Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Policy Uncertainty Shocks and Small Open Economies in Monetary Union: a Case Study of Ireland

Jonathan Rice

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Abstract

This paper explores the implications of policy uncertainty shocks for Ireland, a small open economy operating within monetary union. Exogenous domestic uncertainty shocks foreshadow persistent declines in Irish investment and employment, with no clear response by the ECB. On the other hand, no such decline in demand is observed following global uncertainty shocks, largely resulting from an accommodative monetary policy stance by the ECB. Results from this paper suggest that policy uncertainty shocks have negative and persistent effects on Irish real activity, only when monetary policy does not counteract these shocks. Common identification problems in the literature are also discussed and suggestions are made for future work in the area.

JEL classification: E2, E3, E4

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1 Introduction

Policy uncertainty has remained heightened for a number of years despite periods of relative calm in financial markets. Events such as the eurozone debt crisis, Greek crisis, U.S "debt ceiling" and the "Brexit" referendum have been key contributors. Research has documented sizeable short-run consequences of heightened policy uncertainty, with evidence of sharp declines in firm investment, output and employment (e.g. Baker et al. 2016). In this paper I consider the contribution of foreign and domestic policy uncertainty shocks to economic activity in a small open economy, using Ireland as a case study.

Small open economies are largely exposed to, and have little control over, spillovers of policy uncertainty from abroad. Further, if these economies operate within a monetary union, they are partly constrained in their ability to accommodate these shocks. Ireland has a high level of trade openness, a large presence of multinational corporations, free capital and labour mobility and a large financial sector - characteristics that are typical of well-developed small open economies. As a member of a currency union, Irish policy-makers are further restricted by an inability to counter uncertainty shocks using monetary policy. Given Ireland's reliance on foreign demand for goods and services and foreign direct investment of large multinationals, Ireland may be particularly responsive to heightened foreign uncertainty.

In line with Baker, Bloom and Davis (BBD, 2016), I consider economic policy uncertainty as general uncertainty about; (i) who will make policy decisions (e.g. election outcomes); (ii) what actions policy-makers will choose to take and when, and;(iii) the potential economic effects resulting from such policy actions. In addition, economic uncertainty may be induced by policy inaction, and in the wake of threats to national security and other policy matters that are not chiefly economic in nature. In this way, the scope of possible factors contributing to economic policy uncertainty is large, and may include uncertainty surrounding policies of various forms (e.g. monetary, fiscal, trade, social and national security, regulation, health care, tax, government spending and law). For a small open economy, it is likely that a significant portion of economic policy uncertainty stems from abroad. Banks, businesses, consumers and policy-makers operating in Ireland are likely to be responsive to foreign policy uncertainty where this uncertainty shrouds economic outcomes primary to them. Concerning exposure to foreign uncertainty shocks, the extent of domestic trade openness is important since a sizeable share of domestic firms rely on foreign markets, both as a source of imports and as consumers of their exports. Similarly, the size of the foreign sector is important since a large share of multi-national companies is likely to create more reliance on foreign debt and equity inflows. The size of the financial sector is relevant because recent research finds uncertainty shocks operating through financial frictions channels, and negatively impacting the real economy (Gilchrist et al., 2014). Foreign uncertainty has also been shown to impact capital inflows into small open economies (Choi and Furceri, 2018).

My analysis requires four steps. To begin I construct an Economic Policy Uncertainty index for Ireland in the spirit of Baker, Bloom and Davis (2016). This index is shown to be strongly correlated with measures of EPU for other developed countries, particularly the UK, euro area and the US. Secondly, I construct a "foreign" component of EPU using Principal Components Analysis (PCA), and using regression techniques, obtain an orthogonal

Irish-domestic EPU series. Finally, I consider the dynamic effects of foreign and domestic policy uncertainty on economic activity, focusing on the role of supranational monetary authorities. I discuss identification issues in the literature, and suggest use of sign and narrative restrictions (Rubio-Ramirez et al., 2018), which I leave for further work.

Evidence from Structural Vector Autoregressions in this paper suggests that macro economic responses to Irish EPU shocks depend crucially on the source of those shocks. There appears to be an important role for monetary policy in stabilising the macro economy following uncertainty shocks. However, once foreign uncertainty is purged from the Irish EPU series, such that the EPU series in the VAR indicates domestic uncertainty only, the ECB no longer respond to these shocks, and the impact on businesses appears larger and more persistent. Global EPU shocks coincide with a sharp reduction in the shadow interest rate, but no short run response by Irish businesses. Interestingly, results in this paper imply that global EPU shocks have an expansionary effect on the Irish economy, with investment and employment both seeing overshooting in the medium and long term. On the other hand, where ECB monetary policy is constrained, this paper gives evidence that Global EPU shocks may result in unfavourable outcomes, with sizeable declines in investment and employment and no overshooting (i.e. resembling the outcome following Domestic EPU shocks). Should researchers consider the Irish EPU series alone, without deconstruction into its foreign and domestic components, these dynamics are hidden from view.

The rest of the paper is organised as follows, Section 2 discusses the literature. Section 3 details the construction of the Irish EPU series. Section 4 contains the principal components analysis to extract a common Global and a Domestic EPU. Section 5 presents the empirical analysis. Section 6 addresses identification issues and introduces sign and narrative restrictions, and Section 7 concludes.

2 Literature

This paper overlaps three strands of literature. Firstly, there is a literature on uncertainty and *real options* and *financial frictions* theories. Real options theory is a means of evaluating an investment for a firm, where this investment usually takes the form of the purchase of new capital, or the hire of new labour. This literature dates back to Bernanke (1987) and is formalised by Dixit and Pindyck (1994), with a new theoretical approach to capital investment decisions that stresses the irreversibility of many investment decisions, and the ongoing uncertainty of the economic environment in which these decisions are made. Their approach recognises the value to a firm of waiting for more (but never complete) information before committing to irreversible investment. This literature is cited widely in recent work on uncertainty and economic activity. Bloom, Bond and Van Reenen (2007) and Bloom (2009) show that uncertainty has a sizeable impact on a firms' capital and labour investment. The latter paper constructs a model with time-varying second moment to simulate a macro uncertainty shock. The author finds dynamics consistent with *real options* theory, higher uncertainty causes firms to temporarily pause their investment and hiring in the short-term and leads to an overshoot of output and employment in the medium term once the shock has dissipated and pent-up investment ensues. Gulen and Ion (2016) use firm-level data and a news-based measure of policy uncertainty. They observe a negative relation

between policy uncertainty and capital investment that is significantly stronger for firms with a higher degree of irreversible investment, indicating precautionary investment delays consistent with real options theory. Bloom (2017) argues that firms are more forward looking, more attentive to future events and suffer more from increases in uncertainty than consumers do. Consumers, on the other hand, are more myopic and may only be sensitive to fluctuations in uncertainty where wages and employment are affected, which typically occurs with a few quarters' delay.

Secondly, there is a literature specifically focused on policy uncertainty. Closest to this paper is a paper by Zalla (2016), who uses the Baker Bloom and David approach to construct an Irish Economic Policy Uncertainty Index similar to that in this paper. Zalla's contribution uses alternative corpus of data which differs from that used in this paper and covers one Irish paper rather than the two covered in this contribution.[1]. Rodrik (1991), Higgs (1997) and Hassett and Metcalf (1999), address uncertainty in monetary, fiscal and regulatory policies and negative economic outcomes. Born and Pfeifer (2014) use an estimated New Keynesian model and show that the "uncertainty" effect of policy risk is unlikely to play a major role in business cycle fluctuations, despite the high presence of policy risk itself. Baker, Bloom and Davis (2016), create a time series for Economic Policy Uncertainty (hereafter BBD EPU) for the US based on newspaper articles, and use both firm-level data and macro data to demonstrate the link between economic policy uncertainty and economic activity. Their VAR analysis gave evidence that for the US, EPU shocks foreshadow declines in investment, output and employment. Bordo, Duca and Koch (2016) exploit cross-sectional heterogeneity in detailed banking data to consider whether economic policy uncertainty restrained U.S. bank lending during key policy events (using the BBD EPU measure). The authors uncover significant evidence both in cross-sectional data, and over time, that heightened policy uncertainty decreases the growth rate of both bank lending and GDP.

Finally, there is an emerging literature on the spillover of uncertainty shocks (e.g. Gourio et al. (2013); Cesa-Bianchi et al. (2014); Klossner and Sekkel (2014); Armelius et al. (2017); Cheng et al. (2017); Cerda et al. (2018)). Gourio et al. construct a RBC model with time-varying uncertainty, where countries have heterogeneous exposure to global uncertainty shocks. They apply their framework to the data by taking averages of volatilities in equity returns for G7 countries and show that spikes in international uncertainty precede a fall, rebound and overshoot response in industrial production for all countries. Cesa-Bianchi et al. (2014) use a Global-VAR to consider the impact of volatility on economic activity across multiple countries. Klossner and Sekkel (2014) find evidence of strong linkages of economic policy uncertainty across multiple countries, with the U.S. the largest exporter. Born et al. (2013) argue that terms of trade uncertainty may be a driver of real GDP in Chile. Armelius et al. (2017) construct an EPU series for Sweden and compare shocks to this series against shocks to the U.S. and German EPU on domestic macro variables. They use VAR analysis and uncover impulse response functions indicating a maximal impact on GDP within the same quarter following Swedish EPU shocks, whereas U.S. and German EPU shocks affect Swedish GDP with a one-quarter lag. Cheng et al. (2017) develop a BBD style EPU index for Hong Kong and find large international EPU spillovers from

[1]Ryan Zalla's data series is available on www.policyuncertainty.org

other major economies to Hong Kong. Furthermore, the authors demonstrate that domestic economic policy uncertainty leads to tight financial conditions and lower investment and vacancy postings.

3 Construction of the Irish EPU series

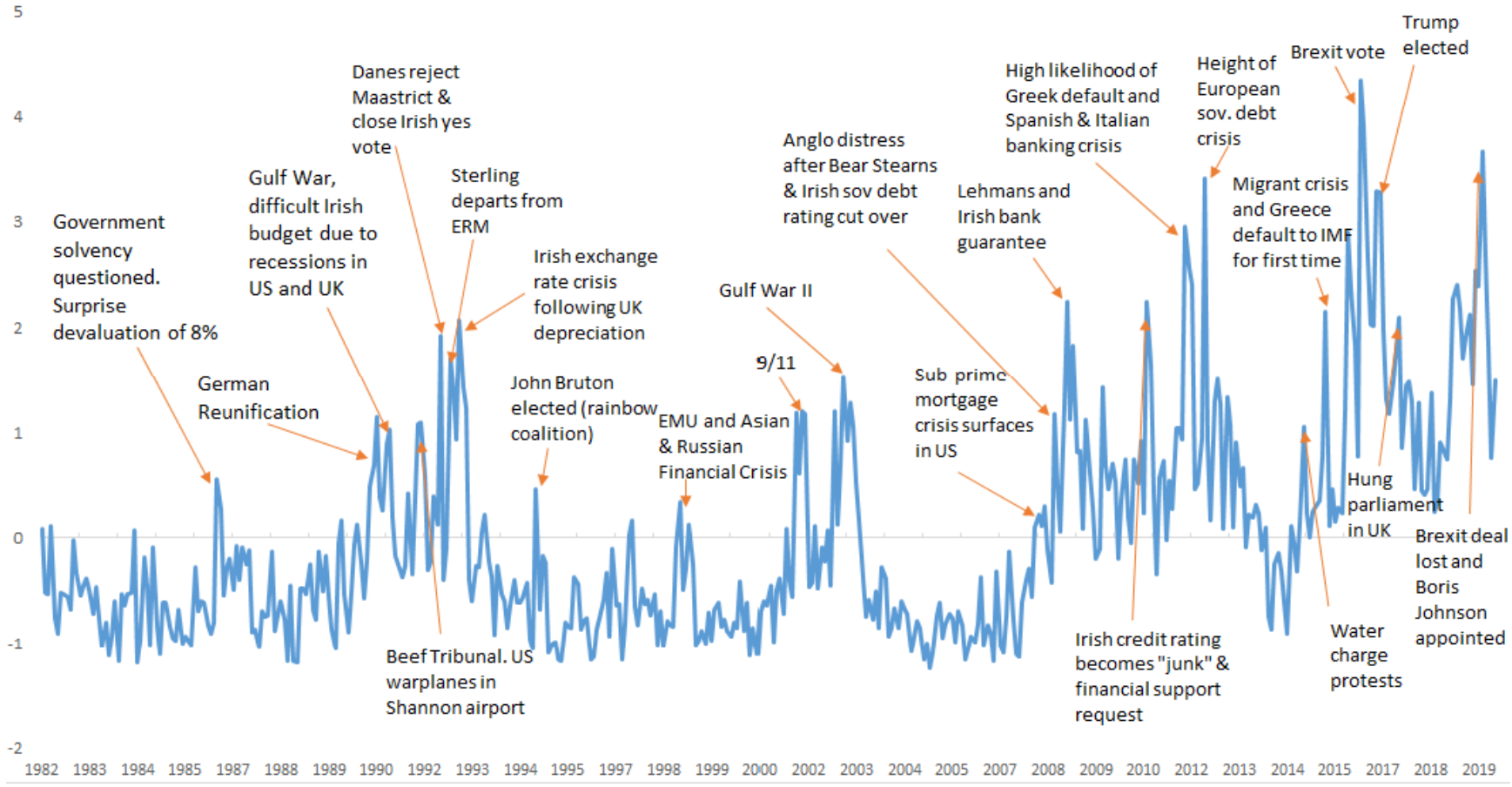
Following the method of Baker, Bloom and Davis (2016), I construct a monthly measure of Economic Policy Uncertainty (EPU) from January 1982 to August 2019 based on both print and digital newspaper articles from two leading Irish newspapers - The Irish Times and the Irish Independent. Founded in 1905, *The Irish Independent* is Ireland's largest selling newspaper. Close behind, the *Irish Times* remains Ireland's second largest selling newspaper.[2]

Specifically, I conduct a keyword search within the electronic archives of both newspapers for articles that contain one or more of the words "uncertainty" or "uncertain", AND one or more of the words"economic" or "economy", AND one or more of the words, "legislation"; "regulation"; "Dail"; "budget"; "deficit"; "government"; "Central Bank", or; "Taoiseach".[3] I scale the resulting monthly count in both papers by the total number of articles published in both newspapers each month, standardise the data to unit standard deviation and a mean value of 0 over the full time sample. Figure 1 below shows the resulting annotated series. The series is shown to peak around both domestic and foreign events. For domestic events, there are peaks surrounding close general elections, referenda and the 08/09 Irish banking crisis. Much of the series however, appears to be driven by foreign events, with uncertainty surrounding the Exchange Rate Mechanism (ERM) crises in Europe, terrorism and geopolitical events such as 9/11 and the Gulf War, bankruptcies in U.S. and euro area banks, political turmoil in Greece, the Brexit vote in the U.K. and some U.S. elections.

[2]Market shares between these two papers have remained relatively stable over time, although readership appears to be have been declining in recent years. According to the Irish Audit Bureau of Circulations (ABC), recent figures show *The Irish Independent* has average daily sales of print and digital versions of about 96,000, while the *Irish Times* had daily sales of around 78,000

[3]The Dail is the name given to Ireland's parliamentary buildings, and "Taoiseach" is the Irish head of government

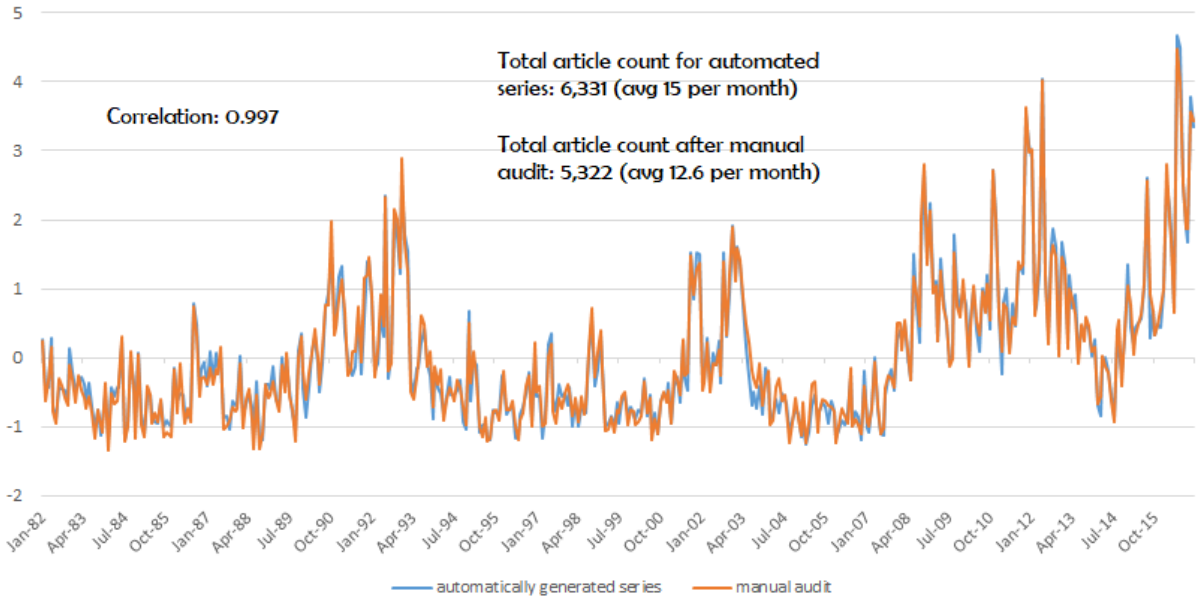
Figure 1: Irish EPU



3.1 Manual Audit of Irish EPU Series

I now turn to consider the accuracy of the BBD approach. To begin I conduct an extensive manual audit whereby I read each of the articles identified in the keyword search above and remove articles which I deem as being irrelevant. From over 6,300 articles I discounted 9% as being irrelevant (such as those referring to uncertainty in distant history), and 3.5% which referred to isolated policy uncertainty in distant developing economies that I deemed as having no economic consequence for Ireland. Figure 2 presents the outcome of this audit. Despite almost 1000 articles being discounted following the manual search, the correlation between the computer-generated series and the series following manual audit is very high (99.7%). The series are near-identical because articles are discounted following the audit in a uniform manner across the time series and as such, erroneous articles do not appear to be concentrated in specific periods. One noteworthy critique of the BBD approach is that the keyword search may also be identifying articles which refer to a decrease (rather than increase) in economic policy uncertainty, but reassuringly there were very few of these.[4] For the analysis presented in this paper I use the original series rather than the series following these omissions.

Figure 2: Automated and Manual Audit



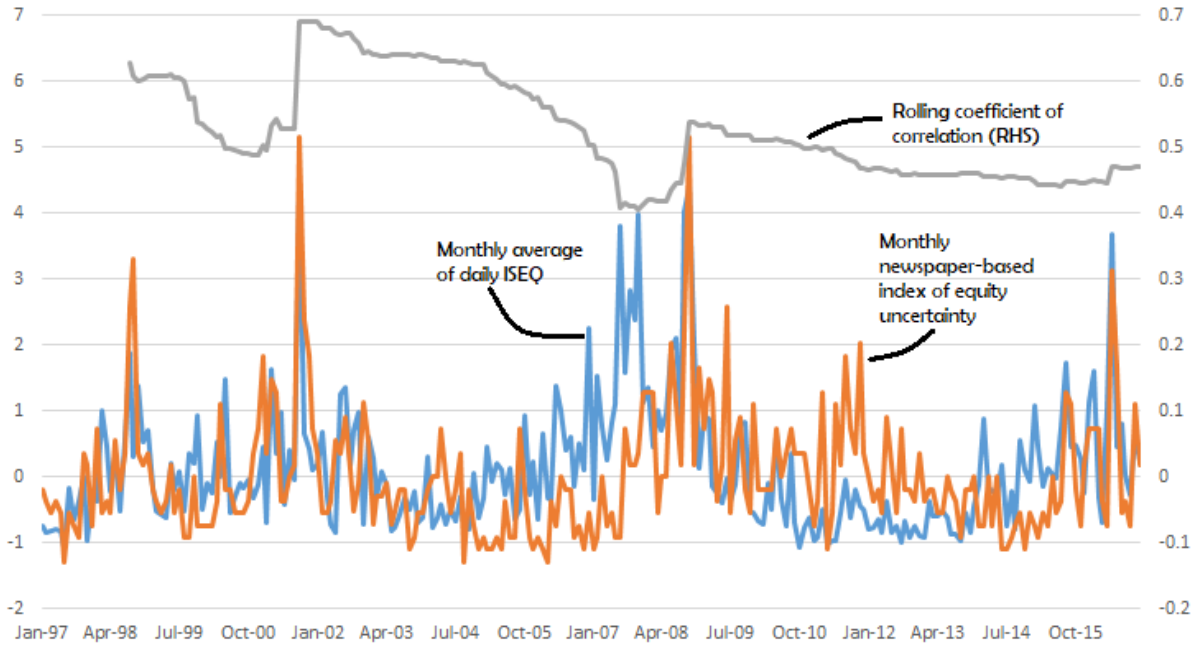
3.2 Testing the BBD Approach on Irish Equity Price Volatility

Next I test the BBD newspaper-based approach itself by using it to generate an artificial newspaper-based equity price volatility series that I can compare to actual data. Using

[4]It is noteworthy that here I only consider the presence of Type 2 errors. Since I do not consider articles that were missed by the keyword search, I can say nothing about the presence of Type 1 errors.

data on average daily returns for all listed companies on the Irish Stock Exchange (ISEQ) I compute average within-month volatility. Next, I repeat the BBD keyword search and (rather than searching for articles relating to economic policy uncertainty), search for articles that contain at least one of the keywords "volatile" or "volatility", AND at least one of the keywords "ISEQ" or "Irish stock exchange". Figure 3 compares the real data on monthly ISEQ volatility with the data series generated from the BBD newspaper-based approach. The blue line shows the monthly average of daily ISEQ returns and the orange line shows the monthly newspaper-based approach, finally the grey line shows the 2-year rolling coefficient of correlation between the two series. Despite a disentangling leading up to, and following, the financial crisis the two series contain a sizeable amount of co-movement. The rolling correlation peaks at almost 0.7, and dips to 0.4 at its trough, with an average correlation of 0.57 over the time sample.[5]

Figure 3: Monthly Average of ISEQ and Newspaper-based approach for Irish Equity Price Uncertainty



Finally I show a correlation table in the Appendix (Table 1) of the Irish EPU series and a number of EPU series from other countries, a measure of global EPU (from "policyuncertainty.org"), the VIX, a financial uncertainty series for Ireland based on the approach of Jurado, Ludvigson and Ng (2015), and some commonly used sentiment indices for Ireland - the consumer sentiment index[6] and the Purchasing Manager Indices (PMIs)[7]. The Irish

[5]Monthly ISEQ returns data were not available prior to 1997

[6]Sourced from the European Commission's Consumer Sentiment Surveys

[7]Sourced from Datastream and I thank Chris Redl at the Bank of England for sharing Irish financial uncertainty data

series appears highly correlated with other small open economies, such as Japan and the U.K. It is also unsurprising that, in addition to large economies (such as the U.S., Germany and France), these countries are highly correlated with the measure of global EPU. There is also a high correlation between Ireland, the U.S. and core euro area countries.

4 Global and Domestic Components of Irish Economic Policy Uncertainty

There appears to be a strong common (or global) component in our EPU data. It is informative to strip out this global component in order to separate global (or foreign) uncertainty from underlying domestic uncertainty, to be used in our empirical specification. The conventional way to do this is using Principal Component Analysis (PCA). Once the global component of EPU is uncovered, I use OLS techniques to isolate the domestic component of Irish EPU.

PCA extracts the variance structure of a set of variables using linear combinations of the data. It can identify similarities between data series, and compress these data in a way that highlights similarities with minimal loss in information. This technique is useful when one believes that a set of variables contain much of the same underlying information, and where one is interested in deciphering this information from the "noise" contained in individual variables. In our case, this underlying information is global economic policy uncertainty, which we interpret as country-level shocks of global importance, while the residual "noise" represents country-level shocks that are not globally systemic in nature.

Principal components (PCs) for the set of EPU series are obtained using eigenvalue decomposition of the observed variance matrix. The first PC is interpreted as the linear combination of the observed variables that accounts for the maximal amount of cumulative variance in the series. Each other principal component maximises variance using linear combinations that are orthogonal (or uncorrelated) to the previous components. In this way, as more components are calculated, one is accounting for an increasing amount of the total variance contained in the dataset.

I use monthly data for all 16 countries with EPU data available from 1998 to 2018.[8] Since I am are interested in foreign policy uncertainty I exclude Ireland from the PCA analysis.

In Figure 8 in the Appendix, I show the first three principal components, multiplied by their corresponding shares of marginal variance contribution. The sum of each of these series combines the first three principal components and explains 76% of the total variance in the data. There are a number of rules of thumb in the literature when deciding on the number of principal components to include, and I decided to use three components - the number of components that would ensure a minimum of 70% explained variance in the variables. In Appendix 9 I also compare the outcome to the BBD "Global Policy Uncertainty Index", demonstrating that these two series are very similar.

I am interested in the effect of both foreign, and domestic EPU on the real economy. In

[8]This includes the U.S., Australia, Brazil, Canada, Chile, China, Germany, Italy, U.K., France, Greece, Japan, South Korea, Mexico, Russia and Sweden

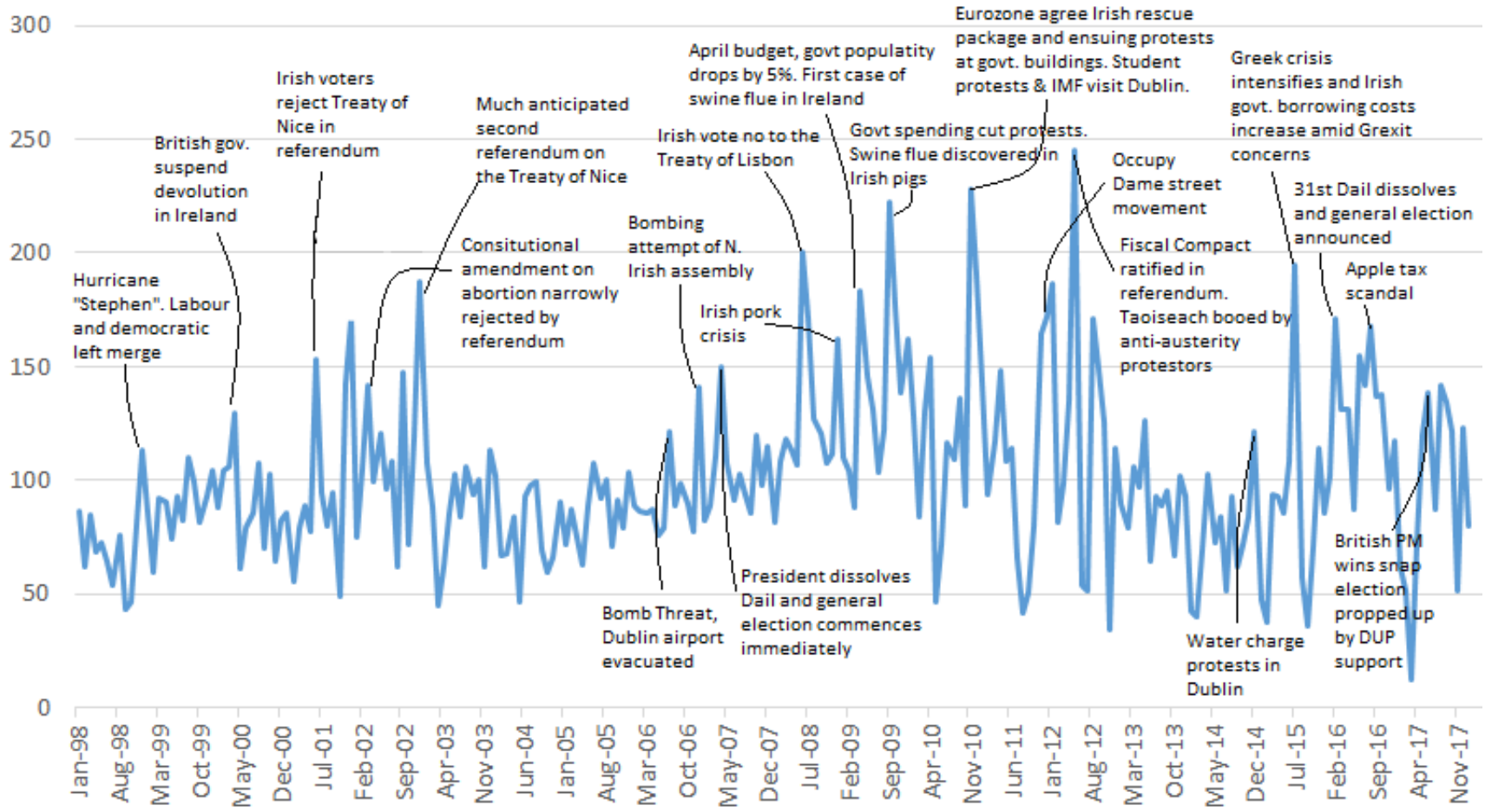
order to estimate domestic EPU, I take the Irish EPU series and regress it on the foreign principal component constructed above as follows:

$$IreEPU_t = \alpha_t \ + \beta_1 \ (GEPU_t) + \beta_2 \ (GEPU_{t-1}) + \beta_3 \ (GEPU_{t-2}) + \beta_4 \ (GEPU_{t-3}) + \epsilon_t$$

"Domestic" EPU is recorded in the residuals (vector ϵ). In other words, that which is not explained by current or past lags of global uncertainty. The resulting series could be interpreted as uncertainty resulting from domestic events, and by construction the domestic series is orthogonal to the global series. Figure 4 below plots the resulting annotated domestic uncertainty series.[9] The series behaves as expected, with elevated uncertainty surrounding key domestic events, such as general elections; referenda; public protests; matters of national security, and; noteworthy budgetary announcements.

[9]This series has been normalised to a mean of 100

Figure 4: Domestic EPU



5 Empirical Analysis

With these measures of foreign and domestic uncertainty at hand, it is useful to estimate their co-movement with Irish economic activity and to consider the transmission channels at work. I run a Structural Vector Autoregression model (SVAR) with identification based on recursive assumptions (Cholesky), as is standard in the literature (e.g. Bloom, 2009; Baker, Bloom and Davis, 2016). However, it is important that the shocks to EPU are correctly identified, so I consider the historical decomposition of EPU within my SVAR specification to consider how well Cholesky decomposition isolates exogenous uncertainty shocks, and I leave alternative identification schemes for future work.

I identify structural shocks in the VAR system by applying a Cholesky decomposition. This identification strategy involves the decomposition of the variance covariance matrix Σ of reduced form residuals into an upper triangular matrix S' and a lower triangular matrix S. The $n(n-1)/2$ restrictions required to identify the structural model are imposed as zero restrictions on the matrix S, which links the reduced form and structural residuals. Intuitively, these restrictions ensure that some of the structural shocks are unable to have a contemporaneous impact on some of the variables.

I estimate the VAR with its structural form as shown in (1). I include two lags as informed by AIC information criterion and estimate the VAR using quarterly data from 1999Q1 to 2018Q1[10]. Variables are seasonally adjusted, in log levels and in constant terms, with the exception of the uncertainty series' and the shadow rate which are in levels and are not seasonally adjusted. For all specifications I include both a constant and a trend.

$$AY_t = \alpha_t + trend_t + \sum_{i=1}^{2} A_i^* Y_{t-i} + \epsilon_t \tag{1}$$

I use underlying investment[11], and general employment. The interest rate is the shadow rate computed using the method of Wu and Xia (JMCB forthcoming). Use of this series ensures that any ECB response spans both conventional and unconventional monetary policies. The measure of financial uncertainty is derived using the Jurado, Ludvigson and Ng (2015) approach - estimating the unforecastable variation within a set of Irish financial variables.[12] I order variables as indicated by vector (2) below.

$$Y_t = \begin{bmatrix} investment_t \\ cpi_t \\ consumption_t \\ employment_t \\ epu_t \\ financialuncertainty_t \\ ECBshadowrate \end{bmatrix} \tag{2}$$

[10]The period over which the ECB have been the monetary authority in the euro area

[11]This is a measure of investment for Ireland that strips out intangibles and aircraft related investment. These items are highly volatile and large investments in these areas are often detached from underlying domestic activity

[12]We thank economists at the Bank of England for use of their data. The list of Irish financial variables is included in the Appendix, please refer to their paper for details of the methodology

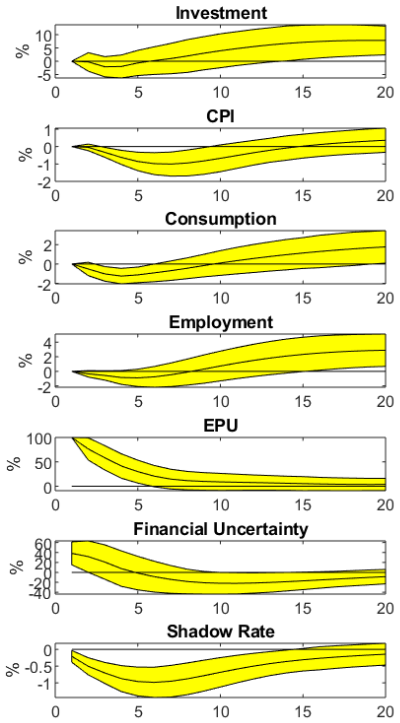
The literature is undecided on the appropriate ordering of uncertainty among other economic variables when using recursive ordering. I order the uncertainty variables last, with EPU ordered prior to financial uncertainty. Ordering EPU second last is the most conservative decision, since I assume that investment, employment and consumption do not react contemporaneously to uncertainty shocks. Given that financial variables are generally faster to react than other economic variables I order financial uncertainty after EPU.

To begin I run the baseline specification described above and consider the Impulse Response Functions (IRFs).

5.1 Results - Baseline Specification

Impulse responses from the SVAR specification using the main Irish EPU series are shown in Figure 5 below. Impulse responses are plotted with centred 90% confidence bands. A standardised shock is applied to Irish EPU and all responses can be interpreted as percentage deviations from initial values.

Figure 5: Irish EPU - Impulse Response Functions



Although large in magnitude, the response of investment is not statistically significant. The price level declines by 0.6%, returning to trend levels thereafter. Consumption declines

by more than 1% and responds similarly to employment - which reaches its peak decline four quarters after the initial EPU shock, and is statistically significant. The EPU shock is persistent, remaining in the system for up to four quarters, and EPU shocks appear to often coincide with financial uncertainty. Given that the investment response is not statistically significant, it is difficult to argue that these results align with real options theory (i.e. where firms respond to uncertainty by delaying hiring and investment until more information is available).

There is a sizeable decline in the ECB Shadow Rate, which begins in the same period as the initial EPU shock. It is possible that this monetary policy response is obscuring the short-term real economic effects of uncertainty shocks. This implies that the ECB's reaction has largely mitigated the negative effects of uncertainty shocks on Irish investment in the short run. In the medium and long-term however, there appears to be an overshooting in the real economy - once the uncertainty shock dissipates, amid a more accommodative monetary policy regime, investment and employment exceed previous growth trends.

As discussed above, these results suggest an important role for monetary policy in accommodating uncertainty shocks. However, while policy uncertainty has been growing in the years following the Global Financial Crisis, interest rates have moved very little. In 2016, following the Brexit vote, and in the years that have passed since, the ECB have had little opportunity to adjust rates further by conventional means. Furthermore, since Ireland is a minor contributor to euro area output, it is unlikely that Irish domestic uncertainty shocks would foreshadow any response by the ECB, and thus the economic effects may be more severe and persistent.

For these reasons, it is informative to consider the real economic effects of uncertainty where there is no monetary policy response. To do so using an empirical specification (rather than a full model) is difficult. However, exploiting the fact that the ECB are unlikely to respond to policy shocks in Ireland - a small open economy with a number of historic domestic policy uncertainty events (recorded above) - I make use of the orthogonal global and domestic components of Irish EPU, and draw suggestive implications for the role of monetary policy. In addition, I construct a counter-factual experiment whereby a series of shocks are imposed on the Shadow Rate within a Global VAR specification, such that the impulse response for the Shadow Rate remains at zero for the duration of the outcome period. As discussed below, this counter-factual experiment gives insight into the general contribution of monetary policy in driving domestic economic outcomes following global uncertainty shocks.

5.2 Results - Foreign and Domestic Policy Uncertainty

I individually replace the main Irish EPU series with its orthogonal domestic and global components. Intuitively, given that Ireland is a small economy within a large monetary union, one would not expect the ECB to respond to Irish domestic uncertainty shocks. Therefore, domestic EPU shocks may result in a more significant and persistent negative response of real macroeconomic aggregates. On the other hand, in the case of shocks to the global component of the Irish EPU series, one might expect a stronger accommodative stance by the ECB, and a less protracted response in Irish macroeconomic aggregates. I then run an experiment where I consider what the responses might have looked like had

there been no response by the European Central Bank (ECB) in accommodating shocks by lowering interest rates. To do this, I force a counter-factual sequence of shocks to the shadow interest rate within the Global EPU VAR specification, such that the rate remains at its baseline. One may interpret the resulting counter-factual responses of other variables in the VAR as responses to EPU shocks unaccompanied by changes in monetary policy stance.[13]

Figure 6: Global(LHS), Domestic (Middle) and Domestic with Global Counter-factual (RHS)-Impulse Response Functions

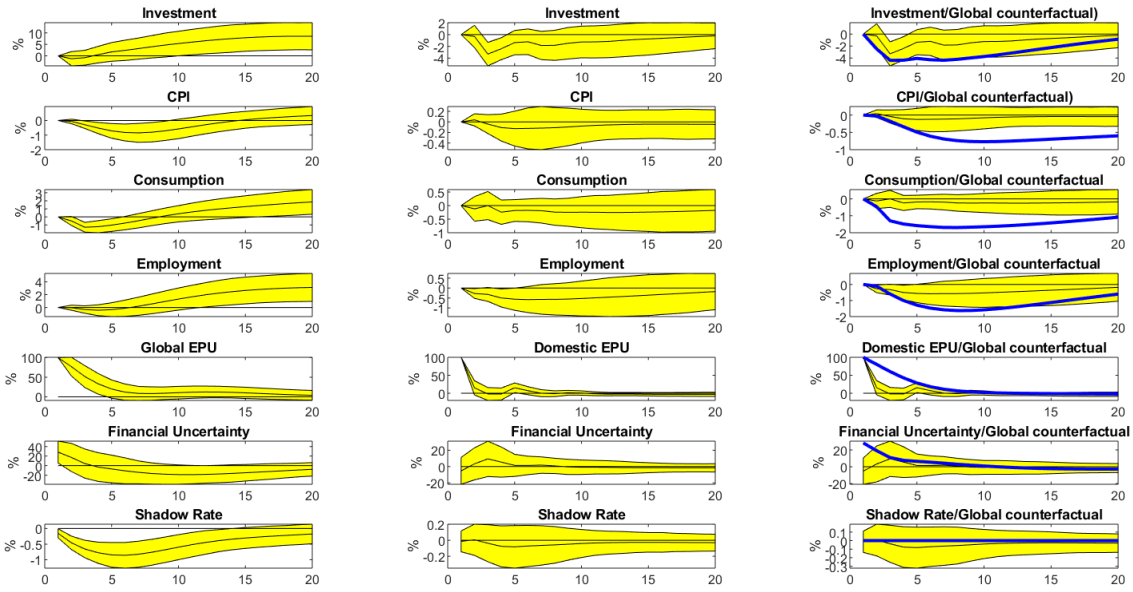


Figure 6 shows the Impulse Response Functions (IRFs) for shocks to Global EPU (LHS) and Domestic EPU (middle) in addition to a counter-factual experiment where domestic EPU response functions are overlaid with median responses whereby the Global EPU shocks are forced not to coincide with a monetary policy response (RHS). Both the Global and Domestic EPU series are standardized with a mean of zero and standard deviation of 1, and the imposed shocks are 1 standard deviation to the respective series.

As expected, the global shock coincides with an accommodative monetary policy stance by the ECB. As observed in the baseline case, there does not appear to be a statistically significant initial response in Irish investment and employment following global uncertainty shocks. This finding implies that businesses operating in Ireland do not generally slow-

[13]While informative, this is not a conditional forecast

down investment and hiring in response to economic policy uncertainty that is happening abroad. There is however a small short-term reduction in consumption (of just over 1%) and a decline in the price level. The response in financial uncertainty remains similar to that in the baseline case, suggesting that global uncertainty shocks coincide with financial uncertainty. In addition to these dynamics there is a sizeable overshoot in both investment and employment. Interestingly, this strong overshoot appears be largely driven by the reduction in interest rates. Combined with a muted short-term response of Irish businesses, the favourable economic environment appears to have an expansionary effect of investment and employment.

Turning to the results of the domestic EPU specification, there are persistent declines in investment and employment despite relatively short-lived EPU shocks. The investment response is delayed, coming in the second quarter following the initial EPU shock, and reaches a trough at -3.5%, remaining statistically significant for the second and third quarters following the initial uncertainty shock. Employment declines by 0.6% relative to trend, and this result is also statistically significant. Furthermore, domestic EPU shocks do not precede declines in CPI or financial uncertainty and, as expected, do not coincide with a reduction in interest rates. Due to the lack of a monetary policy reaction, the over-shooting dynamics seen in the case of foreign EPU shocks are not present, and the negative response of investment and employment persists for longer than in the baseline case.

In the rightmost column of Figure 6, I run the counter-factual series of shocks to the ECB Shadow Rate described above. I compare this to the IRFs from the Domestic EPU VAR specification. Caution should be made in interpreting the comparative magnitude of the responses (since the underlying shocks differ from one another), however it can be seen that the direction and duration of the impulse responses of investment and employment align more closely with those observed in the Domestic EPU specification. This result gives evidence for the hypothesis that monetary policy plays a crucial role in accommodating uncertainty shocks. The lack of a short-term response in investment and employment following a Global EPU shock previously uncovered in Figure 6, does not hold when the shadow interest rate is held constant.

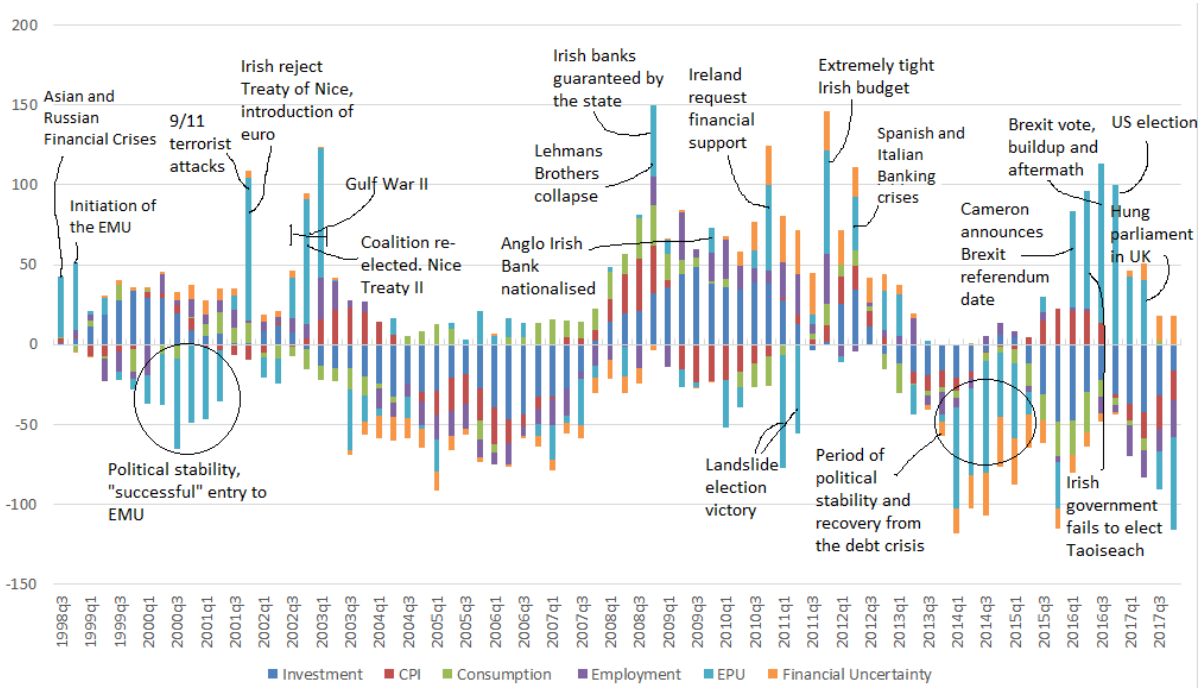
The above results represent an insightful contribution to the literature on uncertainty shocks in small open economies operating in monetary union. Since domestic Irish shocks are not sizeable enough to warrant a response by the European Central Bank, Irish businesses forgo investment and employment in the short-term until the uncertainty has withered. Irish businesses do not appear to respond in the same way to global shocks, where these shocks do not coincide with domestic uncertainty. Instead, the ECB respond to these shocks, benefiting Irish businesses in the medium-term. However, where monetary policy is constrained, this paper gives evidence that Global EPU shocks may result in unfavourable outcomes, with declines in investment and employment resembling those observed following Domestic EPU shocks. Should researchers consider the Irish EPU series alone, without deconstruction into its foreign and domestic components, these dynamics are hidden from view.

5.2.1 Shock Identification

EPU shocks in the above VAR analysis may be capturing other things, such as first moment shocks to domestic demand, or bad news shocks to the economy. To consider the extent to which this may be the case, we can consider the historical decomposition of EPU shocks for our baseline case using Cholesky ordering. In doing so we can consider the drivers of movements in EPU, and whether the EPU shocks in our VAR are reflective of uncertainty, or rather bad news. The information contained in the historical decomposition could also reveal the extent to which domestic and foreign events are driving shocks to EPU.

The historical decomposition of Irish EPU is given in Figure 7 below. The contribution of EPU shocks to the historical decomposition of EPU is shown in light blue. In general these shocks appear to line up to what one might expect - events that are exogenous in nature to the domestic economy (such as Asian and Russian financial crises, the 9/11 terrorist attacks, the second Gulf War and Brexit) coincide with quarters in which the contribution of EPU is much greater than the contribution of domestic macroeconomic variables. There are also a number of events (both domestic and foreign), that contribute to quarterly movements in EPU, but do so to a lesser extent than does the total contribution of domestic macroeconomic variables (such as the Irish bank guarantee/ collapse of Lehman brothers, the nationalisation of Anglo Irish Bank, and the 2017 hung parliament in the U.K.).

Figure 7: Historical Decomposition of Irish EPU Shocks (baseline case)



In summary, the recursive identification scheme employed in this paper appears to iden-

tify exogenous shocks to Irish EPU quite well. Despite this, it is worthwhile however to consider other possible approaches to identification. Traditional sign restrictions are more flexible than recursive identification schemes such as that employed in this paper. One shortfall (as demonstrated by Kilian and Murphy (2012)) is that one imposes only a small number of sign restrictions, and therefore may obtain a large set of structural parameters with implausible implications for the impulse response functions and historical decomposition. One solution to improving this approach is to use narrative restrictions, as proposed by Antolin-Diaz and Rubio-Ramirez (2018). The idea is to come up with a small number of additional uncontentious restrictions to accompany traditional sign restrictions, helping to reduce the set of admissible structural parameters and allowing us to reach clearer economic consensus. Narrative sign restrictions constrain the structural parameters by ensuring that structural shocks, and the historical decomposition, agree with the established narrative. This narrative is informed by the researchers' prior knowledge of uncontroversial characteristics of historical events occurring during the data sample. To give an example, a narrative sign restriction may be imposed on the structural shocks to rule out any structural parameters that do not agree with the fact that "a positive shock to uncertainty occurred in the US in September 2001". A narrative restriction on the historical decomposition may further impose that "uncertainty was the most important driver of the shock to EPU in September 2001". In theory, such an approach could give confidence to the claim that the observed responses are reflective of Knightian uncertainty, rather than aggregate demand or bad news shocks.

6 Conclusion

In this paper I have constructed a measure of Irish Economic Policy uncertainty using the techniques of Baker et al. (2016) and carefully tested the approach and resulting series. Irish EPU is shown to be largely driven by global policy events, particularly those emanating from the U.S., U.K. and countries in the core of the euro area. I provide evidence that exogenous domestic uncertainty shocks foreshadow declines in Irish investment and employment, with no clear response by the ECB. On the other hand, global uncertainty shocks generally coincide with a sharp reduction in the shadow interest rate, and no such negative outcome for investment. Exploiting Ireland's role as a small open economy (with little influence on ECB monetary policy), and the orthogonality properties of the Global and Domestic components of EPU derived in this paper, I provide evidence that policy uncertainty shocks have negative and persistent effects on Irish real economic activity, only where the monetary authority does not react. I give further evidence for this claim by using a counter-factual empirical specification, where the median response of the ECB Shadow Rate is forced to remain unchanged for the duration of the outcome period, following a shock to global policy uncertainty.

In addition to these findings, Irish consumers are shown to respond negatively to global shocks (perhaps driven by general pessimistic sentiment or fear), but not to domestic shocks. The price level behaves similarly, declining following foreign shocks, and not responding to domestic shocks. Common identification problems in the literature are also discussed and suggestions are made for future work in the area.

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8 Appendix

8.1 Appendix Table 1

	Ire	Global	US	UK	Ger	Ita	Fra	Spa	PMI	CSI	VIX	F.unc
Ireland	1											
Global	0.82	1										
US	0.64	0.85	1									
UK	0.76	0.81	0.53	1								
Germany	0.71	0.85	0.70	0.72	1							
Italy	0.51	0.61	0.52	0.48	0.53	1						
France	0.70	0.82	0.64	0.73	0.74	0.65	1					
Spain	0.51	0.66	0.60	0.49	0.60	0.43	0.54	1				
PMI	0.21	0.12	0.36	-0.10	0.01	0.08	-0.03	0.01	1			
CSI	0.34	0.25	0.43	0.01	0.11	0.08	0.05	0.09	0.89	1		
VIX	0.38	0.42	0.55	0.07	0.31	0.15	0.15	0.23	0.63	0.74	1	
Fin.unc	0.38	0.32	0.41	0.08	0.19	0.07	0.13	0.28	0.48	0.64	0.74	1

8.2 Principal Components Analysis

Figure 8: First Three Principal Components (multiplied by shares in total variance)

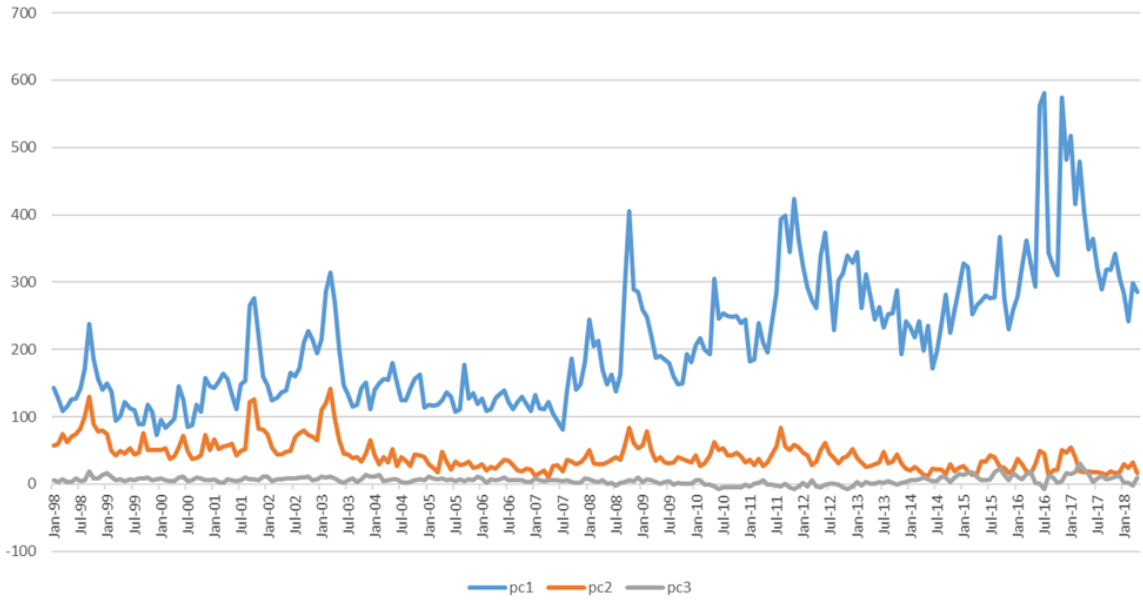
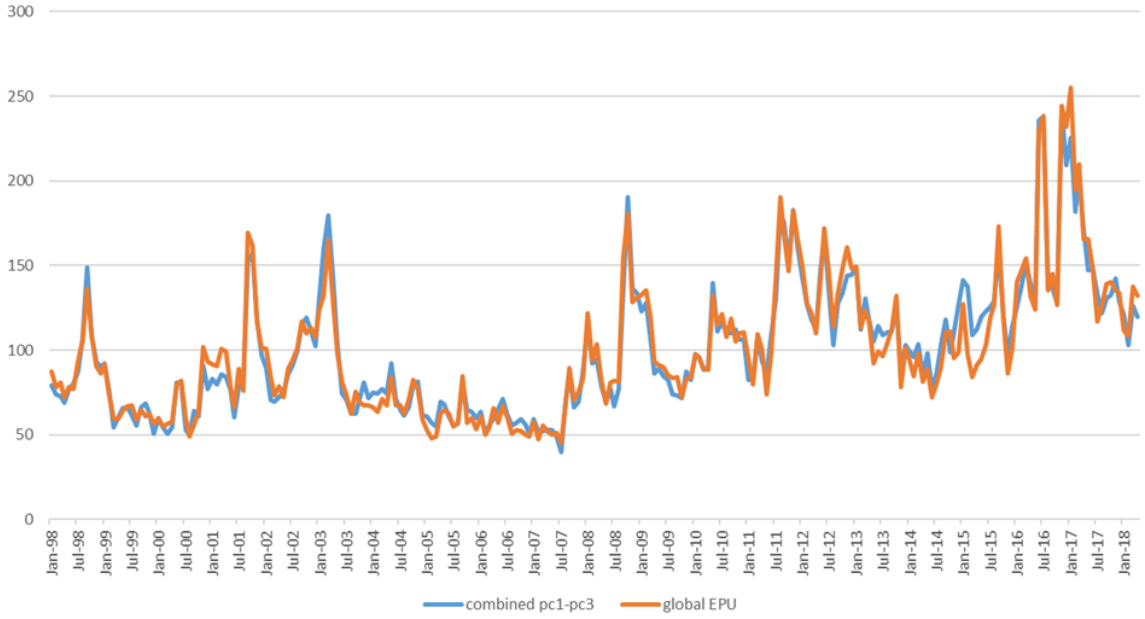


Figure 9: Comparison between PCA-based Global EPU and Baker, Bloom and Davis Global EPU



8.3 Baseline SVAR - Cholesky Identification

Using the ordering in the Cholesky decomposition described in this paper, the relationship between the reduced form residuals, e_t, and the structural shocks ϵ_t, can be written as follows.

$$\begin{pmatrix} e_t^{int.r} \\ e_t^{f.unc} \\ e_t^{epu} \\ e_t^{emp} \\ e_t^{cons} \\ e_t^{cpi} \\ e_t^{inv} \end{pmatrix} = \begin{pmatrix} S_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 & 0 & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & 0 & 0 \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} & 0 \\ S_{71} & S_{72} & S_{73} & S_{74} & S_{75} & S_{76} & S_{77} \end{pmatrix} * \begin{pmatrix} \epsilon_t^{int.r} \\ \epsilon_t^{f.unc} \\ \epsilon_t^{epu} \\ \epsilon_t^{emp} \\ \epsilon_t^{cons} \\ \epsilon_t^{cpi} \\ \epsilon_t^{inv} \end{pmatrix} \quad (3)$$