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Article

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Economic Policy Uncertainty and Corporate Investment Efficiency: Evidence from Australian Energy Companies

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ABSTRACT

This study examines the impact of Economic Policy Uncertainty (EPU) on corporate investment efficiency. I argue that EPU increases financing constraints or induces firms to postpone investment projects, thereby reducing their investment efficiency. Using a data set of Australian energy firms from 2010 to 2022 and the EPU index of Australia, the findings show that the EPU index has a significant and negative effect on corporate investment efficiency. The results hold in fixed-effects and dynamic GMM models and after control for firm-specific factors, suggesting that a macroeconomic factor like the EPU index also plays an important role in determining the efficiency of Australian energy companies' investments.

Keywords: Economic Policy Uncertainty, Corporate Investment Efficiency, Energy Company, Australia
JEL Classifications: G31, G32, Q43, E60

1. INTRODUCTION

Corporate investment is one of firms' important financial management decisions to help them grow. By taking investment projects, firms can expand their current business or develop new products and services. However, if corporate investments are unsuccessful or inefficient, firms may suffer from the capital depletion, financial distress, and even bankruptcy in the extreme case. The inefficiency of corporate investments is reflected in the problems of overinvestment and underinvestment based on the agency cost theory by Jensen (1986). According to this theory, the conflicts of interest between managers, stockholders, and bondholders may cause firms to invest in negative-NPV projects (the overinvestment problem) or forgo positive-NPV investments (the underinvestment problem). These problems are enhanced when there is the economic policy uncertainty (EPU). The EPU literature documents that when EPU is high, it is more difficult for firms to raise capital due to an increase in financing costs (Gungoraydinoglu et al., 2017; Pástor and Veronesi, 2012; 2013) or because of the limited access to bank loans (Bordo et al., 2016; Gilchrist et al., 2014). External financing becomes more difficult or costly when EPU is high, leading firms to abandon or postpone good investments. This explanation is based on real options, specifically, the timing options in investment decisions, which suggest that when there is more uncertainty of economic policies, firms tend to postpone their investments to wait for another time (Bernanke, 1983). As a result, high EPU may negatively affect the efficiency of corporate investments.

This study examines the effect of EPU on corporate investment efficiency. Prior studies have documented some determinants of corporate investment efficiency, such as firm size, leverage, and profitability. To the best of my knowledge, no study has examined the effect of EPU on corporate investment efficiency, especially for Australian energy companies. I choose the energy sector as firms in this sector have a great need for capital spending for large investment projects and face more uncertainty in terms of investment and financing risks. For example, low-carbon investments and research and development into green energy technologies are capital-intensive projects (Bosetti et al., 2011;

Fuss et al., 2011; Yu et al., 2022). Firms may have to postpone these investments if they cannot mobilize needed funds. Using the real options model with stochastic prices and the ability to delay investments, Koch et al. (2017) find similar results when examining the investment behaviors of energy firms under alternative scenarios of prices and policy regimes. These findings suggest that investment management is an important decision of energy companies. In this study, I examine the Australian EPU together with firm-specific factors to see if EPU is a significant determinant or its effect is subsumed by other factors. My study contributes to the literature in several ways. First, it contributes to the corporate investment literature as it investigates a new determinant of investment efficiency for Australian energy firms. Second, findings of my study contribute to the literature on the importance of macroeconomic policies as the Australian government's economic policy uncertainty has a significant impact on firm-level investment decisions.

In recent years, people pay more attention to economic uncertainty (Stock and Watson, 2012). Uncertainty related to economic policies, including fiscal and monetary policies, is mentioned in many newspapers, policymakers' statements, and academic studies (PwC News Release, 2017; Reuters, 2017). Stanley Fischer, the Federal Reserve Vice Chairman, once said: "Uncertainty about the outlook for government policy in health care, regulation, taxes, and trade can cause firms to delay projects until the policy environment clarifies." (Bloomberg Economics, 2017). In the literature, researchers find evidence supporting negative effects of EPU on corporate investments and mergers and acquisitions (Bernanke, 1983; Bloom, 2009; Bonaime et al., 2018; Gulen and Ion, 2016; Julio and Yook, 2012) but no study investigates the effect of EPU on the efficiency of investment decisions. In this study, I use the Australian EPU index, which is based on newspaper coverage frequency and constructed by Baker et al. (2016), to measure the uncertainty of economic policy[1]. This index is widely used in the literature and is computed monthly with high index value indicating high uncertainty. I use June EPU index since the Australian financial year ends in June. I also follow the common approach in the literature to compute the average EPU index of each financial year by taking the average of 12 monthly EPU indexes from July to June. I then examine how the investment efficiency of firms in the energy sector is affected by the Australian EPU index and other firm-specific factors.

My sample consists of energy companies in Australia from 2010 to 2022 obtained from the Thomson Reuters EIKON database. Since the pooled ordinary least squares (Pooled OLS) approach assumes no correlation between residuals and covariates, it might have an endogeneity bias caused by measurement errors, omitted variables, or simultaneity. I test the robustness of my results using fixed-effects (FE) and dynamic generalized method of moments (dynamic GMM) models. The results show that the EPU index, including June EPU and Average EPU indexes, negatively affects corporate investment efficiency. The results hold after controlling for firm-level factors.

1 The monthly EPU index for Australia is obtained from www.PolicyUncertainty.com (Baker et al., 2016).

The remainder of this study proceeds as follows. Section 2 discusses the literature and develops hypotheses. Section 3 describes the data and methodology. Empirical results are analyzed in Section 4, and Section 5 concludes.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Agency costs occur due to the conflict of interests between managers, stockholders, and bondholders. Jensen (1986) states that when firms have too much free cash flow, managers may use it to invest in negative-NPV projects for their own interests. The free cash flow hypothesis suggests that debt can be used to mitigate this agency cost. Debt repayment as an obligation can help reduce free cash flows, thereby decreasing the opportunity of managers spending on bad investments. By managing the issue of free cash flows, debt can also produce profits and increase the firm's performance. However, debt can create an agency problem between equity holders and debt holders: the agency cost of debt (Jensen and Meckling, 1976). Due to this conflict of interests, firms might not undertake profitable or positive-net present value projects (Myers and Majluf, 1984).

2.1. The Overinvestment Problem

First, the over-investment problem occurs due to the interest conflict between stockholders and managers who pursue different objectives in making investment decisions (Jensen, 1986). The stockholders' interest is mainly maximizing their wealth which means that they want to invest in profitable projects and strongly reject negative-NPV projects. On the other hand, managers who pursue their own benefits might invest in unprofitable projects to enhance their power. Managerial entrenchment applied in corporate investments may cause the overinvestment problem (Jensen, 1986; Stulz, 1990).

Second, the agency cost of debt generated by the stockholders-bondholders' conflict of interest might also lead to the over-investment problem. These agency costs are especially significant when firms are in financial distress. Shareholders have the tendency to take highly risky projects to speculate on gaining greater benefits for themselves at the expense of debt holders. If the projects are unsuccessful, losses will be borne by debt holders (Jensen and Meckling, 1976).

2.2. The Underinvestment Problem

In terms of the underinvestment problem, information asymmetry and the conflict of interest between shareholders and bondholders can be the main cause, especially in the context of financial constraints. These constraints reduce the firm's ability to invest in profitable projects. Additionally, bondholders might require higher returns due to lacking information or accessibility to evaluate the profitability and quality of the project that the firm invests in (Stiglitz and Weiss, 1981). Consequently, firms might forgo positive-NPV investments due to high financing costs or the lack of available financing sources.

2.3. Economic Policy Uncertainty (EPU) and Corporate Investment Efficiency

Economic policy uncertainty has a significant effect on firm-level financial management decisions. The literature has provided evidence to support the negative effect of EPU on corporate investments. Gulen and Ion (2016) find the negative relationship between EPU and firm investments, especially for firms with high level of investment irreversibility or more dependent on government spending. Chen et al. (2020) have similar findings for Australian firms. Other studies have found the positive impact of EPU on corporate cash holdings (see, for example, Phan et al., 2019 for the U.S.; Li, 2019 for cross-country data; Trinh et al., 2022 for the Australian energy sector). However, to the best of my knowledge, no studies have examined the relationship between EPU and the efficiency of firm investments.

Corporate investment efficiency is measured by the degree to which firms deviate from the predicted investment level. That means investments are inefficient when firms overinvest or underinvest. The literature documents some factors affecting firm investment efficiency, such as corporate social responsibility (Samet and Jarboui, 2017), financial reporting quality (Biddle et al., 2019; Gomariz and Ballesta, 2014), information disclosure (Dutta and Nezlobin, 2017), accounting conservatism (Lara et al., 2016), government intervention (Chen et al., 2011; Chen et al., 2017a), analysts' forecast quality (Chen et al., 2017b), lead independent director (Rajkovic, 2020), and institutional ownership (Cao et al., 2020). In the presence of economic policy uncertainty, firms face more financial constraints (Bordo et al., 2016; Gilchrist et al., 2014; Gungoraydinoglu et al., 2017; Pástor and Veronesi, 2012; 2013) and postpone investments (Bernanke, 1983; Gulen and Ion, 2016). This might result in the inefficiency of firm investments, especially for firms in the energy sector since they often have large investment projects and hence any shocks of economic policies tend to greatly impact their operations and investment activities. As Dr. Fatih Birol, Executive Director of the International Energy Agency, said: "Large-scale investment to boost the development, deployment and integration of clean energy technologies – such as solar, wind, hydrogen, batteries and carbon capture (CCUS) – should be a central part of governments' plans…" (Australian Energy Council, 2020). Therefore, it is essential to investigate the possible effect of EPU on investment efficiency of Australian energy companies. Based on the arguments above, the following hypothesis is developed.

Hypothesis: EPU has a negative effect on corporate investment efficiency.

3. DATA AND METHODOLOGY

I examine the impact of EPU on corporate investment efficiency of Australian firms in the energy sector. Accounting data are obtained from the Thomson Reuters EIKON database. The Australian news-based EPU index is constructed by Baker et al. (2016) and available on www.PolicyUncertainty.com. The sample period is from 2010 to 2022. Following prior studies (Almeida and Campello, 2007; Gilchrist and Himmelberg, 1995), I exclude observations with missing values or errors such as negative assets, negative cash, leverage <0 or >1, and negative market-to-book ratio. The final sample consists of 542 firm-year observations.

Since the EPU index is estimated monthly while other accounting variables are annual data, I use Average EPU index, which is the average of monthly EPU index over 12 months of the financial year. In addition to this common approach, I also examine whether June EPU index affects investment efficiency. The Australian financial year ends in June and firms investments might be affected by the uncertainty of economic policy during the last month of the financial year, which is captured by June EPU index.

Below are the regression specifications:

First, I estimate the degree of inefficiency in firm investments using the approach of Richardson (2006). Firms achieve the optimal investment when they have the capacity to pursue all positive-NPV projects and not to invest in projects with negative NPV. Otherwise, their investments are inefficient. Therefore, the investment inefficiency is the deviation from the expected optimal level of investment, i.e. it is measured by the absolute value of the residual from the regression model (1) below. Since the original value of corporate investment inefficiency contains zeros after the decimal point, it is multiplied by 100 to improve the visual appearance of an estimated value. The higher value indicates the more inefficiency or less efficiency of firm investments.

$$IN_{i,t} = + \beta_1 GROWTH_{i,t-1} + \beta_2 CASH_{i\ t-1} + \beta_3 LEV_{i,t-1} + \beta_4 RET_{i,t-1} + \beta_5 AGE_{i,t-1} + \beta_6 SIZE_{i,t-1} + \beta_7 IN_{i,t-1} + \sum Year + u_{i,t} \quad (1)$$

where:
the subscripts i and t indicate firm i and year t, respectively;
IN: Corporate investment scaled by total assets (*IN = capital expenditure/total assets*);
GROWTH: Growth opportunity measured by Tobin's Q (*GROWTH = (book value of total liabilities + market value of equity)/total assets*);
CASH: Cash scaled by total assets (*CASH = (cash + cash equivalents)/total assets*);
LEV: Leverage (*LEV = (long-term debt + short-term debt)/total assets*);
RET: Stock return (*RET = (ending-year stock price – beginning-year stock price)/beginning-year stock price*);
AGE: Firm age, measured by the number of years since firms were incorporated;
SIZE: Firm size, measured by the natural logarithm of total assets;
Year: Year fixed effects; and
u: Error term.

After estimating investment inefficiency, the main regression model is developed to investigate the impact of EPU on this investment inefficiency with control variables being firm-specific factors used in the model of Lv and Xiong (2022).

$$INIE_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 AGE_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 STATE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 ROE_{i,t} + \varepsilon_{i,t} \quad (2)$$

where:
the subscripts i and t indicate firm i and year t, respectively;
INIE: Investment inefficiency, measured by the absolute value of residual from Equation (1), multiplied by 100 to improve the visual appearance;
EPU: EPU index, can be *JEPU* (EPU index in June) or *AvgEPU* (average of monthly EPU index over 12 months of the financial year);
STATE: State ownership dummy (*STATE* is 1 if firms have the

majority of state ownership, *STATE* is 0 otherwise).
ROE: Return on equity (*ROE = net income/total equity*);
Other variables: The same as in Equation (1); and
ε: Error term.

Among explanatory variables in Equation (2), EPU is considered an exogenous factor, while other variables are endogenous to investment inefficiency. Therefore, it is necessary to address the endogeneity issue to avoid potential incorrect signs of coefficients (Ketokivi and McIntosh, 2017) or potential wrong inferences of causal effects. For panel data, fixed-effects model can be used to handle endogeneity problems caused by omitted variables. However, according to Arellano and Bond (1991) and Blundell and Bond (1998), the dynamic GMM model is a better solution to endogeneity bias, especially for panel data. Wintoki et al. (2012) also say that dynamic GMM model provides consistent estimates when there are different sources of endogeneity such as simultaneity, unobserved heterogeneity, unobserved firm-specific fixed-effects, and dynamic endogeneity. By internally transforming data and including lagged values of the dependent variable, the dynamic GMM model removes endogeneity and improves the model's efficiency (Arellano and Bover, 1995; Roodman, 2009; Wooldridge, 2012). Thus, I estimate the regression model using Pooled OLS, fixed-effects, and dynamic GMM approaches to ensure that the coefficient estimates are consistent, efficient, and robust.

4. EMPIRICAL RESULTS

4.1. Overview of the Economic Policy Uncertainty (EPU) Index of Australia

The EPU index of Australia is estimated by Baker et al. (2016) using news from eight major Australian newspapers: Daily Telegraph, Courier Mail, The Australian, The Age, The Advertiser, Mercury, Sydney Morning Herald, and The Herald Sun. This index is the monthly index, therefore, I calculate the annual index by taking the average of 12 monthly indexes from July to June of each financial year and call it Average EPU index. This approach is commonly used by researchers in the literature. In addition, I also use June EPU index, the EPU index in the last month of Australian financial year, to examine how firms' investment efficiency is affected by the uncertainty in economic policy happening during the last month of the financial year.

June EPU index is the EPU index in June. Average EPU index is the average of 12 monthly indexes from July to June of each financial year of Australia.

June EPU index is the EPU index in June. Average EPU index is the average of 12 monthly indexes from July to June of each financial year of Australia.

Figure 1 illustrates June EPU index and Average EPU index of Australia from 2010 to 2022. Since Average EPU index is the average of monthly EPU indexes over 12 months, this index has lower volatility than June EPU index. For example, from 2013 to 2019 Average EPU index ranged from 73 to 130 while June EPU index fluctuated between 72 and 206. These two indexes sometimes moved together, such as in the 2011-2014 and 2018-2022 periods. However, they were in opposite directions in other periods, such as the 2014-2017 period. Both June EPU index and Average EPU index reached the maximum in 2012 (about 236 and 215, respectively). But June EPU index is lowest (about 67) in 2014 whereas Average EPU index has the minimum of about 73 in 2018. In general, these two indexes are not strongly correlated with each other with the correlation coefficient of 0.62. Therefore, although Average EPU index is often used by researchers, it is necessary to investigate how the investment efficiency of Australian energy firms is affected by the economic policy uncertainty measured by both indexes.

Figure 1: June EPU index and Average EPU index from 2010 to 2022

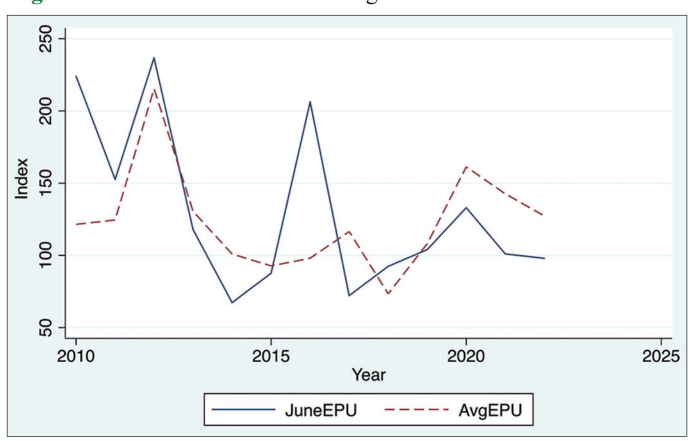

Table 1: Descriptive statistics

Variables	n	Mean	Median	Minimum	Maximum	SD
INV	542	0.121	0.090	0	0.637	0.116
INIE	542	6.352	4.450	0.042	32.695	6.138
JEPU	542	133.607	117.868	67.341	236.638	57.331
AvgEPU	542	127.086	124.474	73.432	215.278	36.222
GROWTH	542	1.388	0.985	0.018	9.586	1.482
CASH	542	0.211	0.138	0.003	0.926	0.208
LEV	542	0.093	0.005	0	0.658	0.143
RET	542	0.167	−0.063	−0.834	6.766	0.921
AGE	542	2.917	2.833	1.386	4.727	0.751
SIZE	542	18.99	18.438	14.319	24.189	2.293
ROE	542	−0.104	−0.062	−2.738	3.438	0.646
STATE	542	0.304	0.000	0	1	0.461

The sample consists of 542 firm-year observations from 2010 to 2022. Variables are defined in Section 3. Continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. SD: Standard deviation

4.2. Descriptive Statistics

Table 1 presents the descriptive statistics of all variables. In general, investment inefficiency (*INIE*) has a mean of 6.352 and a maximum of 32.695. The higher this variable is, the more inefficient the firm investments suffer. Mean of June EPU index (*JEPU*) is higher than that of Average EPU index (*AvgEPU*) (133.607 and 127.086, respectively). June EPU index has a lower minimum value, higher maximum value, and greater standard deviation than Average EPU index, indicating that June EPU index is more volatile than Average EPU index. Energy firms in the sample have the mean leverage (*LEV*) of 0.093. Mean of firm age (*AGE*) is 2.9 years, whereas that of firm size (*SIZE*) is 18.99. Return on equity (*ROE*) has a mean of -0.104, indicating a loss of average earnings for firms in the sample. Mean of state ownership (*STATE*) is 0.304, showing that about 30.4% of observations have the majority of state ownership.

4.3. Correlation

Table 2 provides the correlation coefficients of variables in the main regression model (Equation 2). Investment inefficiency is positively correlated with both June EPU and Average EPU indexes, and the correlations are statistically significant, consistent with my prediction that the higher the EPU, the more inefficiency of firm investments. Corporate investment inefficiency is also significantly correlated with firm age, size, state ownership, leverage, and return on equity. All of these correlation coefficients are negative, suggesting that these firm-specific factors can enhance the efficiency of firm investments. Although some explanatory variables are correlated with each other, none of them has the absolute values of correlation coefficients greater than 0.7. Thus, multicollinearity is not an issue in my study.

5. REGRESSION RESULTS

5.1. EPU Measured by June EPU Index

Table 3 presents the results of Pooled OLS, fixed-effects, and dynamic GMM regressions. The coefficient on *JEPU* is positive and statistically significant in all three regressions, supporting the hypothesis. For the dynamic GMM model, the coefficient is 0.00461, implying that when June EPU index increases by 10 points, on average the inefficiency of firm investments increases by 0.046. The coefficient on *JEPU* is statistically significant even after controlling for other factors that may affect corporate investment efficiency. Since the dynamic GMM model is optimal in addressing the endogeneity problem, the following discussions are on these control factors in the dynamic GMM model.

The coefficients on *AGE* and *SIZE* are negative and statistically significant. This result supports the prediction that the more mature and larger the firm is, the higher efficiency of firm investments. However, state ownership, leverage, and return on equity do not have a significant effect on investment efficiency. The coefficients on *STATE* and *LEV* variables have anticipated negative signs but are not statistically significant in the dynamic GMM model. For *ROE*, the coefficient is positive, in contrast with the expectation, but it is also insignificant.

Table 2: Pearson correlations

Variables	INIE	JEPU	AvgEPU	AGE	SIZE	STATE	LEV	ROE
INIE	1.000							
JEPU	0.073***	1.000						
AvgEPU	0.046***	0.517***	1.000					
AGE	−0.206***	−0.068***	−0.042***	1.000				
SIZE	−0.279***	−0.057***	−0.034***	0.379***	1.000			
STATE	−0.166***	−0.146***	−0.080***	0.217***	0.661***	1.000		
LEV	−0.130***	−0.062***	−0.017	0.149***	0.395***	0.250***	1.000	
ROE	−0.139***	0.033***	0.004	0.160***	0.316***	0.169***	0.060***	1.000

The sample consists of 542 firm-year observations from 2010 to 2022. Variables are defined in Section 3. Continuous variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively

Table 3: Regression results when using June economic policy uncertainty index

Variables	Pooled OLS	Fixed effect	Dynamic GMM
Constant	14.92*** (17.86)	14.87*** (7.84)	18.02*** (5.66)
INIE(-1)			−0.355*** (−10.50)
JEPU	0.00639*** (2.70)	0.00236* (1.95)	0.00461*** (4.37)
AGE	−0.577*** (−7.00)	−1.756*** (−5.70)	−1.119*** (−4.05)
SIZE	−0.609*** (−14.13)	−0.308*** (−2.72)	−0.533*** (−2.82)
STATE	0.584*** (3.24)	0.254 (1.08)	−0.319 (−0.86)
LEV	2.168*** (4.77)	1.563** (2.55)	−1.760 (−1.45)
ROE	−0.333*** (−3.48)	−0.132 (−1.21)	0.128 (0.59)
Industry FE	Yes	No	No
Year FE	Yes	Yes	No
Firm FE	No	Yes	No
Observations	542	542	408
R^2	0.147	0.046	
Adjusted R^2	0.119	−0.181	
F	5.316	3.500	

The sample consists of 542 firm-year observations from 2010 to 2022. In the dynamic GMM model, the number of observations is 408 since lagged values are used. Variables are defined in Section 3. Continuous variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively; t statistics are in the parentheses. OLS: Ordinary least squares, GMM: Generalized method of moment

In general, after controlling for factors that are considered to affect corporate investment efficiency in the literature, the coefficient on June EPU index is still statistically positive, suggesting that June EPU index is a new and significant determinant of corporate investment efficiency of Australian energy companies. These firms have lower investment efficiency when the economic policy is more uncertain during the last month of the financial year as indicated by the higher value of June EPU index. Moreover, by re-examining the control firm-specific factors, findings confirm that firm age and firm size are other determinants of Australian energy companies' investment efficiency

5.2. EPU Measured by Average EPU Index

Table 4 shows the regression results with Average EPU index. As discussed in previous sections, researchers often use the average of twelve monthly EPU indexes to compute the index of each year. Since Australian financial year is from July to June, I calculate the average of EPU index over 12 months from July to June of each financial year and examine how this Average EPU index affects corporate investment efficiency. Although the coefficient on *AvgEPU* is not significant in the fixed-effects model, it is positive and statistically significant in the dynamic GMM model, supporting the hypothesis. The coefficient value of 0.00654 suggests that investment inefficiency increases by 0.065 if Average EPU index increases by 10 points. The economic policy uncertainty measured by Average EPU index is a significant determinant of corporate investment efficiency of Australian energy firms, even after controlling for other factors.

The results of control factors are similar to those in Table 3. In the dynamic GMM model, not only firm age and firm size but also leverage have a significantly negative relationship with inefficiency. In other words, these variables increase firm investment efficiency. State ownership and return on equity do not determine the efficiency of corporate investments.

In summary, similar to the results in Section 4.4.1 where June EPU index is used, the findings of Average EPU index confirm that EPU negatively affects corporate investment efficiency. When the policy uncertainty increases, Australian energy firms suffer from the lower efficiency of their capital investments. The greater coefficient in Table 4 than in Table 3 shows that compared to June EPU index, Average EPU index has a stronger effect on investment efficiency. Australian energy firms' investment efficiency is more affected by the level of EPU throughout the financial year.

6. CONCLUSIONS

One of the important roles of financial managers is making investment decisions to help firms grow. This study investigates the effect of economic policy uncertainty on investment efficiency of Australian energy companies. I argue that EPU affects corporate investment efficiency due to the financial constraints it causes in financial markets and the delay in companies' projects when the economic policy becomes uncertain.

I examine corporate investment efficiency of Australian energy firms from 2010 to 2022 using data from the Thomson Reuters EIKON database and the Australian EPU index constructed by Baker et al. (2016). I find that both June EPU and Average EPU indexes have a positive and significant effect on the inefficiency of investments. Specifically, when June EPU index or Average EPU index increases, Australian energy firms suffer from a decrease in their investment efficiency, and the effect seems stronger for Average EPU index which measures the uncertainty of economic policy throughout the financial year. My results hold in fixed-effects and dynamic GMM models and after controlling for firm-specific factors. Among these control variables, firm age and firm size significantly increases investment efficiency, whereas the results of leverage, state ownership, and return on equity are mixed and insignificant, suggesting that these three factors are not the determinants of investment efficiency of Australian energy companies.

My study contributes to the literature on corporate investments as it documents a macroeconomic factor - the EPU index - as the new determinant of investment efficiency of Australian energy firms. To the best of my knowledge, no study in the literature has examined the effect of EPU on investment efficiency of Australian companies, especially companies in the energy sector, while firms in this sector have a great need of capital-intensive projects, such

Table 4: Regression results when using average economic policy uncertainty index

Variables	Pooled OLS	Fixed effect	Dynamic GMM
Constant	33.09*** (5.13)	15.72*** (8.51)	18.39*** (5.87)
INIE(-1)			−0.361*** (−10.55)
AvgEPU	−0.138*** (−2.70)	0.000418 (0.25)	0.00654*** (4.32)
AGE	−0.577*** (−7.00)	−1.950*** (−6.69)	−1.086*** (−3.93)
SIZE	−0.609*** (−14.13)	−0.309*** (−2.73)	−0.567*** (−3.03)
STATE	0.584*** (3.24)	0.190 (0.82)	−0.320 (−0.88)
LEV	2.168*** (4.77)	1.590*** (2.59)	−2.119* (−1.77)
ROE	−0.333*** (−3.48)	−0.126 (−1.16)	0.142 (0.67)
Industry FE	Yes	No	No
Year FE	Yes	Yes	No
Firm FE	No	Yes	No
Observations	542	542	408
R^2	0.147	0.044	
Adjusted R^2	0.119	−0.183	
F	5.316	3.374	

The sample consists of 542 firm-year observations from 2010 to 2022. In the dynamic GMM model, the number of observations is 408 since lagged values are used. Variables are defined in Section 3. Continuous variables are winsorized at the 1st and 99th percentiles. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively; t statistics are in the parentheses. OLS: Ordinary least squares, GMM: Generalized method of moment as investments in renewable energy technologies. My study also contributes to the EPU literature by providing evidence that EPU index affects firm-level investment efficiency. The finding has implications for policymakers and regulators in Australia as the uncertainty of their economic policies plays an important role in determining the investment efficiency of Australian energy companies. In addition to corporate investment efficiency, future studies might explore how EPU affects other corporate decisions, such as capital structure and dividend policies, of energy firms and firms in other sectors.

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