The effects of political referendums on investment: Evidence from Scotland

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Abstract

Using a longitudinal panel of Scottish firms over the period 2008-2016, I observe a negative relationship between political and policy uncertainty in Scotland and investment rates in fixed tangible assets. Employing an unsupervised machine learning algorithm, I first unveil three types of unique uncertainty indices displayed by the Scottish news media: Scottish political uncertainty, *Brexit* uncertainty and Scottish policy uncertainty. Results indicate that a one standard deviation increase in Scottish political uncertainty co-moves with a drop in investment of 4% the average firm investment rate while same analogy retrieves a decline in investment by 8% and 6% when *Brexit* and Scottish political uncertainty rises. Besides, I find weak evidence that manufacturing and unlisted companies reduce investment more abruptly to these types of uncertainty measures while strong evidence for a higher reduction in investment from more financially constrained firms.

keywords— Political uncertainty, investment, machine learning, textual-data

JEL classifications: C80, D80, E22, E66, G18, G31

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1 Introduction

Scotland has recently been affected by two unprecedented episodes of political uncertainty: Brexit (June 2016), and the Scottish referendum for independence (September 2014). These two events led to a number of policy changes. For example, in Scotland, the British Government promised extensive new powers to Scotland if the No option should win the referendum for independence. By March 2016, the Scottish Parliament unanimously passed a bill devolving further legislative and fiscal powers. Furthermore, after the leave option won the Brexit referendum, trade, fiscal, and legislative agreements with the EU are bound to change.

This paper investigates the link between the uncertainty derived from these two referendums (the Scottish referendum for independence and Brexit), Scottish policy uncertainty, and private investment. To do so, I proceed using two steps. Firstly, I compute these three news-based uncertainty indices using an unsupervised machine-learning algorithm. This algorithm is able to unveil news article topics without incurring into labelled data. Secondly, I examine the impact of these indices by applying a standard investment regression to a longitudinal panel dataset formed of 2,170 Scottish firms.

Scottish political uncertainty whose most representative words are independence, SNP [Scottish National Party], referendum, party, and vote covers around 10% of all news articles describing overall economic uncertainty in the Scottish press. It has increased steadily since the UK approved the Scottish referendum for independence (January 2012), until its actual occurrence (September 2014), rising again around mid-2016. Additionally, uncertainty caused by Brexit whose most representative words are EU, Brexit, European, UK, and negotiations (appearing in 4% of all Scottish economic uncertainty news) was at its pinnacle during the Brexit referendum (June 2016), and the general elections of June 2017. Lastly, Scottish policy uncertainty whose most representative words are Scotland, Scottish, govern, budget, and public (appearing in 9% of all economic uncertainty news) peaks during the Scottish public-sector strikes (November 2011) and Brexit (June 2016).

The literature acknowledges three channels by which uncertainty negatively influences investment. The first channel is based on models of the real-option effects of uncertainty (Bernanke, 1983; McDonal and Siegel, 1986; Dixit, 1989; Bloom, 2000). When investment is irreversible (that is, when capital can only be resold at a lower price than its original purchase price) firms will only invest when demand for their products goes above a certain threshold . During periods of uncertainty, this threshold rises, causing a delay in investment.

The second channel is built from models in which uncertainty influences financing constraints (Arellano et al., 2011; Gilchrist et al., 2013; Byrne et al., 2015). An increase in uncertainty carries a rise in asymmetric information; this in turn reduces credit access. A natural response by firms with difficulty accessing credit is to cut down on investment. The third channel has to do with the precautionary savings behaviour of consumers, which ultimately affects firms investments (Fernandez-Villaverde et al., 2011; Leduc and Liu, 2016). In order to reduce exposure to the increase in uncertainty, and to preserve a smooth consumption pattern, when uncertainty rises agents reduce the consumption of goods produced by firms. Firms react to this drop in demand by reducing investment. As an alternative to these theories, the so-called growth option theory states that firms will increase (rather than decrease) investment as a response to uncertainty (Bar-Ilan and Strange, 1996; Pastor and Veronesi, 2006; Segal et al., 2015). The intuition behind this channel lies in the positive link between risk and returns. An increase in uncertainty raises the risk perceived by companies.

The baseline findings of this paper suggest that a one standard deviation increase in Scottish political uncertainty co-moves with a drop in investment of 4% in the average firms investment rate. The same analogy posits a drop in investment by 8% and 6% when Brexit and Scottish political uncertainty rise, respectively. Given that I control for firm cash-flow levels and sales growth, this reduction in investment is most plausibly explained using either the real-option or the financing-constraint channels. In order to examine this question further, I investigate whether uncertainty has the same impact across different types of companies. I have found weak evidence that manufacturing companies and firms with a priori higher irreversible-investment levels reduce investment more abruptly than non-manufacturing companies. In addition, I find strong evidence that those firms that are more financially constrained decrease investment more abruptly in the presence of uncertainty.

These results hold up to a series of robustness tests, as follows. Firstly, I incorporate a wide range of variables into my research that aim to capture investment opportunities such as cash flows, sales growth rates, and GDP growth rates. Secondly, I add alternative measures of uncertainty, such as the implied volatility index (VFTSE), election years, and firm future-profitability uncertainty to the regression equation. Additionally, in order to account for the possibility that uncertainty might affect investment with a delay , I place the uncertainty measures with a lag of one year. Finally, I make sure that the results are also robust to several econometric specifications, including simple panel regressions both with and without fixed effects, first-difference specification, as well as dynamic panel specifications estimated using the System GMM estimator.

2 Political and policy uncertainty in Scotland

2.1 LDA model

To unveil the distinctive sources of uncertainty, I use the approach proposed by Azqueta-Gavaldón (2017). This approach applies an unsupervised machine learning algorithm to all news-articles describing economic uncertainty (all news articles containing any form of the words *economy* and *uncertainty*) in order to unveil their themes. The unsupervised machine learning algorithm, called Latent Dirichlet Allocation (LDA) and developed by Blei et al. (2003), reveals the themes of articles without the need of prior knowledge about their content. Intuitively, the algorithm studies the co-occurrences of words per articles to frame each topic as a composition of the most likely words (more likely to appear together) while each article as a distribution of topics.

In other words, LDA is a generative probabilistic model that infers the distribution of words that defines a topic, while simultaneously annotating each article with a distribution of topics. The model recovers these two distributions by obtaining the model parameters that maximize the probability of each word appearing in each article given the total number of topics K (exogenously give). The probability of word w_i occurring in an article is:

$$P(w_i) = \sum_{j=1}^{K} P(w_i|z_i = j)P(z_i = j) \tag{1}$$

where z_i is a latent variable indicating the topic from which the *ith* word was drawn and $P(w_i|z_i = j)$ is the probability of word w_i being drawn from topic j. Moreover, $P(z_i = j)$ is the probability of drawing a word from topic j in the current article, which will vary across different articles. Intuitively, $P(w|z)$ indicates which words are important to a topic, whereas $P(z)$ is the prevalence of those topics within an article. The goal is therefore to maximize $P(w_i|z_i = j)$ and $P(z_i = j)$ from equation (1). However, a direct maximization is susceptible of local maxima and slow convergence (Griffiths and Steyvers, 2004). To overcome this issue, I use *online variational Bayes* as proposed by Hoffman et al. (2010). This method approximates the posterior distribution of $P(w_i|z_i = j)$ and $P(z_i = j)$ using an alternative and simpler distribution: $P(z|w)$, and associated parameters.[1]

2.2 News-article Data

I apply the LDA algorithm to three of the most read Scottish newspapers: *The Glasgow Herald* (UK coverage and based in Glasgow), *The Scotsman* (UK coverage and based in Edinburgh), and *The Aberdeen Press and Journal* (Scottish coverage). I use *Nexis*, an online database of journalistic documents to gather all news-articles containing any form of the words economy and uncertainty from the three newspapers. [2] The total number of news articles associated with any form of these two terms from January 1998 to June 2017 (including) was 18,125. In this *corpus*, aggregation of all articles, there are over one million unique words.

Following a common practice in the literature, I preprocess the data (words): *stopwords* are removed (words that do not contain informative details about an article, i.e. *that* or *me*), all words have been converted to lower case, and each word has been converted to its root (stemming). Finally, to find the most likely value of topics K, I use the *likelihood* method. This method consists of estimating empirically the likelihood of the probability of words for

[1] For more details about the implementation see Řehůřek and Sojka (2010).

[2] In principle news-articles containing any form of the words *economy* and *uncertainty* describe overall economic uncertainty (see Baker et al, 2016).

a different number of topics $P(w|K)$. This probability cannot be directly estimated since it requires summing over all possible assignments of words to topics but can be approximated using the harmonic mean of a set of values of $P(w|z, K)$, when z is sampled from the posterior distribution (Griffiths and Steyvers, 2004). This method indicates that the most likely number of topics in this corpus is $K = 20$ (see Table 1).

Table 2 displays all the 20 topics unveiled by the LDA in this corpus and their most representative words for each topic. Recall that words appear in lower cases and root format. From these 20 topics, I choose the three topics related to political and policy uncertainty:

- **Scottish Political uncertainty:** *independ, snp, mr, referendum, parti, vote, labour, minist, scotland, elect, campaign, would, sturgeon*
- **Brexit uncertainty:** *eu, brexit, european, britain, europ, union, uk, negoti, leav, countri, membership, singl, trade, brussel*
- **Scottish Policy uncertainty:** *scotland, scottish, govern, budget, busi, univers, public, educ, need, fund, council, report, tax*

Building each time series requires few extra steps. Firstly, I label each article according to its most representative topic (the topic with the highest percentage in the article). Secondly, I produce a raw count of the number of news-articles for every topic in each month (20 *raw time-series*). Lastly, since the number of news articles is not constant over time, I divide each *raw time-series* by the total number of news articles containing the word *today* each month (the proxy for the total number of news articles, see Azzimonti, 2015).

2.3 Uncertainty indices

Figure 1 shows the evolution of Scottish political uncertainty, Brexit uncertainty and Scottish policy uncertainty indices from Jan 2008 to June 2017 (included). *Scottish political uncertainty* covers around 10 percent of all news articles describing economic uncertainty. It shows spikes when the UK officially approved the Scottish referendum for independence (Jan 2012); when the chancellor of the Exchequer George Osborne declared that a 'Yes' vote means leaving the pound (Feb 2014)[3]; the Scottish referendum for independence (Sept 2014); and Brexit (June 2016). Moreover, Brexit uncertainty (4 percent of all economic uncertainty news) displays its pinnacle during Brexit referendum (June 2016); and the general elections of June 2017. Lastly, Scottish policy uncertainty (9 percent of all economic uncertainty news) peaks when the SNP budget got approved after initial rejection (Feb 2009); Scottish public sector strikes (Nov 2011)[4], and Brexit (June 2016).

Moreover, to validate that these indices are capturing uncertainty, I compare each uncertainty index with the implied volatility index (VFTSE). The VFTSE index measures stock market expectations of volatility in the near future and it has been widely used by many studies as a proxy for overall uncertainty (see for example Baker et al., 2016 and Gulen and Ion, 2016). Leaving the financial crisis and the European debt crisis episodes behind (where the VFTSE shows its two most prominent peaks) the implied volatility index and the uncertainty indices display similarities: the Scottish referendum for independence or *Brexit* and its previous months. Worth is pointing out that after *Brexit* the implied volatility index did not rise but rather kept low levels, while the three uncertainty indices maintained an average high level. This indicates that uncertainty perceived by financial markets after *Brexit* was not as high as the one reported by the three political/policy indices unveiled in my analysis. The question of the effect of uncertainty on investment takes, therefore, an interesting turn: would these three measures of uncertainty be able to additionally explain patterns in private investment while controlling for classical measures of uncertainty?

3 Firm level data and methodology

3.1 Data

To answer this question I look at firm level investment rates. I extract the data from the profit & loss and balance sheet section assembled by the Bureau Van Dijk Electronic Publishing available in the *Financial Analysis Made Easy* (FAME) dataset. This dataset provides yearly information on British and Irish companies for the period 2008-2017. To

[3]See http://www.bbc.co.uk/news/uk-scotland-scotland-politics-26166794
[4]See http://www.bbc.co.uk/news/uk-scotland-scotland-politics-15938970

be consistent with the uncertainty measures, I include in the analysis only companies operating in Scotland. The companies selected perform in a wide range of industrial sectors: agriculture, forestry, and mining; manufacturing; construction; retail and wholesales; hotels and restaurants; and business and other services.[5]

Following the work of Guariglia (2008), I measure investment rate as the purchase of fixed tangible assets by the firm over the replacement value of the capital stock at $t-1$. Investment amounts to the difference between the book value of tangible fixed assets of end of year and end of year $t-1$ plus depreciation. Replacement value of capital stock (K) is measured according to the perpetual inventory formula (Blundell et al., 1992): $K_{t+1} = K_t(1-\delta)(p_{t+1}/p_t) + I_{t+1}$, where t indexes time, δ represents the depreciation rate, which it is assumed to be a constant equal to 5.5% for all firms; and p_t is the price of investment goods, which I proxy with the implicit deflator for gross fixed capital formation (taken from the *Office for National Statistics* ONS). For each firm's first year of data, I assume that its replacement value of capital equals the historical value of it (this latter being set to be the value of fixed assets). The other two variables of interest are Cash Flows (CF) which is computed as the sum of firm's after-tax profits and depreciation and sales growth rates (SG).

Finally, I exclude firms that do not have complete records on investment, cash flows, or sales growth rates, as well as those companies with less than three years of observations. Also, to control for the potential influence of outliers, I exclude observations in the 1% tails for each of the regression variables. These types of rules are common in the literature and ensure comparability with previous work (Bond et al., 2003; Guariglia, 2008; and Gulen and Ion, 2016). The data used for estimation adds to a total of 2,170 companies or 14,558 firm-year observations; from which 596 companies (4,216 firm-year observations) operate in the manufacturing sector and 30 firms (209 firm-year observations) are listed companies (see Table 3).

[5] For standard reasons, I exclude companies operating in the financial and regulated sectors.

3.2 Econometric framework

To study the relationship between investment and uncertainty, I use the classical investment regression and augmented it to include political/policy uncertainty measures and a set of macroeconomic variables:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \beta_1 PU_t + \beta_2 \frac{CF_{i,t}}{K_{i,t-1}} + \beta_3 SG_{i,t} + \beta_4 M_i, t + \epsilon_{i,t} \tag{2}$$

where $i = 1, 2, ..., N$ indexes cross-section dimension and $t = 1, 2, ..., T$ the time series dimension. $I_{i,t}/K_{i,t-1}$ is the ratio between investment in fixed tangible assets and the replacement value of the capital stock at the beginning of the period, α_i is firm fixed effects which removes firm-specific time invariant omitted variables, PU_t indicates the yearly average news uncertainty indices, $CF_{i,t}/K_{i,t-1}$ corresponds to cash flows scaled by the replacement value of the capital stock at the beginning of the period and $SG_{i,t}$ stands for sales growth rates. Finally, M_t represents additional control variables at the macro level and standard errors are clustered at the firm level to correct for potential cross-sectional and serial correlation in the error term ϵ_{it} (Petersen, 2009).

Given that the uncertainty indices are firm invariant (affect all firms equally), *time-fixed* effects cannot be placed since doing so would automatically absorb the explanatory power in from the uncertainty indices. To dissipate concerns that results might be driven by time-dependent factors such business cycles or year-specific effects, I include a battery of macroeconomic variables M_t aiming at capturing these effects. The main concern when studying the impact of uncertainty and investment comes in the form of countercyclical behaviour of political/policy uncertainty: [...] *during bad economic outcomes, policy-makers often feel increasing pressure to make policy changes* (Gulen and Ion, 2016). To this end, I use Scottish GDP growth rates[6] to control for business cycles (in line with Azimonti, 2017; Gulen and Ion, 2016; and Baker et al., 2016).

Additional concerns appear for other measures of uncertainty since political/policy uncertainty might be capturing different types of uncertainties. For example, our political uncertainty indices might be recording risk derived from election years when investment

[6] Available at http://www.gov.scot/Topics/Statistics/Browse/Economy/PubGDP

tends to drop (see for instance Julio and Yook, 2012). Given that I want to isolate the additional or abnormal political uncertainty component from the cyclical or expected one (given by election periods), I add a dummy variable which takes the value 1 at if during that year a Scottish parliamentary election occurred and 0 otherwise (in line with Gulen and Ion, 2016). For robustness tests, I also consider general election (at UK level) dummies.

Besides, I include the implied volatility index (VFTSE) which serves as a proxy for overall uncertainty (obtained from Bloomberg). Recall that the graphical comparison between the three measures of uncertainty and the VFTSE showed important dissimilarities in the aftermath of the Brexit referendum: while the three uncertainty measurements maintained high average levels, the VFTSE displays low average amount. Finally, include a proxy variable for future firm profit uncertainty. Following the work of Gulen and Ion (2016), I build this variable by computing the cross-industry standard deviation of the growth rate of profits (profits after tax scaled by total sales).

4 Results and discussion

Table 4 shows the empirical results that arise from equation (2). To facilitate the interpretation, each uncertainty coefficients has been normalized by their sample standard deviation. Therefore, each coefficient can be interpreted as the change in investment rate associated with a one-standard deviation increase in uncertainty. Columns 1-3 include only firm-specific controls (cash flows and sales growth), while columns 4-6 add additional control variables: GDP growth rates, the implied volatility index, regional election dummy and profitability uncertainty.

Column 1 shows that a one standard deviation increase in Scottish political uncertainty co-moves with a drop in investment rate of -0.016. This magnitude is equivalent to a drop of 10% of the average firm investment rate for the whole sample. Nonetheless, when additional control variables are introduced (Column 4), this magnitude drops to 4%.A similar behaviour appears for Brexit uncertainty: a unit standard deviation increase in Brexit uncertainty co-moves with a drop in 11% of the average investment rate for the sample when only firm controls are placed (Column 2) and 8% when additional controls are included (Column 5). In addition, Scottish policy uncertainty's coefficient barely changes when additional controls are incorporated. Both specifications indicate a drop in 6% of the average investment rate for every standard deviation increase of Scottish policy uncertainty. These results are very similar to the ones reported by Gulen and Ion (2016) for American listed companies: *"a one standard deviation increase in policy uncertainty is associated with an average decrease in quarterly investment rates of approximately 6.3% relative to the average investment rate in the sample"*.

When all uncertainty indices are placed together (Column 7), *Brexit* uncertainty displays the only negative and significant coefficient. A possible explanation is that while the Scottish referendum for independence resulted in the prevalence of the *status quo* (the *No option* won), *Brexit* referendum experienced the opposite outcome. Nonetheless, having all the uncertainty indices together is likely to bias the coefficients due to multicollinearity. Therefore, column 7 should be taken as a qualitative rather than a quantitative description.

4.1 Heterogeneous effect of uncertainty: Manufacturing and Listed companies

So far, we assumed that the effect of uncertainty is equal for all different types of companies. However, there are reasons to believe that this is not the case. On the one hand, recent surveys indicate stronger adverse effects of the uncertainty derived from Brexit for the manufacturing sectors than the rest of industries. For example, the *Decision Maker Panel* survey reported that firms in the manufacturing sector are the most likely to move part of their operations outside the UK due to the uncertainty produced by Brexit (Bloom et al. 2017). On the other hand, listed companies are less likely to suffer from financial constraints than their unlisted counterparts since they have fewer problems derived from asymmetric information (Carpenter and Petersen, 2002).

To study how firms complying with these characteristics might react differently to the uncertainty measures previously described, I include an interactive term for the uncertainty measure and a dummy variable describing these heterogeneous characteristics (manufacturing or listed firms):

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \beta_1 PU_t + \beta_2 PU_t \cdot H_i + \beta_3 \frac{CF_{i,t}}{K_{i,t-1}} + \beta_4 SG_{i,t} + \beta_5 M_i, t + \epsilon_{i,t} \quad (3)$$

where $H_{i,t}$ stands for *heterogeneity* characteristics that takes values 1 if the company is a manufacturing (or listed) firm and 0 otherwise. The interactive coefficient β_2 allows us to validate the hypothesis of whether or not the effect of uncertainty on investment is equal for manufacturing (or listed) firms than for their counterparts. Along this line, when $H_i = 1$, the uncertainty coefficient is $\beta_1 + \beta_2$, whereas in the case of $H_i = 0$, the uncertainty coefficient is only β_1. Most importantly, if β_2 is significantly different from zero we will reject the null hypothesis that political uncertainty affects both types of companies equally.

Table 5 shows the results from equation (3). Although the interactive term between Brexit uncertainty and manufacturing dummy is negative, it fails the significance test. Similar behaviour appears for Scottish policy uncertainty and Scottish political uncertainty (positive and not significant for this latter one). Additionally, Panel B suggests that the relationship of uncertainty and investment is weaker for listed companies than unlisted ones. All interactive terms between the three different types of uncertainty and Listed company dummy are positive. Nonetheless, only Scottish policy uncertainty shows significance. This is not entirely surprising since listed companies *a priori* are less financially constrained.

4.2 Financing constraints and uncertainty

To further investigate to what extent the *financing constraints* channels is responsible for any heterogeneous effects of uncertainty on investment a proceed in two steps. Firstly, I construct four proxy variables for financing constraints commonly used in the literature. Secondly, I test its implications with uncertainty applying the interactive approach described in the previous section.

Recall that the *financing constraints channel* states that an increase in uncertainty carries a rise in asymmetric information. This, in turn, reduces credit access as it becomes more difficult for lenders to assess the probability of repayment. We will, therefore, expect that companies with higher difficulty to access credit will cut investment more abruptly as uncertainty rises than those with easier access to credit. As Doshi et al. (2017) predict, the adverse effect of uncertainty on investment will be more powerful for financially constrained firms since they will lower their capacity in a bid to minimize ex-post costs of financial distress.

I use the level of cash flows and coverage ratio to measure the degree of *internal financial constraints* while firm's years of existence (age) and size to measure the degree of *external financial constraints* (see Bond and Van Reenen, 2005; Guariglia, 2008). On the one hand, *internal financial constraints* operates through internal funds generated by the firm that can be guided towards investment. Along this line, firms with higher cash flows and lower coverage ratio will be able to place more funds into investment than those firms with low levels of cash flows or high levels of coverage ratio. On the other hand, *external financial constraints* operate through information asymmetries. For example, younger and smaller firms are more likely to face problems of asymmetric information given their short track records (Schianterelli, 1995)

Following the approach of Guariglia (2008), I first define a dummy variable describing high *internal financial constraints* base on the levels of cash flow: $NegCF = 1$ for company i when its cash flow is negative and $NegCF = 0$ otherwise. The intuition behind using negative cash flows to describe firms with high levels of internal financial constraints hinges on empirical evidence. Given that cash flows are the main source of variation in internal funds, firms with negative cash flow are likely to have a low or negative level of internal funds (Cleary et al., 2007). Therefore, those firms with low levels of cash flows will find it hard to rise internal funds to finance investment.

Additionally, as a second proxy for internal financing constraints, I use the coverage ratio. It is defined as the ratio between firm's total profits before tax and before interest and their total interest payments. It is a measurement of the number of times a company could make its interest payments with its earnings before interest and taxes (Guariglia, 2008). As previously, a company with high internal constraints based on their coverage ratio is defined as $NegCR = 1$ for company i when its coverage ratio is negative and $NegCR = 0$ otherwise.

Next, I use age and size as a measurement of *external financing constraints* (Cleary et al., 2007; and Guariglia, 2008). The intuition is that older firms can provide a historical market record to potential investors and are more likely of having established close ties with credit suppliers while larger firms tend to have higher collateral levels which would facilitate credit. Following Guariglia (2008), I define company i as $Young = 1$, if its age falls within the lowest quartile of the distribution of the ages of all firms operating in their sector and $Young = 0$ otherwise. Similarly, I define company i as $Small = 1$, if its total assets fall within the lowest quartile of the distribution of total assets of all firms operating in their sector and $Small = 0$ otherwise.

To test whether or not companies fulfilling these characteristics react similarly to uncertainty, I use the same interactive regression as in equation (3). Results regarding internal financing constraints (Table 6) show that political and policy uncertainty have a larger impact on investment for more internally constrained firms. This relationship is particularly strong in companies with negative coverage ratio under Brexit and Scottish policy uncertainty. For example, for every unit increase in Brexit uncertainty, companies with negative coverage ratio decrease investment by 14% the average investment rates in the sample whereas this magnitude is only 4% for companies with positive coverage ratio levels.

Likewise, I find higher coefficients relating investment and Brexit uncertainty for young companies than for older ones (Table 7). A one standard deviation rise in Brexit uncertainty foreshadows a drop in investment by 13% the average investment rates for young companies while 9% in the case of older companies. Overall, seems reasonable to state that those firms with higher financial constraints are particularly vulnerable to uncertainty. This is particularly strong for companies with negative levels of coverage ratio and young exposed to *Brexit* uncertainty.

5 Robustness

In this section, I test the robustness of the baseline results to several alternative methodological specifications and additional control variables. Firstly, I incorporate additional controls at the firm and macro level to further dissipate concerns of edogeneity. Secondly, I apply different econometric models to the main specification to ensure that results are not driven by the framework of choice.

Concerning additional variables, I first consider the total number of employees as an alternative measure of firm size (earlier I characterized firm size based on firm's total assets). Following Duchin et al. (2010), I now add the log of the total number of employees as a measure of firm's size. Panel B of Table 8 shows that the uncertainty coefficients barely change and remain strongly statistically significant. Besides, I use UK's general election dummy instead of Scottish parliamentary elections (Panel C). This alternative specification displays a rise in magnitude and significance of the uncertainty indices when national election dummy is placed instead of Scottish parliamentary election dummy. This is not entirely surprising since the indices are built from Scottish press and therefore are more prone to reporting Scottish electorate themes.

Regarding the econometric framework, I first exploit the interaction between financing constraints dummy variables that fluctuate from year to year to include time fixed effects instead of our control variables for business cycles. The concern is that our model is not adequately specified based on the controls placed: GDP growth rates, the implied volatility index and election years since we might miss additional time specific information such confidence indices. Recall that in the baseline specification I could not place time fixed effects which get rid of any year-specific omitted variable since the uncertainty indices do not differ from company to company in a given year. Nonetheless, when we interact variables that vary across firm and years with our uncertainty indices, we can place time fixed effects instead of our controls of choice. Along this line, variables such negative cash flows and coverage ratio as well as whether or not a company's total assets fall within the lowest quartile of the industry in which operates give us the necessarily dynamism since they change trough years. As can we see from the three panels in Table 9 all uncertainty indices remain negative and significant, and its magnitude is even higher than when business cycles controls are placed instead of time fixed effects. These results remove any concern of upward bias in the baseline model.

Additionally, I study whether clustering standard errors by time instead of at firm level retrieves different results. The concern once again is that investment errors might be correlated with years due to omitted business-cycle variables. Nonetheless, this is not the case since the standard errors tend to decrease rather than increase (Table 10, Panel B). Besides, I consider the model in first differences rather than using firm fixed effects to remove any firm time-invariant omitted variable bias. This approach also addresses the worry that results may be driven by a spurious correlation due to a common trend in the uncertainty and investment variables. The first differences approach deals with these two concerns by taking the first differences of every variable (including the error term):

$$\Delta \frac{I_{i,t}}{K_{i,t-1}} = \beta_1 \Delta PU_t + \beta_2 \Delta \frac{CF_{i,t}}{K_{i,t-1}} + \Delta\beta_4 M_i, t + \Delta\epsilon_{i,t} \quad (4)$$

Nonetheless, one of the downsides of the first differences approach is that it removes a whole year of observations in the sample and two observations per firm when there is a gap in the series of observations. Additionally, the interpretation of variables in growth rates and dummy variables can be problematic. For this reason, the variables included under M_t in equation (4) amounts to GDP growth rates, the implied volatility index and firm-specific uncertainty since election dummy in first differences does not make economic sense. Once again, our main result remains virtually unchanged (Table 10, Panel C).

Next, I examine the investment regression in a dynamic panel format by incorporating the lag dependent variable as a control (see for example Bloom et al., 2007):

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \rho \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_1 PU_t + \beta_2 \frac{CF_{i,t}}{K_{i,t-1}} + \beta_3 SG_{i,t} + \beta_4 M_t + \epsilon_{i,t} \quad (5)$$

Because the within-group and first-difference transformation needed to eliminate the firm fixed effects mechanically correlates the lagged investment variable with the error term, I estimate this specification using the system GMM methodology (Blundell and Bond, 1998). Following the approach of Gulen and Ion (2016), I use $\frac{I_{i,t-2}}{K_{i,t-3}}$ and $\frac{I_{i,t-3}}{K_{i,t-4}}$ as instruments for $\Delta\frac{I_{i,t-1}}{K_{i,t-2}}$ in the difference equation, and $\Delta\frac{I_{i,t-2}}{K_{i,t-3}}$ as an instrument for $\frac{I_{i,t-1}}{K_{i,t-2}}$ in the level equation. This set up rejects AR(1) errors while not AR(2) errors. As can be seen, the coefficients for the uncertainty indices remain negative but only Brexit uncertainty displays statistical significance (Table 10, Panel D). Nonetheless, the inclusion of these instruments reduces the sample data considerably by removing 4 years of observations which could induce sample bias. This fact, together with the impossibility to cluster standard errors by id or year makes the static specification the preferred one.

Lastly, I consider for the possibility that uncertainty affects investment with a delay. To this end, I model investment using the same specification as in the baseline regression (equation 2) but entering the uncertainty indices with a lag of one year:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \beta_1 PU_{t-1} + \beta_2 \frac{CF_{i,t}}{K_{i,t-1}} + \beta_3 SG_{i,t} + \beta_4 M_t + \epsilon_{i,t} \tag{6}$$

Panel E of Table 10 shows that both political uncertainties (Scottish political and Brexit uncertainty) remain negative and significant. This suggests that the effects on political uncertainty have lasting effects on investment for at least one full year: a one standard deviation rise in Scottish political uncertainty and Brexit uncertainty foreshadows a drop in investment of 3% and 7.5% the average investment rate in the sample. These coefficients are significant at the 90% and 99% confident internal while the coefficient for policy uncertainty is not statistically significant.

6 Conclusion

In this study, I analyse the effect of three distinctive uncertainty narratives embedded in the Scottish press, namely *Scottish political uncertainty; Brexit uncertainty; and Scottish policy uncertainty*, on private investment of Scottish firms. To frame these distinctive sources of uncertainty, I use an unsupervised machine learning algorithm able to classify news-articles with a range of themes without prior knowledge regarding their content. The baseline findings suggest that a one standard deviation increase in Scottish political uncertainty co-moves with a decline in investment of 4% the average firm investment rate. The same analogy retrieves a drop in investment by 8% and 6% when *Brexit* and Scottish political uncertainty rises. These results are robust to controlling for alternative measures of investment opportunities and macroeconomic uncertainty as well as to several identifying econometric frameworks.

Additionally, I test whether the relationship between uncertainty and investment differs from the type of company considered. Along this line, I examine the hypothesis of whether manufacturing companies, unlisted, and more financially constrained companies cut down investment more abruptly than the rest of companies as a result of an increase in uncertainty. Results unveil weak evidence that manufacturing and unlisted companies reduce investment more abruptly to these types of uncertainty measures while strong evidence for higher reduction in investment from firms more financially constrained.

The resulting policy implications are important, in particular to the current economic climate. Referendums is becoming a popular tool for politicians, yet its consequences as a source of uncertainty often scape the political debate. In this paper, I show not only that referendums are the main source of political and policy uncertainty but also that they affect private investment independently of their outcome.

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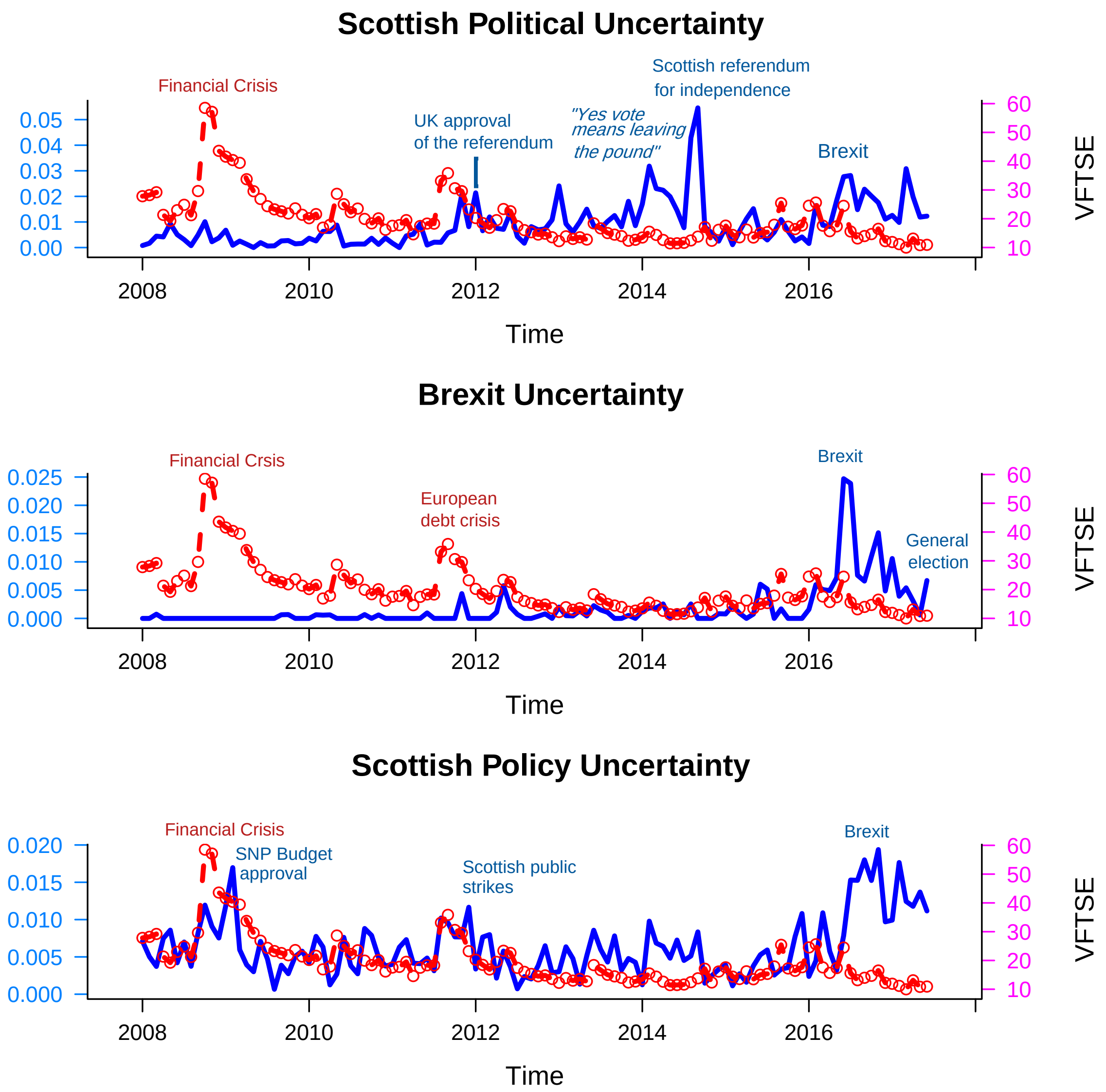
Figure 1: Evolution of Uncertainty indices in Scotland (continuous line, left legend) and the implied volatility index, VFTSE (dotted line, right legend)



Notes: Scottish Political Uncertainty, Brexit Uncertainty and Scottish Policy Uncertainty indices are built by computing the monthly ratio between news-articles describing these given uncertainty topics and the total number of news-articles. The newspapers used are *The Aberdeen Press & Journal*, *The Glasgow Herald* and *The Scotsman*. Time period from Jan 2008 to June 2017. The implied volatility index, VFTSE, in levels is extracted from *Bloomberg*.

Table 1: Number of topics and log-likelihood scores

	10	20	30	40	50	60
log P(w | K)	-24502056	-24465226	-24477848	-24485771	-24581108	-24609611

Definitions of the variables used:

Investment. It is constructed as the difference between the book value of tangible fixed assets (which include land and building; fixtures and fittings; plant and vehicles; and other fixed assets) of end of year and end of year t-1 adding depreciation of year t.

Replacement value of the capital stock. It is calculated using the perpetual inventory formula (Blundell et al., 1992; Mizen and Vermeulen, 2005). Following Guariglia (2008), I use tangible fixed assets as the historic value of the capital stock. We assume that replacement cost and historic cost are the same in the first year of data for each firm. We then apply the perpetual inventory formula as follows: replacement value of capital stock at time +1 = replacement value at time *(1-dep)*(t+1 /)+ investment at time +1, where dep represents the depreciation rate, which we assume to be constant and equal to 5.5% for all firms; and is the price of investment goods, which we proxy with the implicit deflator for gross fixed capital formation.

Cash flow. It is defined as the sum of after tax profit and depreciation.

Coverage ratio. It is defined as the ratio between the firms total profits before tax and before interest (also referred as Operating Profit or EBIT) and its total interest payments.

Total assets. It is defined as the sum of fixed assets and current assets.

Table 2: Topics unveiled by the LDA

Label	%	Top words
Scot. Political	9.9	independ, snp, mr, referendum, parti, vote, labour, minist, scotland, elect, campaign, would, sturgeon, tori, ye, salmond, polit, scottish, voter, poll, westminister, govern, conserv, leader, parliament, cameron
FTSE	9.8	cent, per, share, 5p, 1, ftse, stock, index, 2, 3, fell, 4, 2017, 5, 6, rose, close, analyst, 100, 7, 8, gbp, 9, 0 market, gain, group, biggest, trade, us
Preferences	9.6	say, peopl, thing, one, get, work, think, time, go, feel, like, way, know, realli, someth, lot, make, seem, much, look, art, mani, want, want, always, idea, old, good, even, differ, women
Monetary Policy	9.3	rate, monetari, economi, bank, interest, mpc, inflat, market, polici, cut, recess, econom, us, central, governor, euro, commite, risk, global, england, crisi, dollar, recoveri, would, king, fed, low, carney
Economy	9.2	cent, per, growth, month, survey, quarter, uk, rise, figur, year, manufactur, sector, show, 0, increas, retail, consum, 2, forecast, said, economi, 1, output, rate, economist, report, sale, latest, spend, fall
Scottish Policy	9	scotland, scottish, govern, budget, busi, univers, public, educ, need, fund, council, report, tax, local, commun, support, work, enterpris, plan, organis, sevic, challeng, sector, develop, research, student, econom
Business	7.2	compani, busi, profit, year, firm, group, sale, oper, acquisit, 2016, brand, turnov, execut, million, said, market, pre, revenu, whiski, custom, scotch, half, chief, trade, manag, deal, continu, murgitroyd, base
Oil	4.8	oil, ga, invest, sea, north, asset, investor, barrel, price, equiti, fund, trust, bp, field, compani, industri, shell, explor, aberdeen, portfolio, product, bond, manag, yield, drill, opec, crude, wood, return, petroleum
Jobs	4.7	job, said, moray, staff, fish, closur, raf, mr, worker, highland, trourism, employ, redund, plant, visitor, base, workforc, industri, 000, app, announc, futur, visitscotland, paterhead, fisheri, island, defenc, factori, buchan
Banks	4.4	bank, rb, financi, lloyd, mortgag, load, lend, lender, debt, credit, hbo, insur, clydesdal, tsb, custom, hsbc, barclay, taxpay, repay, billion, borrow, sharehold, royal, save, money, fund, gdp, deposit, branch, pay
America	3.6	obama, trump, centuri, world, american, human, bush, church, america, clinton, man, histori, donald, death, burn, republican, presid, barack, sdg, white, father, detent, polit, woman, supper, live, africa, nation, god
Brexit	3.5	eu, brexit, european, britain, europ, union, uk, negoti, leav, countri, membership, singl, trade, brussel, immigr, agreement, vote, greec, member, deal, want, referendum, free, hammond, exit, relationship
Farmers	3.3	pension, farm, farmer, agricultur, incom, scheme, ubi, payment, rural, pay, retir, nfu, crop, annuiti, milk, cap, beef, legisl, employe, dairi, sheep, food, fee, 2019, meat, benefit, tonn, wheat, employ, lamb
Transport	2.9	citi, airport, aberdeen glasgow, transport, passeng, rail, council, airlin, road, project, centr, rout, councillor, traffic, bu, ferri, site, local, inver, plan, skinner, baa, heathrow, develop, travel, edinburgh, east, firstgroup
Geopolitical	2.3	war, militari, iraq, armi, presid, polic, russian, russia, hester, attack, hamon, ministri, un, prision, iran, weapon, islam, afghanistan, troop, protest, marshal, holland, socialist, ukrain, egypt, bomb, sanction, arab

Other Topics		
Sports	2.1	club, footbal, ranger, game, leagu, cup, sport, celtic, player, hotel, season, murray, team, golf, spl, fan
Real Estate	2	properti, hous, home, buyer, estat, rent, market, tenant, offic, housbuilding, land, build, edinburgh
Energy	1.5	energi, wind, electr, carbon, edf, offshor, emiss, nuclear, turbin, coal, power, googl, onshor, rivaz, water
Unknown	0.8	scotsman, com, http, www, facebook, click, scotsmanbusi, read, mail, link, page, parcel, lossiemouth, kinloss
Cars	0.2	car, motor, ford, cc, q, bmw, walsh, diesel, gsk, poundland, glaxo, atlanti, mudoch, handbag, uber, barnard

Notes: This table displays the most representative words per topic unveiled by the *Latent Dirichlet Allocation* (3rd column), the proportion of the the given topic with respect to all topics (2nd column), and the label given to each topic (1st column)

Table 3: Descriptive statistics

	Whole Sample	Manufacturing	Listed	Young	negCF
$I_{i,t}/K_{i,t-1}$	0.16	0.161	0.177	0.182	0.111
	(0.263)	(0.246)	(0.215)	(0.297)	(0.259)
$CF_{i,t}/K_{i,t-1}$	0.843	0.597	0.789	1.006	-0.575
	(2.337)	(1.563)	(2.388)	(2.710)	(0.971)
$SG_{i,t}$	0.056	0.056	0.072	0.08	-0.026
	(0.232)	(0.227)	(0.258)	(0.269)	(0.278)
n	2,170	596	30	611	
N	14,558	4,216	209	3,951	1,611

Notes: This table reports sample means and standard deviations (in parenthesis) for the variables of interest and different subgroups. The subscript i indexes firm, and the script t represents time, where $t = 2009 - 2016$. $I_{i,t}/K_{i,t-1}$ represents investment rate, where $I_{i,t}$ is investment in fixed assets and $K_{i,t-1}$ is the replacement value of capital at $t-1$; $CF_{i,t}/K_{i,t-1}$ indexes cash flows over replacement value of capital and $SG_{i,t}$ represents sales growth. Manufacturing and Listed companies are those operating in the manufacturing sector and which are traded in a listed stock exchange respectively. Young companies are those whose age falls within the highest quartile of the distribution of the ages of all firms operating in their sector whereas negCF are those observations with negative cash flows.

Table 4: Baseline regression Results

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Political	-0.016^{***}			-0.006^{*}			-0.002
	(0.002)			(0.003)			(0.004)
Brexit		-0.018^{***}			-0.013^{***}		-0.023^{*}
		(0.002)			(0.004)		(0.012)
Budget			-0.010^{***}			-0.011^{***}	0.012
			(0.002)			(0.004)	(0.012)
$CF_{it}/K_{i,t-1}$	0.023^{***}	0.023^{***}	0.024^{***}	0.022^{***}	0.022^{***}	0.022^{***}	0.022^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
SG_{it}	0.104^{***}	0.100^{***}	0.102^{***}	0.103^{***}	0.102^{***}	0.103^{***}	0.102^{***}
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
ΔGDP_t				0.020^{***}	0.007	0.016^{***}	0.002
				(0.004)	(0.006)	(0.004)	(0.009)
$VFTSEsd$				0.031^{***}	0.022^{***}	0.033^{***}	0.011
				(0.005)	(0.007)	(0.005)	(0.012)
Local Elections				-0.040^{***}	-0.017	-0.023^{**}	-0.018
				(0.007)	(0.011)	(0.011)	(0.012)
Δ profit $\text{sd}_{i,t}$				0.0002	0.0003	0.0003	0.000
				(0.002)	(0.002)	(0.002)	(0.002)
N	14,558	14,558	14,558	14,558	14,558	14,558	14,558
R^2	0.041	0.042	0.039	0.045	0.045	0.045	0.045
Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Clustered id	yes	yes	yes	yes	yes	yes	yes

Notes: In this table, I regress investment rate $I_{it}/K_{i,t-1}$ (Investment in fixed assets scaled by the replacement value of capital stock at the beginning of period) on three measures of uncertainty: Scottish policy uncertainty, Brexit uncertainty, or Scottish policy uncertainty. Additionally, Columns 1-3 contain cash flows scaled by the replacement value of the capital stock at the beginning of the period ($CF_{i,t}/K_{i,t-1}$), and sales growth rate ($SG_{i,t}$). In columns 4-6, I add the Scottish GDP growth rate to control for business cycles (ΔGDP_t), the implied volatility index ($VFTSE$), local election dummy to control for elections uncertainty and the spread of cross-industry standard deviation of the growth rate of profits (proxy for profitability uncertainty). Column 7 contains all uncertainty indices together. All regressions include fixed effects, and standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5: The Heterogeneous effect of policy uncertainty on investment

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Manufacturing versus non-manufacturing companies			
	Scot. Political	Brexit	Scot. Policy
	(1)	(2)	(3)
Political	−0.006*	−0.013***	−0.009**
	(0.003)	(0.004)	(0.004)
UncertaintyXManufacturing	0.002	−0.0003	−0.004
	(0.005)	(0.004)	(0.004)
R^2	0.045	0.045	0.045
Panel B: Listed versus non-listed companies			
Uncertainty	−0.006*	−0.013***	−0.011***
	(0.003)	(0.004)	(0.004)
UncertaintyXListed	0.006	0.025	0.025*
	(0.014)	(0.016)	(0.014)
R^2	0.045	0.045	0.045
N	14,558	14,558	14,558
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Clustered id	yes	yes	yes

Notes: In this table, I regress investment rate $I_{it}/K_{i,t-1}$ (Investment in fixed assets scaled by the replacement value of capital stock at the beginning of period) on the three types of uncertainty (Scottish political uncertainty, Brexit uncertainty or Scottish policy uncertainty), an interacted dummy variable for manufacturing or listed firms (panel A and B respectively) and these types of uncertainty. Additional controls are cash flows scaled by the replacement value of the capital stock at the beginning of the period ($CF_{i,t}/K_{i,t-1}$), sales growth rate ($SG_{i,t}$), the Scottish GDP growth rate to control for business cycles (ΔGDP_t), the implied volatility index ($VFTSE$), local election dummy to control for elections uncertainty and the spread of cross-industry standard deviation of the growth rate of profits (proxy for profitability uncertainty). All regressions include fixed effects, and standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 6: Internal financial constraints and the effect of policy uncertainty on investment

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Negative CF vs. positive CF			
	Scot. Political (1)	Brexit (2)	Scot. Policy (3)
Uncertainty	−0.005 (0.003)	−0.012*** (0.004)	−0.010** (0.004)
UncertaintyX$negCF$	−0.012 (0.007)	−0.009 (0.006)	−0.007 (0.006)
N	14,558	14,558	14,558
R^2	0.045	0.045	0.045
Panel B: Negative vs. positive Coverage Ratio			
Uncertainty	−0.004 (0.003)	−0.006 (0.004)	−0.005 (0.004)
$negCR$	−0.001 (0.009)	−0.001 (0.009)	−0.0005 (0.009)
UncertaintyX$negCR$	−0.006 (0.008)	−0.016** (0.006)	−0.016*** (0.006)
N	10,822	10,822	10,822
R^2	0.041	0.042	0.042
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Clustered id	yes	yes	yes

Notes: In this table, I regress investment rate $I_{it}/K_{i,t-1}$ (Investment in fixed assets scaled by the replacement value of capital stock at the begining of period) on the three types of uncertainty (Scottish political uncertainty, Brexit uncertainty or Scottish policy uncertainty). Additional controls are cash flows scaled by the replacement value of the capital stock at the beginning of the period ($CF_{i,t}/K_{i,t-1}$), sales growth rate ($SG_{i,t}$), the Scottish GDP growth rate to control for business cycles (ΔGDP_t), the implied volatility index ($VFTSE$), local election dummy to control for elections uncertainty and the spread of cross-industry standard deviation of the growth rate of profits (proxy for profitability uncertainty). All regressions include fixed effects, and standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 7: External financial constraints and the effect of policy uncertainty on investment

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Young vs. old companies			
	Scot. Political	Brexit	Scot. Policy
	(1)	(2)	(3)
Uncertainty	−0.005	-0.011^{**}	-0.009^{**}
	(0.003)	(0.004)	(0.004)
Uncertainty X $Young$	−0.005	-0.009^{**}	−0.006
	(0.005)	(0.004)	(0.004)
R^2	0.045	0.045	0.045
N	14,558	14,558	14,558
Panel B: Small vs. Big Companies			
Political	-0.006^{*}	-0.014^{***}	-0.010^{***}
	(0.003)	(0.004)	(0.004)
$Small$	−0.018	−0.019	−0.018
	(0.012)	(0.013)	(0.013)
Uncertainty X $Small$	−0.004	−0.001	−0.004
	(0.005)	(0.005)	(0.005)
R^2	0.044	0.045	0.045
N	14,238	14,238	14,238
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Clustered id	yes	yes	yes

Notes: In this table, I regress investment rate $I_{it}/K_{i,t-1}$ (Investment in fixed assets scaled by the replacement value of capital stock at the begining of period) on the three types of uncertainty (Scottish political uncertainty, Brexit uncertainty or Scottish policy uncertainty). Additional controls are cash flows scaled by the replacement value of the capital stock at the beginning of the period ($CF_{i,t}/K_{i,t-1}$), sales growth rate ($SG_{i,t}$), the Scottish GDP growth rate to control for business cycles (ΔGDP_t), the implied volatility index ($VFTSE$), local election dummy to control for elections uncertainty and the spread of cross-industry standard deviation of the growth rate of profits (proxy for profitability uncertainty). All regressions include fixed effects, and standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 8: Robustness tests: additional control variables

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Baseline results			
	Scot. Political	Brexit	Scot. Policy
	(1)	(2)	(3)
Uncertainty	-0.006^{*}	-0.013^{***}	-0.011^{***}
	(0.003)	(0.004)	(0.004)
N	14,558	14,558	14,558
R^2	0.045	0.045	0.045
Panel B: Baseline plus log Number of employees			
Uncertainty	-0.007^{**}	-0.013^{***}	-0.010^{**}
	(0.003)	(0.004)	(0.004)
N	12,890	12,890	12,890
R^2	0.045	0.045	0.045
Panel C: General elections dummy instead of local Scottish elections			
Uncertainty	-0.019^{***}	-0.019^{***}	-0.019^{***}
	(0.003)	(0.002)	(0.002)
N	14,528	14,528	14,528
R^2	0.042	0.045	0.045
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Clustered id	yes	yes	yes

Notes: In this table, I present results of the baseline specification (panel A) and results from incorporating alternative control variables. Panel B incorporates the natural log of the total number of employees to the baseline regression. Panel C, uses a dummy for general elections Scottish rather than parliamentary elections. For expositional clarity, only the coefficients estimates of the variable of interest are shown (uncertainty coefficients). All regressions include fixed effects, and standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 9: Internal and External financial constraints: including time fixed effects

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Negative vs. positive Cash-Flows			
	Scot. Political	Brexit	Scot. Policy
	(1)	(2)	(3)
Uncertainty	-0.034^{***}	-0.025^{***}	-0.034^{***}
	(0.004)	(0.003)	(0.004)
negCF	0.009	0.009	0.009
	(0.009)	(0.009)	(0.009)
UncertaintyX*negCF*	-0.012	-0.009	-0.007
	(0.007)	(0.006)	(0.006)
N	14,558	14,558	14,558
R^2	0.046	0.045	0.045
Panel B: Negative vs. positive Coverage Ratio			
Uncertainty	-0.031^{***}	-0.021^{***}	-0.030^{***}
	(0.005)	(0.003)	(0.004)
negCR	-0.001	-0.001	-0.0005
	(0.009)	(0.009)	(0.009)
UncertaintyX*negCR*	-0.005	-0.016^{**}	-0.016^{**}
	(0.008)	(0.006)	(0.006)
N	10,822	10,822	10,822
R^2	0.041	0.042	0.042
Panel C: Small vs. Big firms			
Uncertainty	-0.035^{***}	-0.026^{***}	-0.034^{***}
	(0.004)	(0.003)	(0.004)
Small	-0.021^{*}	-0.020	-0.020
	(0.013)	(0.013)	(0.013)
UncertaintyX*Small*	-0.004	-0.001	-0.004
	(0.005)	(0.005)	(0.005)
N	14,238	14,238	14,238
R^2	0.045	0.045	0.045
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Time Effects	yes	yes	yes
Clustered id	yes	yes	yes

Notes: In this table, I regress investment rate $I_{it}/K_{i,t-1}$ (Investment in fixed assets scaled by the replacement value of capital stock at the beginning of period) on the three types of uncertainty (Scottish political uncertainty, Brexit uncertainty or Scottish policy uncertainty). Additional controls are cash flows scaled by the replacement value of the capital stock at the beginning of the period ($CF_{i,t}/K_{i,t-1}$), and sales growth rate ($SG_{i,t}$) and the spread of cross-industry standard deviation of the growth rate of profits (proxy for profitability uncertainty). All regressions include firm and time fixed effects, and standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 10: Robustness tests: alternative econometric frameworks

	Dependent variable: Investment rate ($I_{it}/K_{i,t-1}$)		
Panel A: Baseline results			
	Scot. Political	Brexit	Scot. Policy
	(1)	(2)	(3)
Uncertainty	-0.006^{*}	-0.013^{***}	-0.011^{***}
	(0.003)	(0.004)	(0.004)
N	14,558	14,558	14,558
R^2	0.045	0.045	0.045
Panel B: clustered standard errors at year level			
Uncertainty	-0.006^{**}	-0.013^{***}	-0.011^{***}
	(0.003)	(0.002)	(0.003)
N	14,558	14,558	14,558
R^2	0.045	0.045	0.045
Panel C: First Differences Model			
Uncertainty	-0.007^{**}	-0.015^{***}	-0.013^{***}
	(0.003)	(0.003)	(0.003)
N	12,360	12,360	12,360
R^2	0.019	0.019	0.019
Panel D: General Method of Moments (GMM) estimation			
Uncertainty	-0.013	-0.024^{*}	-0.021
	(0.009)	(0.012)	(0.013)
N	12,062	12,062	12,062
Panel E: Lagged uncertainty indices			
Uncertainty	-0.005^{*}	-0.012^{***}	0.005
	(0.0025)	(0.004)	(0.0031)
N	14,558	14,558	14,558
R^2	0.045	0.045	0.045
Controls	yes	yes	yes
Fixed Effects	yes	yes	yes
Clustered id*	yes	yes	yes

Notes: In this table, I present results of the baseline specification (panel A) and results from alternative econometric specifications. Panel B clusters standard errors by years instead of by observation. Panel C estimates the model using first differences as oppose to firm-fixed effects. Local election dummy in the first differences specification is excluded since it does not make economic sense. Panel D estimates a dynamic investment model using the General method of moments (GMM), and Panel E places the uncertainty indices with a lag ($t-1$) instead of at time t. For expositional clarity, only the coefficients estimates of the variable of interest are shown (uncertainty coefficients). All regressions include firm fixed effects, and standard errors are clustered at the firm level (*except in panel B which are clustered at the year level). t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.