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The asymmetric impact of economic policy uncertainty on firm-level investment in South Africa

Firm-level evidence from administrative tax data

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Abstract: This paper uses firm-level data and a news-based measure of economic policy uncertainty to provide empirical evidence that economic policy uncertainty has a negative impact on firm-level investment in South Africa. Firms' investment decisions in response to uncertainty reflect firms' heterogeneity. Medium-sized firms and, to a different extent, small firms reduce their investment by much more than large firms in response to increased policy uncertainty. The relationship between firms categorized by size and the degree of financial constraints they face implies that financially constrained firms are more sensitive to uncertainty than large, unconstrained firms.

Key words: economic policy uncertainty, firm-level investment, South Africa, firm heterogeneity

JEL classification: E22, E4, E5

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1 Introduction

This paper investigates the impact of economic policy uncertainty on firm-level investment in South Africa over the period from 2010 to 2016. Private sector, fixed investment in South Africa has been on a downward trend since 2011 and, over the same period, companies' cash deposits and close corporations with banks steadily rose from an annual growth rate of 4.1 per cent in 2010 before peaking at 9.0 per cent in 2015.[1] Since 2010, the domestic economic environment has been characterized by a high level of policy uncertainty. In its Article IV South Africa visit meetings, the IMF (2018) cited the impact of 'elevated policy uncertainty' as a constraint on growth, confidence, and private investment. Therefore, subdued investment growth rates and significant growth in firms' cash holdings in South Africa suggest that domestic firms are reluctant to invest despite having the resources to do so. This paper seeks to provide empirical evidence on the impact of economic policy uncertainty on investment, using firm-level data from South Africa. Specifically, the paper tests this investment–uncertainty nexus using tax administrative data (National Treasury and UNU-WIDER 2019) which has balance sheet and income statement information on firms. To measure economic policy uncertainty, the paper uses the 'news chatter' based index developed by Hlatshwayo and Saxegaard (2016), based on the approach first developed by Baker et al. (2016). A full description of the index is given in Section 3. Furthermore, firm-level information enables us to categorize firms according to size and to test whether policy uncertainty has an asymmetric impact on firm-level investment.

The paper is motivated by the financial frictions literature and findings by Gilchrist et al. (2014), who showed that uncertainty raises the risk of default and therefore the cost of external finance, leading firms to reduce their investment levels.[2] The negative effect of policy uncertainty on investment by firms is likely to be larger for firms that are financially constrained and have limited access to capital markets.[3] These are typically smaller firms. According to the financial frictions literature, small firms face idiosyncratic risks, have low net worth and limited access to debt markets, and, as a result, they face higher costs of external finance. Therefore, if, as Gilchrist et al. (2014) showed, policy uncertainty leads to higher borrowing costs for firms, then the impact of uncertainty on firm-level investment is expected to be asymmetric. This paper assumes that most firms in the dataset use debt financing from banks instead of equity financing or issuing corporate bonds.[4] Additionally, firm size, which is a common proxy for capital market access, is measured by Statistics South Africa, using the National Small Business Amendment Bill (2003) definition (Republic of South Africa (2003).

The theoretical literature on the impact of uncertainty on firms' investment is ambiguous. There are four main models: real options theory and models of user cost of capital with risk premia

[1] After recovering from the impact of the 2008/09 global financial crisis, gross fixed capital formation grew by 5.5 per cent in 2011 and to negative growth of 3.5 per cent in 2016. Our data is sourced from the South African Reserve Bank Quarterly Bulletin (South African Reserve Bank 2018).

[2] There is an emerging but still scant empirical literature studying the role of agency problems in capital markets in contributing to the negative relationship between investment and economic uncertainty.

[3] See Fazzari et al. (1988), Bernanke and Gertler (1995), and Gertler and Gilchrist (1994).

[4] As of September 2018, only 371 firms were listed on the Johannesburg Stock Exchange (CEIC 2018), whereas our dataset contains over 370,000 firms. In this case, the assumption that most firms in our sample finance investment through debt from banks is valid. Additionally, the South African corporate bond market is small and illiquid (Hassan 2013). Debt financing provided by banks remains the most important source of finance for firms in South Africa.

generate a negative relationship, while growth options models and Abel type models can explain the existence of a positive relationship (Bloom 2014).

Real options theory, in which an uncertainty shock is expected to have a negative effect on firms' investment, is the basis for the model estimated in this paper. When investment is irreversible or partially irreversible (Bernanke 1983), uncertainty increases the real option value of delaying fixed investment, as firms wait for new information about the state of the world before committing to investing (Caballero 1999; Dixit and Pindyck 1994). It assumes that adjustment costs are non-trivial or that investment cannot be reversed without the firm incurring significant costs; firms are able to wait for new information before committing to investment.

Two standard reduced-form equations are often estimated in the empirical literature to investigate the investment–uncertainty relationship. One widely used estimation model is derived from Tobin's Q theory of investment (Tobin 1969); the other is based on an accelerator model.

As measures of Tobin's Q ratio depend on equity market valuations, we do not adopt that model here. Although South Africa has a well-developed stock market—the Johannesburg Stock Exchange (JSE)—the number of listed firms is very small relative to the country's total number of registered firms. Only 371 firms are listed on the JSE, while the total number of firms in our study is 1,500,987.

In this paper, we estimate an accelerator model of investment equation. A standard rationale underlying accelerator models is that the firm's desired level of capital stock is a function of its expected income. With appropriate assumptions about the formation of expectations or capital stock adjustment lags, the firm's rate of investment is modelled as a function of the firm's current income. Focusing on the role of uncertainty in South African firms' decisions, in our model, the determinants of investment include an income variable augmented by a measure of uncertainty, which is similar to the approach used in Lensink and Sterken (2000). The hypothesized role of uncertainty is based on real options theory.

As a macro measure of uncertainty, we calculate an index of economic policy uncertainty. A fixed-effects panel regression model is estimated to control for cross-sectional heterogeneity, and an alternative proxy of economic policy uncertainty is considered to test the robustness of the results. We also estimate a generalized method of moments (GMM) model to control for cross-section heterogeneity, endogeneity, and measurement errors.

The estimated results provide evidence that policy uncertainty has a negative impact on firm-level investment in South Africa in line with real options theory predictions, and this impact is robust to the use of an alternative measure of policy uncertainty. Furthermore, the main fixed-effects model estimates show that investment by medium-sized (and small) firms is more sensitive to policy uncertainty than is the case for large firms. Medium-sized firms reduce their investment spending more sharply when policy uncertainty increases. As there are grounds for believing that large firms are less credit-constrained than medium-sized or small firms (Lesame 2019; Newman et al. 2019), these findings support an argument that policy uncertainty has an asymmetric impact on investment across firms due to financial frictions. This is the first paper, to our knowledge, to examine the effect of uncertainty on firm-level investment in South Africa in the presence of credit constraints.

The rest of the paper is organized as follows: Section 2 presents a literature review; Section 3 describes our data and exploratory data analysis; in Section 4, we summarize our method and present our regression results; and Section 4 concludes with a discussion of potential policy implications.

2 Literature review

The theoretical literature on the relationship between uncertainty and investment is ambiguous as there are four main channels through which uncertainty affects investment. Two of these channels emphasize a negative relationship, while the other two channels suggest that uncertainty may actually encourage investment. See Bloom (2014) for a complete description of these channels. The focus of this paper is on testing the prediction of the real options channel that uncertainty has a negative impact on investment. The real options channel pioneered by Bernanke (1983), Dixit (1989), Dixit and Pindyck (1994), McDonald and Siegel (1986), and Pindyck (1988) presents a theory in which the optimizing behaviour of firms and short-run investment dynamics are compatible. This theory relies on two important assumptions. The first is that investment is irreversible, or partially irreversible, because investment, e.g. building a steel plant, cannot be instantaneously undone without cost. The second is that firms are able to wait for new information which is relevant for judging investment returns, and this information arrives over time. The second assumption does not hold in cases where firms are in a race to patent an idea or to launch a new product ahead of competitors. Then, investment becomes a dynamic stochastic optimization problem where firms' investment choices are seen as a series of options. Firms may choose to delay investment when there is uncertainty and wait for new information to avoid costly mistakes as adjustment costs may be expensive when investment is irreversible. Furthermore, adjustment costs have both a physical and financial element. For example, machinery (e.g. as part of fixed investment when building a steel plant) may get damaged if it is uninstalled or removed. The financial element would be the selling of used machinery at a discounted value if investment were reversed.

Real options theory generally predicts a negative relationship between investment and uncertainty; greater uncertainty raises the option value of waiting, which lowers investment. There is emergent empirical literature that studies the contribution of agency problems to the real options effect of uncertainty on investment.[5] This literature, spurred on by the sharp widening of credit spreads during the 2008 global finance crisis, argues that due to frictions in financial markets, uncertainty further increases the cost of external finance, inducing a reduction in investment spending.

These observations contrast with the theorems of Modigliani and Miller (1958) based on an assumption of frictionless capital markets. Using a firm-level dataset, Gilchrist et al. (2014) provide empirical evidence that uncertainty shocks are an important determinant of credit spreads[6] on a firm's outstanding bonds. Moreover, they find that increases in uncertainty shocks are associated with a substantial decline in investment spending but that the impact of uncertainty on business investment is significantly weakened when the information content of credit spreads is taken into account. Furthermore, policy uncertainty increases the equity risk premium, thereby increasing the cost of external finance (Pastor and Veronesi 2013). More recently, Alfaro et al. (2018), in a heterogeneous firm dynamic model with real[7] and financial frictions, provided further empirical evidence to show that adding financial frictions to stochastic volatility uncertainty shocks roughly doubles the negative impact of uncertainty shocks on investment and hiring.

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[5] See Tan (2010) and Gulen and Ion (2016).

[6] Credit spreads are a common indicator of the tightness of financial markets or degree of financial market frictions.

[7] Investment incurs a fixed cost

3 Data description

This paper investigates the impact of economic policy uncertainty on firm-level investment in South Africa taking account of the role of financial frictions in the uncertainty and investment nexus. The paper uses tax administrative data (National Treasury and UNU-WIDER 2019) from the South African Revenue Services (SARS). The dataset merges company income tax data with employee tax certificates (IRP5) issued to firm employees, as well as value-added tax data for firms and customs data for trading firms. The merged data (the CIT-IRP5 panel) creates a rich annual firm-level dataset containing firms' characteristics, balance sheets, income statements, and tax-related information (see Pieterse et al. 2016).

Firms are grouped according to size[8] to test the theory that uncertainty increases the cost of external finance, thereby having a disproportionate impact on the investment of smaller firms. Firm size definitions, based on turnover,[9] are taken from the Department of Trade and Industry's National Small Business Amendment Act (2003) (Republic of South Africa 2003). The Statistics South Africa (StatsSa) factor adjusts these definitions annually; firm size definitions in this paper are based on factor adjustments published in the 2018 Annual Financial Statistics[10] (AFS) (Statistics South Africa 2019).

The firms included in the study are restricted to firms with non-zero and non-missing observations for the sales or turnover variable. Table 1 briefly shows the descriptive statistics of the variables used in the study. The full description and calculation of the variables are given in Table A1 in the Appendix. The size of a firm is defined according to the Department of Trade and Industry's National Small Business Amendment Act (2003) and is based on turnover alone. In all the variables used in the regression equations, observations above the 99 percentile are removed to exclude possible outliers which could influence the estimated results. We also exclude firms in the financial services and utilities sector, ending up with a CIT-IRP5 unbalanced panel data of 1,500,987 firms. The size distribution of firms in our panel is 1,353,337 small firms, 95,860 medium-sized firms, and 51,790 large firms. However, when running regressions, a large number of firms are lost due to missing and zero observations for variables such as fixed property, plant and equipment, and other fixed property, which are required for calculating the investment dependent variable. For example, the number of firms in the fixed-effects regression estimates falls to 120,564 small firms, 22,204 medium-sized firms, and 11,096 large firms.

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[8] Other proxies are used in the literature to measure and group firms based on the perceived informational problems they face. These include: bond ratings, by Whited (1992), where bond ratings for firms summarize all relevant information about the firms and, as a result, firms that have a bond rating face less informational asymmetries than firms that do not have a rating; dividend payments, by Fazzari et al. (1988); and the asset size measure for measuring firm size, as in Bernanke et al. (1998). The first two proxies are suitable for advanced economies with a large number of public firms and developed corporate bond markets. It is not possible to use these measures in this study due to a lack of data.

[9] Turnover is used to define firm size in line with the definitions provided by the National Small Business Amendment Act (Republic of South Africa 2003), which are factor adjusted by StatsSA each year. Only the variable turnover is factor adjusted by StatsSA.

[10] According to the 2018 AFS report, and based on the variable turnover alone, firm size definitions are as follows: small: turnover <= 25 million ZAR; medium-sized: turnover >= 65 million ZAR; large: turnover >= 255 million ZAR. Note that the small category includes both small and very small firms to create a single small group. Firms with a turnover of 2 million ZAR are included in the dataset.

The main measure of economic policy uncertainty is the economic policy uncertainty index by Hlatshwayo and Saxegaard (2016) which measures economic policy uncertainty in South Africa. The index is based on the approach developed Baker et al. (2016) which counts the use of terms associated with economic uncertainty in newspaper articles. They construct the economic policy uncertainty indices by matching the number of articles to a certain algorithm. The authors use the Dow Jones Factiva[11] aggregator to look for articles that mention the words 'policy', 'economics', and 'uncertainty' within ten words of the words 'South Africa' being mentioned. Although the authors recognize that the uncertainty index is an imperfect proxy, the policy uncertainty measure serves to quantify domestic policy disagreements. The authors first classify the news articles by subject matter, the top three of which in Factiva are 'domestic politics', 'corporate/industrial news', and 'political/general news'. Additionally, in Factiva, more than one type of classification can be assigned to a single article. Secondly, the authors correlate the uncertainty index and the professional forecasting standard deviation which serves as a proxy for economic volatility. A high correlation, near one, suggests that the index just picks up economic uncertainty. They find that the correlation between the uncertainty measure and professional forecast standard deviation or variation is 0.28 per cent, suggesting that the measure principally represents policy uncertainty rather than economic volatility. The index is a quarterly variable. For the purposes of this study, we transform the quarterly figures to annual averages as the frequency of our firm-level dataset is annual.

We use an alternative measure of uncertainty provided by Redl (2015) for South Africa in the regression equations to test the robustness of our findings. That author constructs an index of macroeconomic uncertainty for South Africa using three sources. The first is disagreements between forecasts about macroeconomic conditions, using data forecast run by *Die Beeld*, a South African newspaper, where the disagreements across forecasters are captured by the reported standard deviation of macroeconomic variables. The second source is a number count of news articles from the UK newspaper database Nexis which contain the word stems 'econ*', 'uncert*', and 'South Africa' within ten words of each other. The number of articles is normalized by the number of articles that include the term 'today' within ten words of 'South Africa', to have a mean and standard deviation of 100. The third source is based on a stem count of the word 'uncert*' in the *Quarterly Bulletin* of the SARB and is normalized to have a mean and standard deviation of 100. For more information about this measure, please see Redl (2015).

We employed the Hlatshwayo and Saxegaard (2016) measure of uncertainty in our empirical estimation because the data series is two years longer than Redl's (2015) uncertainty measure. However, both measures show similar trends in economic uncertainty, as shown by Figure A1 in the Appendix, and the correlation coefficient of the two variables is 0.86, which is sufficiently high.

Tables 1–3 show the descriptive statistics for small, medium-sized, and large firms over the period 2010 to 2016.[12] The descriptive statistics for the full sample are shown in Table A1 in the Appendix. In the sample, there are 1,567,671 small firms, 114,255 medium-sized firms, and 62,465 large firms. The sample excludes firms in the finance, insurance and real estate sectors,

[11] Factiva is a global news database which contains nearly 33,000 information sources including publications, websites, and blogs. The database also covers news sources in 28 languages, including 760 which are African-based sources and 700 newswires (e.g. Associated Press and Reuters) as well as press websites (e.g., allAfrica.com; Mail & Guardian Online, etc.) (Hlatshwayo and Saxegaard 2016).

[12] The investment and cash flow variables are scaled by the lag of fixed capital in line with empirical studies in the literature.

professional, technical, and scientific activities, and other services.[13] The firm sample size reduces to over 370,000 when running the regression estimates. Medium-sized firms have, on average, a larger investment ratio (investment as a proportion of one-period-lagged fixed capital) than large firms, while small firms did not increase investment over the sample period. Moreover, firms are more likely to increase their investment spending if average sales growth is higher, as seen in Tables 1–3. Small firms use more debt to finance their expenditures compared with other firm sizes, with the book leverage ratios of 16.11 per cent compared with only 10.4 per cent and 9.05 per cent for medium-sized and large firms, respectively.

Interestingly, medium-sized firms have the greatest cash flow volatility in terms of their standard deviations. Medium-sized firms have, on average, eight times more assets than small firms, whereas large firms have just under three times more assets.[14] The descriptive statistics for the full sample are shown in Table A1 in the Appendix.

Figure 1 plots the investment ratio and the economic policy uncertainty index. The relationship seems broadly positive, i.e. investment increases when uncertainty increases. This contrasts with the real options theory of investment, which is the hypothesis this paper is testing, but supports the 'growth options' and 'Oi-Hartman-Abel' effects, which argue that higher uncertainty will encourage investment.[15] Figures 2 and 3 show the investment ratio by firm size and sector. Over time, the investment ratios are closer to zero and have recently remained stable around that region. The investment ratio of small firms shows larger and sharper fluctuations, while the investment of medium-sized firms has slowed despite having, on average, the largest investment ratio.

Figure 3 shows that the decline in investment is broad based across sectors, with the mining sector noticeably having the lowest investment ratio recently, while the information technology sector is increasing investment. The broader trend across the sectors suggests that there could be macro factors at play underlying the broad-based slowing trend in investment rather than only sectoral factors.

[13] Other services include community, social, and personal services.

[14] Note that the cash flow, investment, and sales variables have been scaled by the lag of fixed capital.

[15] The growth options theory and Oi-Hartman-Abel effect according to Bloom (2009) are based on the insight that uncertainty encourages investment if it increases the potential size of the prize. An example is a pharmaceutical company developing a new drug where the costs to the company of the drug turning out to be ineffective are limited to the lower bound or the sunk development and research costs, whereas profits are not constrained in this way. A rise in mean-preserving risk means higher profits. The Oi-Hartman-Abel effect (Abel 1983; Hartman 1972; Oi 1961) essentially postulates that if firms can expand to exploit good outcomes while insuring against bad outcomes, they may be encouraged to take risks. An example of this is where a factory halves its production when the price of the product declines and doubles production when the price increases. In this case, the firm should desire a mean-preserving increase in uncertainty because it gets much more when outcomes are good than when outcomes are bad.

Table 1: Descriptive statistics (small firms)

	Mean	STD	Median
Cash flow	-0.12	1.85	0.37
Investment	-0.12	0.75	0.13
Sales	2.75	3.09	2.57
Total assets	2,128,270	6,697,548	359,510
Book leverage	16.11	114.32	0.86
Total liabilities	722,354	2,506,751	36,480

Note: the figures are denominated in South African rand.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Table 2: Descriptive statistics (medium firms)

	Mean	STD	Median
Cash flow	0.39	4.54	0.49
Investment	0.28	0.32	0.27
Sales	3.33	2.45	3.22
Total assets	17,200,000	19,700,000	10,900,000
Book leverage	10.40	74.05	1.07
Total liabilities	6,795,788	8,805,907	3,803,194

Note: the figures are denominated in South African rand.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

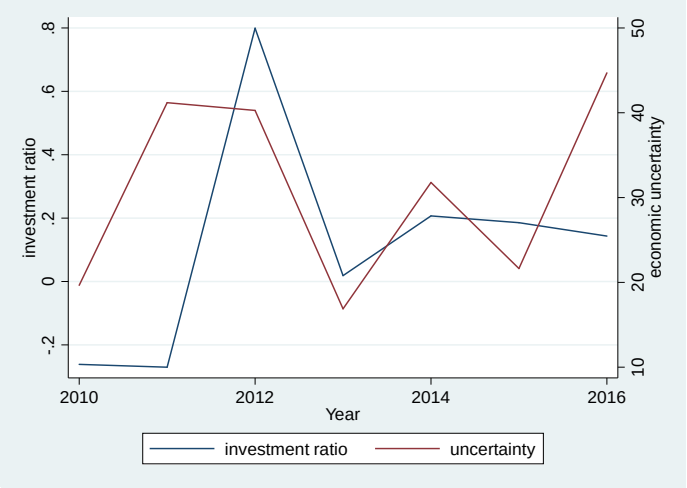
Table 3: Descriptive statistics (large firms)

	Mean	STD	Median
Cash flow	0.44	0.64	0.25
Investment	0.19	0.34	0.17
Sales	3.16	2.16	2.94
Total assets	47,500,000	38,900,000	35,900,000
Book leverage	9.05	63.14	1.10
Total liabilities	17,900,000	16,300,000	12,500,000

Note: the figures are denominated in South African rand.

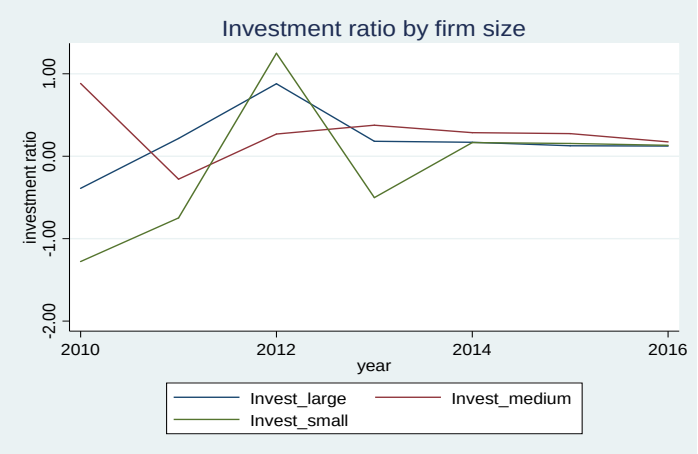
Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Figure 1: Firm-level investment and economic policy uncertainty



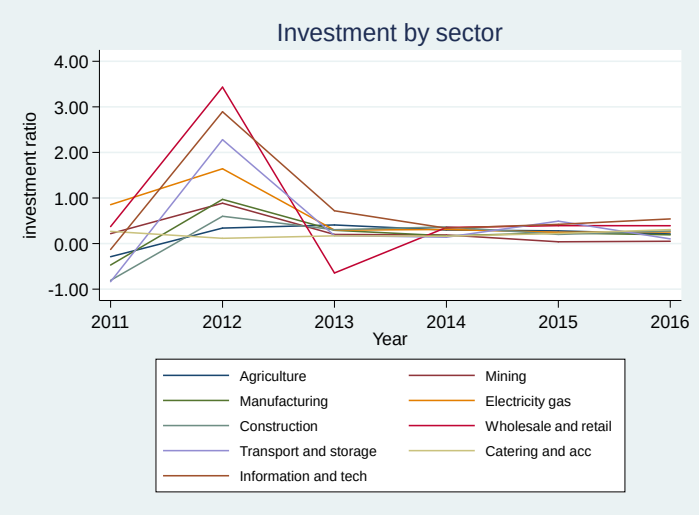
Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Figure 2: Firm-level investment by firm size



Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Figure 3: Firm-level investment by sector



Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

4 Methodology

We estimate a firm-level panel regression equation based on a standard accelerator investment equation over the period 2010 to 2016 based on a simple accelerator theory of investment.

A simple theoretical accelerator principle is shown as follows:

$$I_t = \nu(Y_t - Y_{t-1}) \quad (1)$$

where I denotes investment, Y output, t denotes time in years, and ν is the accelerator coefficient which measures the capital output ratio, which is assumed to be constant. The accelerator investment theory first introduced by Clark (1917) simply postulates that firms adjust their level of capital to their desired level of capital so that investment is proportional to the increase or change in output or sales in any period t.[16] In our case, this adjustment is in the same period or is instantaneous,[17] so that an increase in output will lead to an increase in investment. See Smyth (1964) and Girgin et al. (2018) for more examples of the accelerator theory of investment.

It then follows that the baseline estimated accelerator investment specification is shown by equation 2:

$$I_{i,t} = \alpha_i + \nu(Y_{i,t} - Y_{i,t-1}) + \varepsilon_{i,t} \quad (2)$$

[16] Alternatively, equation 1 can be specified as $I_t = (K_t - K_{t-1}) = (K_t^* - K_{t-1}^*) = \nu (Y_t - Y_{t-1})$ where K_t^* and K_t represent the desired capital stock and actual capital stock, respectively. Firms invest to bring K_t to the desired level of K_t^* in response to an increase in demand or output so that investment is proportional to output changes.

[17] Equation 1 can also be presented such that investment responds to changes to output or sales with a lag. In our case, the response is immediate because of the use of annual data in this study and therefore a delayed response would imply increasing investment only a year later in response to rising current output, which we do not think is feasible.

The baseline investment specification in equation 2 is augmented with the economic policy uncertainty variable as follows:

$$I_{i,t} = \alpha_i + \beta Unc_t + \nu(Y_{i,t} - Y_{i,t-1}) + \theta CF_{i,t} + \pi Controls_t + \varepsilon_{i,t} \quad (3)$$

where the subscripts *i* and *t* represent firm identifier and years, α_i shows the firm fixed effects, and $\varepsilon_{i,t}$ is the error term which is assumed to be independently and identically distributed. *Unc* represents economic policy uncertainty, which is the variable of interest, and *CF* is cash flow. A positive relationship is expected between cash flow and investment because firms that are more liquid have better investment possibilities. Output or sales is captured by *Y* and is calculated as the log difference of sales[18] in equation 3 to measure output or the sales growth rate in line with the theoretical model in equation 1. The latter is also expected to have a positive relationship with the dependant variable in line with predictions of the theory.

The controls included in equation 3 are a one-year ahead forecast of gross domestic product (GDP) from the Bloomberg consensus and a measure of business confidence from the Bureau for Economic Research (BER). The former controls for the possibility that our uncertainty variable may pick up omitted variable bias in our equation, and if these effects are not properly accounted for then they may induce an upward bias in the uncertainty index. The business confidence survey index is also included as a control variable[19] in case the uncertainty index instead captures the firms' sentiments about expected profitability or business conditions. In equation 3, which is the equation we will estimate, the investment and cash flow variables are scaled by the lag of total fixed capital to normalize them in line with other empirical studies. Moreover, the variables are in logs except for the one-year ahead GDP growth rate forecast and for the sales variable, which is in log differences.

We first estimate equation 3 as a panel ordinary least squares (OLS) regression model and then proceed to estimate the same equation using fixed effects, which give the main results reported for this study, to control for unobserved heterogeneity across firms that is fixed over time. The latter estimation uses standard robust errors clustered at the individual firm level to control for potential heteroscedasticity. Additionally, we run the GMM system by Arellano and Bond (1998) to test for potential endogeneity of the regressors and to further test the robustness of the fixed-effects estimates. All variables used in the study are trimmed to exclude all values above the 99th percentile in the distribution of observations in the data to remove outliers.

5 Estimation results

In contrast to the broadly positive relationship between investment and uncertainty suggested by inspection of Figure 1, our econometric estimates indicate the existence of a negative relation consistent with real options theory.

Section 5 reports the main regression results, which are the pooled OLS, fixed effects, and dynamic panel. In all the regression equations, we control for the possibility that the uncertainty measure could pick up expectations about future economic performance, and so we include the one-year

[18] It is standard practice to include sales in empirical studies. For examples, see the papers by Anderson and Kegels (1997), Bloom et al. (2007), and Lensink and Sterken (2000).

[19] The BER business confidence index (BER 2018) is a survey-based measure of the views of manufacturing, building contractor, retailer, wholesaler, and new vehicle dealer businesses about prevailing economic conditions.

ahead GDP forecast from Bloomberg. Furthermore, as the uncertainty index may also capture firms' views about expected profitability or business conditions, we control for this possibility by including the BER's business confidence index in our regressions.

Table 4 gives the baseline pooled OLS results, which show that economic policy uncertainty has a negative and statistically significant impact on firm investment for small and medium-sized firms only and that the magnitude of the impact is larger for medium-sized firms relative to small firms. For large firms, the uncertainty coefficient is positive but not statistically significant. The preliminary regression results are more or less in line with expectations in that firms are expected to reduce investment when economic uncertainty increases and, because smaller firms face external finance constraints, they are likely to cut their investment spending significantly when uncertainty rises because it increases the premium on borrowing costs and capital adjustment costs.

Table 4: Pooled OLS regression results

	(1)	(2)	(3)
VARIABLES	Small	Medium	Large
Uncertainty	-0.0551***	-0.1017***	-0.0235
	(0.0000)	(0.0001)	(0.4266)
Cash flow	0.7363***	0.5456***	0.4190***
	(0.0000)	(0.0000)	(0.0000)
Sales	-0.0473***	-0.0554***	0.0205***
	(0.0000)	(0.0000)	(0.0013)
Confidence	0.3662***	0.7828***	1.1627***
	(0.0000)	(0.0000)	(0.0000)
GDP exp.	-0.0644***	-0.0143***	0.0445***
	(0.0000)	(0.2797)	(0.0058)
Constant	-1.4121***	-2.9568***	-5.8583***
	(0.0000)	(0.0000)	(0.0000)
Observations	168,469	37,940	23,330
R-squared	0.4627	0.2897	0.2275

Note: robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are trimmed to exclude outliers.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Table 5 presents the fixed-effects regressions which remove time-invariant unobserved characteristics across firms by first differencing equation three. The findings are in line with the real options theory of uncertainty and investment as the uncertainty coefficient is negative across firm sizes but is only statistically significant for medium-sized firms. Notably, the effect is relatively large for medium-sized firms. Medium-sized firms, like their smaller counterparts, also have constrained access to credit in South Africa and are likely to experience the amplifying effect of uncertainty on both capital adjustment and financing costs contributing to the real options effect on investment.

Table 5: Fixed-effects regression results

	(1)	(2)	(3)
VARIABLES	Small	Medium	Large
Uncertainty	-0.0153	-0.0966***	-0.0102
	(0.3259)	(0.0003)	(0.7390)
Cash flow	0.8253***	0.6442***	0.5552***
	(0.0000)	(0.0000)	(0.0000)
Sales	0.0139**	0.0468***	0.0665***
	(0.0126)	(0.0000)	(0.0000)
Confidence	0.4835***	0.9703***	1.3963***
	(0.0000)	(0.0000)	(0.0000)
GDP exp.	0.0689***	0.0858***	0.1123***
	(0.0000)	(0.0000)	(0.0000)
Constant	-3.0659***	-5.4616***	-7.7269***
	(0.0000)	(0.0000)	(0.0000)
Observations	168,469	37,940	23,330
R-squared	0.3508	0.2293	0.2239
Number of FID	90,745	19,229	10,242
Firm fixed effects	YES	YES	YES

Note: FID = firm identifier. robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1. Standard robust errors. All variables are trimmed to exclude outliers.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

A one-percentage point increase in uncertainty will reduce investment by 9.7 per cent for medium-sized firms. For small and large firms, investment declines by an average of 1.5 per cent and 1.0 per cent respectively when uncertainty rises. However, the effect of uncertainty on firm-level investment is only statistically significant for medium-sized firms. Furthermore, the coefficients of the control variables, cash flows, one-year ahead GDP forecast, and business confidence variables show the expected positive coefficients and are highly statistically significant. The sales coefficient, which represents the accelerator model, is also positive and statistically significant in line with expectations, suggesting that the accelerator theory of investment is an appropriate approximation of the investment decision-making behaviour of South African firms.

In summary, these results provide evidence to support the theory that firms that are financially constrained and have limited access to credit markets, such as medium-sized firms, are more affected by uncertainty relative to large firms and that these effects are not negligible.

Finally, we test the robustness of our findings by running a fixed-effects regression using the economic policy uncertainty measure by Redl (2015) shown in Table A2 in the Appendix. After lagging the uncertainty variable once, we find a statistically significant and inverse relationship

between firm investment spending and uncertainty for medium-sized and large firms. Again, the uncertainty coefficient is relatively larger for medium-sized firms compared to larger firms. In contrast, for small firms, the uncertainty coefficient is positive and not statistically significant. However, large firms reduce their investment much more than small and medium-sized firms when uncertainty increases.

Table 6 estimates the dynamic two-step system GMM estimators developed by Blundell and Bond (1998) with Windmeijer-corrected (2005) cluster-robust standard errors and including the alternative economic policy uncertainty measure by Redl (2015) as an exogenous instrument. The results in Table 6 are broadly consistent with the estimates in Table 5; that is, economic uncertainty increases the value option of waiting for new information to arrive before investing, and this is the case for all sizes of firms. The uncertainty coefficients are relatively large compared to the results in Tables 4 and 5. Moreover, the uncertainty effect on investment is the largest for medium-sized firms, which is consistent with earlier results.

The tests for both first- and second-order autocorrelation of the residuals in the differences shows that the null hypothesis of no serial autocorrelation is rejected for small and large firms, with p-values that are smaller than at all three levels of significance. The test statistics are reported in Table 6. For medium-sized firms, the null hypothesis for no second-order autocorrelation is not rejected but is rejected for the first-order case. A negative first-order serial correlation is expected because of the use of first-difference transformation and, as a result, the presence of first-order serial correlation does not invalidate our results (Roodman 2009). Therefore, for medium-sized firms, the estimates do not suffer from serial correlation as we find no evidence of second-order serial correlation unlike for small and large firms. The Hansen test statistics, which test the validity of our instrumental variables in the system GMM estimation, are also reported in Table 6. The null hypothesis of instruments being jointly exogenous is not rejected for small and medium-sized firms with corresponding p-values of 0.426 and 0.255 respectively, while the instruments are found to not be exogenous for large firms.

Table 6: GMM regression results

	(1)	(2)	(3)
VARIABLES	Small	Medium	Large
Investment (lagged)	0.4440***	0.4192***	0.4458***
	(0.0000)	(0.0005)	(0.0011)
Uncertainty	-0.1405***	-0.2115***	-0.1021**
	(0.0000)	(0.0000)	(0.0428)
Cash flow	0.5038***	0.4203***	0.3739***
	(0.0000)	(0.0000)	(0.0000)
Sales	-0.0033	-0.0569***	0.0022
	(0.6662)	(0.0000)	(0.8718)
Confidence	1.2124**	2.4302***	6.2940***
	(0.0221)	(0.0029)	(0.0000)
GDP exp.	0.0941***	0.1665***	0.3305***
	(0.0006)	(0.0001)	(0.0000)
Constant	-4.9822**	-8,7814***	-24.9687***
	(0.0135)	(0.0051)	(0.0000)
Arellano Bond Test AR1	-11.83	-6.06	-5.67
Arellano Bond Test AR2	4,76	1.50	2,27

Hansen Test	4.92	6.57	42.34
Observations	67,393	19,096	11,589
Number of FID	43,143	11,584	6,590

Note: robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are trimmed to exclude outliers.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

6 Conclusion

In this paper, we estimated the impact of economic policy uncertainty on firm-level investment in South Africa between 2010 and 2016. We grouped firms by size to test whether the financial constraints or limited access to credit faced by firms amplifies the impact of economic policy uncertainty on their investment depending on their size, which is used as a proxy for firm financial constraints. The evidence presented in this study broadly shows that there is a negative and statistically significant relationship between uncertainty and investment, supporting the real options theory of the role of uncertainty on investment. These results hold even after controlling for expectations of economic performance or GDP and survey measures of business confidence. Moreover, the empirical results are similar across the panel data techniques adopted in this study. We also find evidence that medium-sized firms are more sensitive to uncertainty, that is, when uncertainty increases, medium-sized firms reduce investment spending more sharply than small and large firms. These findings are line with other theoretical and empirical findings. The policy implications of these results are that South Africa's policy makers should focus efforts on reducing and removing policy uncertainty in order to encourage higher levels of investment, employment creation, and economic growth, particularly by medium-sized firms, which are expected to contribute significantly to employment opportunities and economic growth. Fiscal and monetary policy stimulus efforts may be ineffective or less effective when firms have no certainty about economic policy as the evidence shows that this discourages investment.

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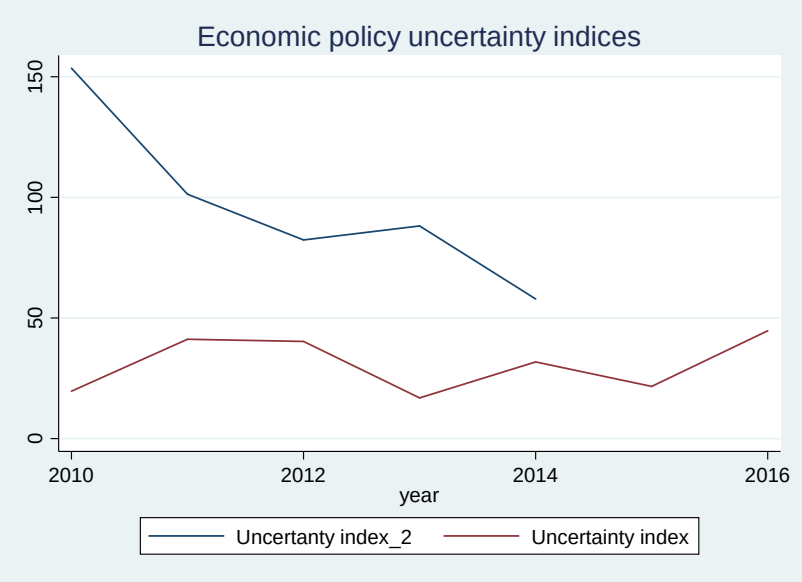
Appendix

Figure A1: Economic policy uncertainty indices



Note: the blue line shows the uncertainty measure developed by Redl (2015) and the red line is the uncertainty measure by Hlatshwayo and Saxegaard (2016).

Source: author's calculations based on Redl (2015) Hlatshwayo and Saxegaard (2016).

Table A1: Descriptive statistics (full sample)

	Mean	STD	Median
Cash flow	0.08	0.11	0.23
Investment	0.19	0.41	0.04
Sales	2.30	3.29	2.31
Total assets	3,863,575	12,500,000	385,804
Book leverage	15.55	109.19	0.82
Total liabilities	1,263,134	4,753,756	32,101

Note: the figures are denominated in South African rand.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).

Table A2: Fixed-effects regression results with alternative uncertainty measure

	(1)	(2)	(3)
VARIABLES	Small	Medium	Large
Uncertainty(lagged)	0.0252	-0.2243***	-0.6398***
	(0.5528)	(0.0026)	(0.0000)
Cash flow	0.8166***	0.6381***	0.5555***
	(0.0000)	(0.0000)	(0.0000)
Sales	0.0148**	0.0392***	0.0658***
	(0.0182)	(0.0012)	(0.0000)
Confidence	0.8384***	1.4043***	2.8299***
	(0.0001)	(0.0000)	(0.0000)
GDP exp.	0.0839***	0.1830***	0.4127***
	(0.0001)	(0.0000)	(0.0000)
Constant	-4.6335***	-6.5121***	-10.8985***
	(0.0000)	(0.0000)	(0.0000)
Observations	146,038	32,443	19,338
R-squared	0.3315	0.2185	0.2282
Number of FID	82,887	17,262	9,144
Firm FE	YES	YES	YES

Note: robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1. Standard robust errors. All variables are trimmed to exclude outliers.

Source: author's compilation based on CIT-IRP5 panel data (National Treasury and UNU-WIDER 2019).