dividend yield is inversely related to the actual ESO life and statistically significant at the 1% level. The volatility in the year prior to exercise is also highly significant. The higher the price variability over the life of the ESO, the earlier employees exercise. There is a highly significant relationship between firm size and the actual ESO life and as predicted, ESOs at larger firms are exercised later. The measure of free cash flow is also significant at the 5% level. If it is a good proxy for firm liquidity, employees at firms with greater liquidity constraints exercise earlier.

The moneyness ratio at exercise has a negative sign, but is insignificant. The main surprise is that the initial moneyness ratio is highly significant. The more the ESO is initially in-the-money, the later it is exercised. This could be driven by the relatively small number of ESOs which are granted deep-in-the-money. In this situation, the ESO exposes the employee to relatively little risk, so they may be prepared to delay exercise. However, for other series, it seems difficult to explain why an option with a lower initial moneyness ratio would be exercised earlier. Although this variable is highly significant, this may be a spurious statistical anomaly.

The results for the RATIO regression are presented in Table 3. As expected, the dividend yield is highly significant: early exercise sacrifices less time value when dividends are higher. It may be rational from a traditional perspective to exercise because of dividends, regardless of the additional benefits for ESOs. The volatility variable has the predicted negative sign, and is also highly significant. Australian employees appear to exercise ESOs when they are deep-in-the-money because of future dividends and an aversion to recent stock price volatility i.e. firm-specific risk.
What Determines Early Exercise of Employee Stock Options?

Free cash flow is insignificant, and has an unanticipated negative sign. The implication is that ESO holders in this Australian sample appear less inclined to sacrifice a significant amount of time value to achieve the benefit of liquidity compared to the US. The desire for liquidity seems to be more of a secondary concern, although the free cash flow variable employed is possibly not a very accurate proxy.

Conclusion

The valuation of ESOs is now a highly relevant issue for firms, with the accounting standard AASB 2 applying from 1 January 2005. AASB 2 requires ‘expected early exercise’ to be taken into account in option pricing models for ESO valuation. Time to maturity is typically five years from the grant date and the average ESO exercise occurs more than 18 months prior to maturity. Less than 10% of the sample exercises occur in the maturity month.

Although a significant part of the maximum life is sacrificed in Australia, in most cases very little option time value is foregone, similar to the US study of Bettis et al. (2005). ESOs are deep-in-the-money at exercise and intrinsic value makes up practically all of the total option value at this point. The expected future decrease in intrinsic value caused by dividends means deep-in-the-money ESOs have practically no time value at exercise. This is emphasised by the high mean RATIO of 0.92.

The importance of dividends is clearly evident in the regressions. Higher dividends cause significantly earlier exercise. Employees do consider dividends when choosing to exercise and this cannot be considered irrational. In fact, as the RATIO regression shows, early exercise when dividend yield is higher sacrifices significantly less time value. The two relationships appear even stronger than in US studies, possibly because dividends are more common and yields higher in Australia due to the imputation tax system.

There is also a desire to diversify exposure to higher price volatility (firm-specific risk) over the ESO’s life by exercising earlier, and employees are prepared to sacrifice more
time value to improve diversification. There is some weaker evidence of the hypothesised relationships between early exercise and size and free cash flow. The results for moneyness ratios in the regressions are puzzling, with moneyness at exercise seemingly unrelated to the dependent variables. The most likely explanation for the lack of importance is that practically all ESOs are exercised deep-in-the-money when very little time value remains. Moneyness at grant is significant more often, but always has an unanticipated coefficient sign. Although this result is highly significant, it may be a spurious statistical anomaly.

It appears important to distinguish ESOs granted to directors when analysing exercise behaviour. Directors appear to exercise much later, very close to maturity, compared to executives and lower level employees, meaning they also sacrifice less option time value. The later exercises do provide some evidence suggesting that directors are more diversified compared to other employees. Alternatively, directors may not want to appear opportunistic by exercising before a ‘large’ dividend which they decided upon. The exercise behaviour of employees seems remarkably similar to executives. Ideally, more information is required when a firm discloses it has an ‘employee’ stock option plan, as opposed to an executive plan.

In terms of early exercise, the RATIO variable indicates that employees sacrifice very little option time value in most cases. In terms of modifying valuation for early exercise, a major implication of this thesis is that conventional pricing models may still have a significant role, possibly with minor adjustments. This is critical for the practical implementation of AASB 2, because although the accounting standard requires the effect of expected early exercise to be taken into account when determining the fair value of ESOs, it provides little guidance as to how this should be done. The Barone-Adesi & Whaley (1987) American option pricing model may sufficiently adjust for early exercise motivated by dividends, which have been found to be the most important factor.
What Determines Early Exercise of Employee Stock Options?

Possibly employees are prevented from exercising until ESOs are deep-in-the-money because performance-based vesting criteria are imposed. These conditions are typically based on stock price or EPS growth relative to an industry index, with exercise not permitted until these criteria are achieved. Australian ESOs are distinguishable from US ESOs because the latter do not have performance-based vesting criteria. In the Australian case, the vesting conditions prevent greater sacrifices of time value, and may actually be relevant when adjusting valuation for early exercise. The relationship between performance-based vesting criteria and early exercise was beyond the scope of this thesis, but now appears to be a key area for future research.
What Determines Early Exercise of Employee Stock Options?

References


### Table 1 Variable Definitions

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAG</td>
<td>Elapsed time in months from the grant month to the exercise month</td>
</tr>
<tr>
<td>RATIO</td>
<td>Intrinsic value at exercise divided by remaining American option value at exercise</td>
</tr>
<tr>
<td></td>
<td><strong>Independent Variables</strong></td>
</tr>
<tr>
<td>DIV</td>
<td>Dividend yield at the end of the financial year prior to grant</td>
</tr>
<tr>
<td>VOLEX</td>
<td>Standard deviation of log returns in the 250 trading days prior to exercise</td>
</tr>
<tr>
<td>SIZE</td>
<td>Log of total assets at the end of the financial year prior to grant</td>
</tr>
<tr>
<td>FCF</td>
<td>Cash from operations minus cash outlays for investments, scaled by total assets for the financial year prior to grant.</td>
</tr>
<tr>
<td>$S_{AVGEX}/K$</td>
<td>Moneyness at exercise using the average stock price for the exercise month</td>
</tr>
<tr>
<td>$S_G/K$</td>
<td>Moneyness at grant using the stock price at the end of the grant day</td>
</tr>
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</table>
What Determines Early Exercise of Employee Stock Options?

Table 2  Regression specification 1: Months after grant

\[ \text{MAG}_i = \alpha_0 + \alpha_1 \text{DIV}_i + \alpha_2 \text{VOLEX}_i + \alpha_3 \text{SIZE}_i + \alpha_4 \text{FCF}_i + \alpha_5 \frac{\text{SAVGEX}_i}{K} + \alpha_6 \frac{\text{SG}_i}{K} + \varepsilon_i \]

Variables are defined in Table 1. All independent variables are normalised. In the WLS regression exercises are weighted by the natural logarithm of the size of the exercise, the number of ESOs exercised multiplied by the strike price. The adjusted \( \text{R}^2 \) for the WLS regression is unweighted. The t-statistics are in italics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS Coefficient</th>
<th>t-statistic</th>
<th>WLS Coefficient</th>
<th>t-statistic</th>
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<tr>
<td>Constant</td>
<td>39.97</td>
<td>62.86***</td>
<td>39.96</td>
<td>61.18***</td>
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<tr>
<td>DIV</td>
<td>-3.17</td>
<td>-3.57***</td>
<td>-2.43</td>
<td>-2.58***</td>
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<tr>
<td>VOLEX</td>
<td>-2.99</td>
<td>-3.43***</td>
<td>-2.37</td>
<td>-2.63***</td>
</tr>
<tr>
<td>SIZE</td>
<td>2.51</td>
<td>3.17***</td>
<td>2.56</td>
<td>3.26***</td>
</tr>
<tr>
<td>FCF</td>
<td>1.34</td>
<td>2.13**</td>
<td>1.57</td>
<td>2.43**</td>
</tr>
<tr>
<td>SAVGEX/K</td>
<td>-0.53</td>
<td>-0.82</td>
<td>-0.62</td>
<td>-0.91</td>
</tr>
<tr>
<td>SG/K</td>
<td>1.74</td>
<td>2.69***</td>
<td>1.94</td>
<td>2.88***</td>
</tr>
</tbody>
</table>

Adjusted \( \text{R}^2 \) 0.11

The t-statistics are based on White (1980) heteroskedasticity-consistent standard errors. ***, **, and * indicates significance at the 1%, 5% and 10% (2-tail) level, respectively.
What Determines Early Exercise of Employee Stock Options?

Table 3  Regression specification 2: RATIO

\[ \text{RATIO}_i = \alpha_0 + \alpha_1 \text{DIV}_i + \alpha_2 \text{VOLEX}_i + \alpha_3 \text{FCF}_i + \varepsilon_i \]

Variables are defined in Table 1. All independent variables are normalised. In the WLS regression exercises are weighted by the natural logarithm of the size of the exercise, the number of ESOs exercised multiplied by the strike price. The adjusted \( R^2 \) for the WLS regression is unweighted. The t-statistics are in italics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS Coefficient</th>
<th>OLS t-statistic</th>
<th>WLS Coefficient</th>
<th>WLS t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.71</td>
<td>47.48***</td>
<td>3.71</td>
<td>44.55***</td>
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<tr>
<td>DIV</td>
<td>0.43</td>
<td>5.20***</td>
<td>0.46</td>
<td>5.47***</td>
</tr>
<tr>
<td>VOLEX</td>
<td>-0.50</td>
<td>-5.11***</td>
<td>-0.48</td>
<td>-4.73***</td>
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<tr>
<td>FCF</td>
<td>-0.10</td>
<td>-1.16</td>
<td>-0.11</td>
<td>-1.25</td>
</tr>
</tbody>
</table>

Adjusted \( R^2 \) 0.19 0.19

The t-statistics are based on White (1980) heteroskedasticity-consistent standard errors. *** , ** , and * indicates significance at the 1% , 5% and 10% (2-tail) level, respectively.