Newspaper-based economic uncertainty indices for Poland

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Contents

Abstract

Using text mining and web scraping techniques, we develop newspaper-based economic uncertainty measures for Poland. We build 'general' economic and economic-policy uncertainty indices, as well as category-specific ones designed to capture e.g. the economic uncertainty related to fiscal policy or to stockmarket movements. Several types of evidence suggest that these indices do proxy for changes in economic uncertainty in Poland. In particular, our measures spike around uncertainty-laden events or periods, such as the initial phase of Poland's post-communist economic transition, the global financial crisis or the European debt crisis that followed. Our indices also exhibit correlation with a variety of other indicators of economic uncertainty, such as financial-market data and results of corporate surveys. The newspaper-based indices behave similarly to uncertainty indicators developed using other textual data and are strongly correlated with relevant economic uncertainty indicators developed by other researchers.

JEL Classification Numbers: C82, D80, E66

Keywords: economic uncertainty, index, macroeconomic policy, text mining, web scraping

1. Introduction

Recent years have witnessed a rise in concerns about economic uncertainty and its implications for the behaviour of economic agents and monetary policymakers, both in Poland and abroad. As a case in point let us quote Mario Draghi, European Central Bank president, who has recently admitted that uncertainty is 'pervasive'[1] and 'persistent'[2], and seriously complicates making monetary policy decisions. Indeed, the last few years were abundant in events or initiatives matching Knight's (1921) definition of uncertainty in that their economic outcome was (and in some cases still is) difficult to measure or predict in advance. Let us name a few of them: Brexit, changes to US trade policy, economic transition in China, European immigration crisis, European debt crisis, Russia's military intervention in Ukraine, US debt-ceiling 'crises', Fed 'tapering', and, last but not least, the global financial crisis.

As perceived uncertainty increased in recent years, research on the methods of measuring it expanded, despite all the difficulties involved. Researchers have typically tried to quantify uncertainty via survey results, the volatility of financial returns or of aggregate economic indicators, the degree of disagreement among economic experts in their forecasts of economic phenomena or by the magnitude of forecast errors (see e.g. Bloom, 2014). Sometimes various uncertainty proxies have been combined into a single indicator (see e.g. Haddow et al. 2013). More recently, yet another method of measuring economic uncertainty has been gaining popularity – one based on automated analysis of textual data, especially newspaper coverage frequency (Alexopoulos and Cohen, 2009, 2015; Baker, Bloom and Davis, 2016). This method basically consists in measuring the frequency of newspaper articles containing specific terms of interest, such as 'uncertainty' (or 'uncertain') and 'economic' or ('economy'), and possibly other terms related to economic phenomena. If the number of articles containing the pre-selected words increases in a given time period (week, month, quarter, etc.) then so does the uncertainty index.

None of the above measures is a perfect proxy for uncertainty, and each has both advantages and disadvantages. As argued by Eckley (2015:1), a fundamental advantage of

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[1] URL: https://www.ecb.europa.eu/press/pressconf/2019/html/ecb.is190307~de1fdbd0b0.en.html (access: 10 April 2019). See also Strauss (2019).

[2] URL: https://www.ecb.europa.eu/press/pressconf/2019/html/ecb.is190410~c27197866f.en.html (access: 10 April 2019). See also: Georgiadis (2019).

text-based measures is that *natural language expressions of uncertainty (…) provide a relatively direct window on the latent intensity of the cognitive state of uncertainty. (…) Other uncertainty measures tend to be based on observed outcomes several steps removed from cognitive state, and thus more vulnerable to conflation with non-uncertainty factors.* Among the advantages of text-based uncertainty indicators one could also include the possibility of fairly easy topical decomposition as the subject of uncertainty is often stated explicitly in the text*,* and the identification of potential heterogeneity in uncertainty perceptions among different authors. Finally, this method might in certain cases also make it possible to obtain a longer time series of uncertainty data by extending the textual analysis back in time.

In this paper, following the approach of Baker, Bloom and Davis (2016), we develop newspaper-based indices designed to measure the level of general as well as policy-specific economic uncertainty perceived in Poland. We also construct three category-specific indicators to capture the level of uncertainty related to stockmarket developments, banking crises and economic uncertainty related to China. The aim of the paper is to assess whether such natural-language-based indices, successfully implemented in the case of other countries, could also be regarded as proxies for economic uncertainty in Poland. Several types of evidence suggest an affirmative answer to this question. In particular, our measures spike around uncertainty-laden events or periods, such as the initial phase of Poland's post-communist economic transition, the global financial crisis or the European debt crisis that followed. They also exhibit correlation with a variety of other proxies for economic uncertainty, such as financial-market data and results of corporate surveys. Finally, the newspaper-based indices behave similarly to uncertainty indicators developed using other Polish textual data and are strongly correlated with the economic policy uncertainty (EPU) indices constructed by Baker, Bloom and Davis (2016) for other countries.

The paper makes a contribution to the dynamically growing literature on using text data in economic applications[3]. Our indices are, to the best of our knowledge, the first published newspaper-based economic uncertainty measures for Poland. They also stretch as far back as to 1989, that is they cover a much longer period, including the tumultuous initial phase of Poland's post-communist economic transition, than any other uncertainty proxies available for this Central European economy. This is an exploratory attempt at developing

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[3] A good introduction to this literature can be found for instance in Bholat et al. (2015).

text-based economic uncertainty measures for Poland, and as such our research has some limitations. In particular, we do not conduct a rigorous analysis of the sensitivity of our results to the key choices in the empirical implementation (such as uncertainty keyphrase selection), or an econometric study of the effects of uncertainty on macroeconomic variables, saving it for future research.

The paper is organized as follows. In section 2 we describe the methods used in index construction. In section 3 we present the results and provide a descriptive analysis of the uncertainty indices developed. Section 4 contains an evaluation of the indices by means of a comparison with other relevant uncertainty proxies available for Poland. Section 5 concludes.

2. Methods

The indices of economic uncertainty for Poland are based on the frequency of articles published in the Polish daily *Gazeta Wyborcza* (henceforth: *GW*). *GW* has been published since May 1989 and is a multi-section non-tabloid daily newspaper with local editions for several Polish cities. For most of the last 30 years it has been among the top three Polish dailies by circulation[4]. *GW* is a rather left-leaning and/or liberal newspaper (see e.g. Dzięciołowski 2017). Political slant could potentially introduce bias to our indices if the articles published in *GW* displayed a tendency to overstress economic uncertainty under right-wing/conservative governments. We, however, fail to notice any significant bias when we cross-check our *GW*-based index against an index developed using articles published in another major Polish daily, *Rzeczpospolita* (henceforth: *RP*), which is usually regarded as more conservative and/or right-leaning[5]. Unfortunately, due to the lower reliability of results obtained by searching *RP*'s online archive, discussed in more depth in Section 4, we decided not to develop our uncertainty indices based on both newspapers. We use the *RP*-based results for comparison and evaluation purposes only.

We search *GW*'s own online archive using our own computer scripts written in the Python programming language. As the archive must be accessed via a dynamic web page we resort to web browser automation software for live interaction with DOM objects. Therefore we use the Selenium module which lets Python directly control the web browser by programmatically clicking buttons or links and filling in search-box information, thereby mimicking human user behaviour.

We follow the approach of Baker, Bloom and Davis (2016) and, using Boolean AND/OR operators, search for articles in Polish containing at least one word from two term-sets: one containing uncertainty (U) terms, and the other – terms about the economy (E). Depending on the type of index, we also require that the article should contain at least one word from a third set of e.g. 'policy' (P) terms or 'category-specific' terms (such as terms related to the stockmarket). As an example, we build a Polish economic policy uncertainty (EPU) index

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[4] See e.g. the following Wikipedia entries:
https://en.wikipedia.org/wiki/List_of_newspapers_in_Poland#All-national_daily_newspapers or https://en.wikipedia.org/wiki/Gazeta_Wyborcza (access: 27 March 2019). The latest data on the circulation of Polish daily newspapers can be found on the Polish Audit Bureau of Circulations website: https://www.zkdp.pl/index.php?lang=en (access: 27 March 2019).

[5] https://en.wikipedia.org/wiki/Rzeczpospolita_(newspaper)#cite_note-2 (access: 27 March 2019)

designed to resemble the benchmark EPU index of Baker, Bloom and Davis (2016) by searching for articles containing the Polish-language equivalents of ('uncertainty' OR 'uncertain') AND ('economy' OR 'economic') AND ('regulation' OR 'deficit' OR 'National Bank of Poland' OR 'government' OR 'parliament' or 'legislation'), including their variants, such as 'regulatory', 'parliamentary', etc.

The decision which words to include in the 'policy' (P) or 'category-specific' term sets is guided by previous research by other authors, native-speaker-of-Polish and trained-economist intuition, the results of preliminary runs of the search algorithm and, last but not least, search-platform limitations. We do not attempt to choose optimal 'policy' or 'category-specific' term sets. This would require a benchmark in the form of a 'human' index, i.e. an index based on the frequency or articles classified by human readers as related to the relevant sub-type of economic uncertainty, and choosing a term set that minimizes the error rate relative to this 'human' benchmark. Unfortunately we currently lack the necessary resources[6] to carry out such an exercise in full scale and save it possibly for future research. Instead we perform a mild form of a check of our indices' sensitivity to the choice of terms by developing two versions of the economic policy uncertainty (EPU) indices, namely, one based on a 'narrow', and the other – on a 'broad' set of terms. In addition we construct an extra version of each of our indices by applying an additional, 'Polish', term-set filter (i.e. requiring that each article contains either of the Polish-language equivalents of the words 'Polish' and 'Poland').

Due to the fact that we search the archive of one newspaper only, and in order to smooth out the potential noise in the results, we perform the search using low frequency, quarterly, intervals starting in 1989q2 and ending in 2018q4. We obtain a raw count of articles containing the search terms as well as the total[7] number of articles published in each quarter. Following Baker, Bloom and Davis (2016) we then divide the raw count by the total count to obtain a scaled frequency (X_t) for each quarter in the interval T (i.e. 1989q2-2018q4). We then compute the variance, σ^2, of the time series in the interval T and

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[6] More than 6000 articles containing words from the E and U sets would have to be read, a task that would probably have to be delegated to a team of independent readers. Baker, Bloom and Davis (2016) report that it took them 6 months to develop a human audit process and another 18 months to run a large-scale human audit study involving teams of students.

[7] Unfortunately search platform limitations prevent us from obtaining the true total and we use the number of articles containing the Polish word 'i' (English: 'and') as a proxy.

standardize X_t by dividing through by the standard deviation σ for all t. As a result, we obtain a series Y_t with unit standard deviation in the interval T. We then compute the mean (M) value of Y_t and multiply Y_t by ($100/M$) for all t to obtain the normalized (to a mean of 100 from 1989 to 2018) index.

3. Results

Three types, or topical groups, of economic uncertainty indices are developed. First, the 'basic', overall economic uncertainty (EU) index based on a search for articles containing just the words pertaining to uncertainty and the economy. Second, economic <u>policy</u> uncertainty (EPU) indices reflecting the frequency of articles containing the economy (E), uncertainty (U) and policy (P) terms. Third, three 'category-specific' economic uncertainty indices, one designed to capture stockmarket-related economic uncertainty (EU-stockmarket), another reflecting banking-crisis-related economic uncertainty (EU-banking crisis) and a third one designed to capture China-related economic uncertainty (EU-China) as perceived in Poland.

3.1. Overall economic uncertainty index

The overall economic-uncertainty (EU) index reflects the relative frequency of articles containing the Polish-language equivalents of the following double: 'economic OR economy' AND 'uncertainty OR uncertain', including their variants (Table 1). As mentioned in the previous section, we also run a search for articles where, in addition to words from the E and U sets, the Polish-language equivalents of the words 'Poland' or 'Polish' are also present. In this way we obtain an index that we name EU-PL (Table 1).

Table 1. Term sets for the overall economic uncertainty index, with translations to English.

| Index	Term set	English translation	Implementation in Polish
EU [-PL]	E	economic, economy	gospodark*, gospodarc*
	U	uncertainty, uncertain	niepewn*[8]
	[PL]	poland, polish	polsk*, polsc*

The 'basic' overall EU index and its PL-suffixed variant are displayed in Figure 1. Both indices exhibit almost identical behaviour, a fact confirmed by a correlation coefficient of 0.96[9]. They also tend to register higher values around the time of important events which would

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[8] The asterisk is a wildcard symbol which broadens a search by finding words that start with the same letters, so that, for instance, "uncertain*" will retrieve "uncertain" and variations like "uncertainty" or 'uncertainties' and "niepewn*" will retrieve "niepewność", "niepewności", "niepewny","niepewnego", etc.
[9] Statistically significant at 1%.

typically be associated with elevated economic uncertainty. In particular, they highlight the massive economic uncertainty of the second half of 1989 and the early 1990s. This was a period of groundbreaking political and economic changes in Poland and other post-communist countries in Europe. The transformation of a centrally-planned economy into a market economy was an exercise without precedence in history and hence carried a huge dose of uncertainty. Furthermore, this transition was taking place against the background of other uncertainty-generating events such as the Gulf War of 1990-1991 or the Exchange Rate Mechanism crisis of 1992-1993. After 1993 the level of uncertainty, as measured by our index, declined substantially. It spiked again in the second half of 1997 when the Asian financial crisis and a Polish parliamentary election (followed by a lengthy process of forming a coalition government) took place (see e.g. Rosati 1997). Following a roughly 3-year lull the index climbs around the time of the '9/11' terrorist attacks, remains relatively elevated during the stockmarket downturn of 2002, and spikes again around the time of the invasion of Iraq (2001q3). Another pronounced increase in the index can be seen in 2006q1, which coincides with a parliamentary crisis in Poland, difficulties with passing the budget law and a looming threat of new election (Kurkowski, 2006). Then come the sharp spikes of 2008q4-2009q1 (the outbreak of the global financial crisis), 2011-2013 (the European debt crisis), 2016 (Brexit referendum, US presidential election), and of the second half of 2018 when uncertainty connected with Brexit mounted and US-China trade tensions escalated.

Figure 1. Overall economic uncertainty index (1989q2-2018q4).
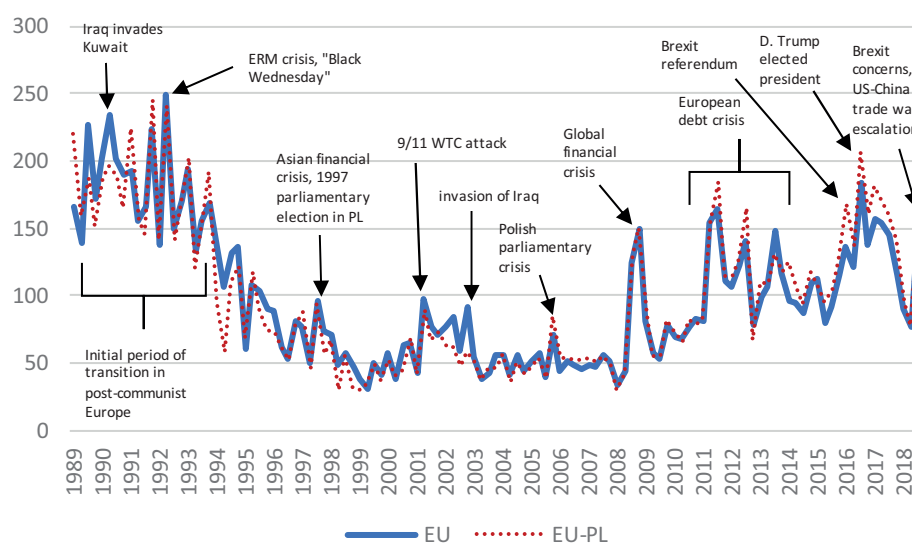
3.2. Economic policy uncertainty indices

The economic policy uncertainty (EPU) indices are developed by imposing the requirement that the articles contain not only the same uncertainty (U) and economic (E) terms as the overall EU index, but also at least one policy-related word from a policy (P) set. We use two 'general' (i.e. not restricted to a specific type of policy, e.g. fiscal or monetary) policy term sets, a narrow and a broad one. The former is designed so as to resemble as closely as possible Baker, Bloom and Davis's (2016) baseline policy set which was found by them to have the lowest error rate versus a human-index benchmark. Their benchmark policy set contains the following six terms: 'regulation', 'deficit', 'legislation' 'federal reserve', 'white house' and 'congress'. We use direct, literal, Polish translations of the first three of these terms (Table 2), while for the last three we choose translations that better reflect Polish reality, namely 'national bank of poland' for 'federal reserve', 'government' for 'white house', as we judge that it better reflects the nature of the Polish political system[10], and 'parliament' for 'congress'. We name the resulting index 'EPU-narrow'. In the 'broad' version of the index (labelled 'EPU-broad') we expand the list of words in the P set. In particular, we add some general policy terms such as 'sejm' (the lower house of Polish parliament), 'senat' (the upper house) and 'bill'. We also add some fiscal policy terms, such as 'fiscal', 'treasury', 'budget', 'tax', and some monetary-policy terms, such as 'Monetary Policy Council (MPC)[11]', 'ECB (European Central Bank)', 'Fed', 'SNB (Swiss National Bank)' and 'Bundesbank'. The decision to include ECB, Fed, SNB and Bundesbank was guided by the fact that monetary policy decisions in those countries could have (had) a significant impact on the decisions of Polish economic agents in certain periods (e.g. in the early 1990s due to significant dollarization of the economy or after Poland's EU accession due to a large share of foreign currency housing loans, mostly in CHF or EUR). The inclusion of these foreign central banks does not seem to have any significant impact on the values of the index, however (Figure A3 in the Appendix).

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[10] A semi-presidential or dual executive system where both the president and the government (Prime minister and cabinet) have the executive powers which is, however, closer to pure parliamentarism than to a pure presidential system.

[11] The Monetary Policy Council, constituted in 1998, is one of the directing bodies of the National Bank of Poland and is responsible, among other things, for setting NBP base interest rates.

Table 2. Term sets for the 'general' economic policy uncertainty indices, with translations to English.

Index	Term set	English translation	Implementation in Polish
EPU-narrow [-PL]	E	economic, economy	niepewn*
	U	uncertainty, uncertain	gospodark*, gospodarc*
	P	regulation, deficit, legislation, National Bank of Poland (NBP), government, parliament	regulac*, deficy*, legislac*, NBP[12], rząd*, parlamen*
	[PL]	poland, polish	polsk*, polsc*
EPU-broad [-PL]	E	economic OR economy	niepewn*
	U	uncertainty OR uncertain	gospodark* OR gospodarc*
	P	sejm, senat, parliament, government, bill, legislation, regulation, fiscal, treasury, budget, deficit, tax, VAT (value-added tax), CIT (corporate income tax), PIT (personal income tax), NBP, MPC, ECB, Fed, SNB, Bundesbank	sejm*, sena*, parlamen*, rząd*, ustawa, legislac*, regulac*, fiskal*, fiskus*, budże*, deficy*, podate*, podatk*, VAT, CIT, PIT, NBP, RPP, EBC, Fed, SNB, Bundesbank
	[PL]	poland, polish	polsk*, polsc*

Figure 2. A comparison of the 'narrow' and 'broad' EPU indices, with and without an additional 'PL' filter.


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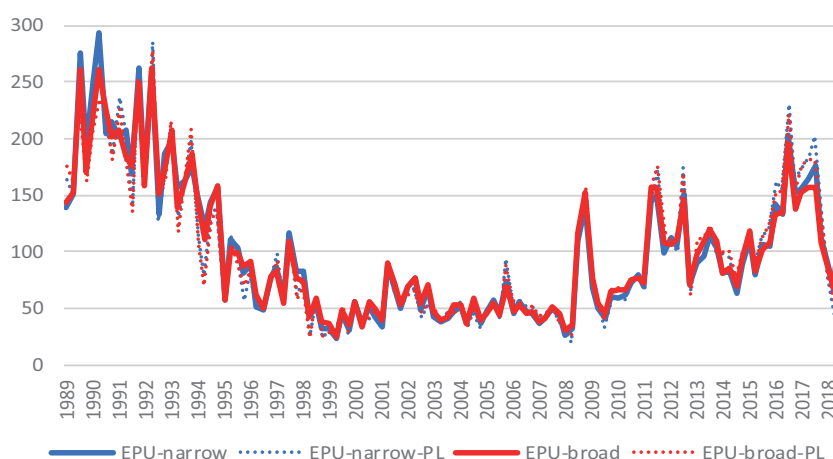
[12] The whole phrase 'Narodowy Bank Polski' could not be used in the search query due to search-platform limitations which make it impossible to search for compound names, i.e. names consisting of at least two adjacent words.

We also build PL-suffixed versions of the 'narrow' and 'broad' EPU indices. As shown in Figure 2, the 'broad' and 'narrow' versions of the EPU index, with and without an additional 'Polish' filter, behave very similarly. The EPU indices also behave almost identically[13] as the overall EU index (Figure 3). The likely reason for this result is that the articles used in the construction of the EPU-broad index account for as much as 86% (Table A1 in the Appendix) of the articles used in the development of the overall EU index (both indices are based on the same E and U sets). This would seem to suggest that policy uncertainty was the most important driver of overall economic uncertainty in Poland in 1989q2-2018q4, with the caveat that this conclusion is based on one newspaper only.

In addition to the 'general' EPU indices (broad and narrow), we construct two 'specialized', category-specific EPU indices: one designed to capture uncertainty related to fiscal policy (EPU-fiscal), the other – to monetary policy (EPU-monetary). A 'narrow' and a 'broad' version of the EPU-monetary index is also built, with the former meant to elicit uncertainty related to purely domestic, Polish, monetary policy, and the latter – to reflect uncertainty related to both domestic and foreign central bank decisions. As argued earlier, the monetary policy decisions of major foreign central banks could have an impact on the behaviour of economic agents in Poland. Moreover, due to Poland being a small open economy they can be expected to have a bearing on domestic monetary policy decisions as well. As before, PL-suffixed versions of the indices are developed too.

**Figure 3.** A comparison of the EPU-broad and EU indices.

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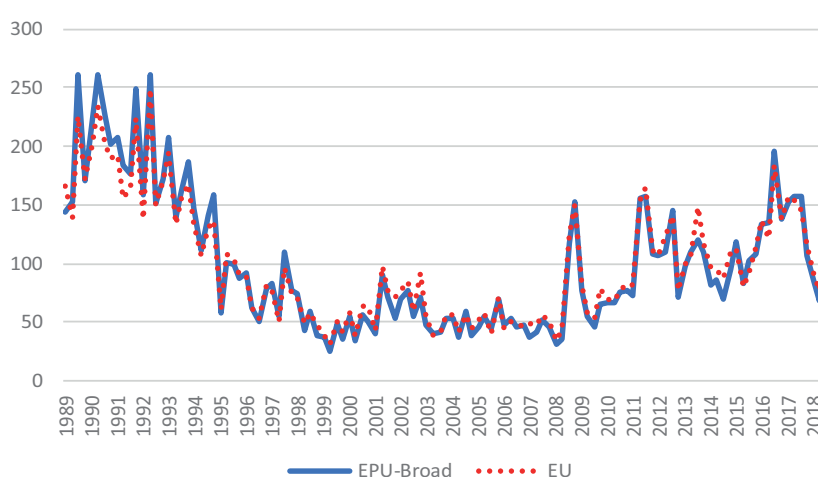
[13] The coefficient of correlation between EU and EPU-broad is 0.99 (statistically significant at the 1% level) in the period 1989q2-2018q4.

Table 3. Policy term sets for the 'category-specific' economic policy uncertainty indices, with translations to English.

Index	Term set	English translation	Implementation in Polish
EPU-fiscal [-PL]	P	fiscal, treasury, budget, deficit, tax, VAT, CIT, PIT	fiskal*, fiskus*, podate*, podatk*, budże*, deficy*, VAT, CIT, PIT
EPU-monetary-narrow [-PL]	P	NBP, MPC	NBP, RPP[14]
EPU-monetary-broad [-PL]	P	NBP, MPC, ECB, Fed, SNB, Bundesbank	NBP, RPP, EBC, Fed, SNB, Bundesbank

In Table 3 we report the terms included in the P sets for the category-specific EPU indices (the E, U and PL sets are the same as in Tables 1 and 2 so we leave them out in order not to clutter the table). Unfortunately, due to *GW*'s search platform limitations[15] we have to settle for rather rudimentary P sets in the case of our EPU-monetary indices. This could, however, leave to doubts whether indices obtained in this way relate to monetary policy *per se*, and not to other issues of concern to the central bank, such as exchange rate policy or financial stability matters.

Figure 4. A comparison of the EPU-fiscal and EPU-broad indices.

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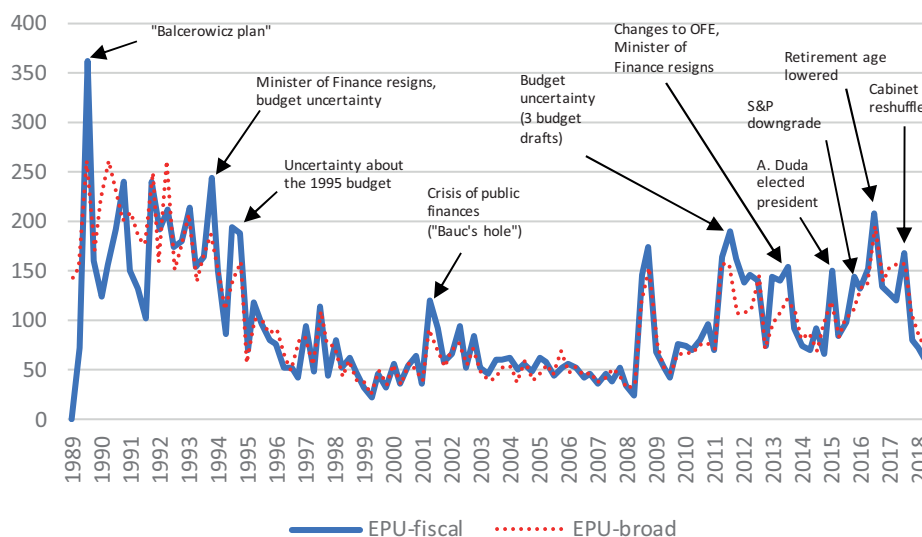
[14] Rada Polityki Pieniężnej.
[15] In particular, they prevent us from searching for compound words such as 'interest rate' or full forms such as 'National Bank of Poland' instead of the abbreviation 'NBP'.

As shown in Figure 4, the EPU-fiscal index peaks in periods of elevated fiscal uncertainty in Poland. These include 1989q4 when the so-called 'Balcerowicz plan'[16], a bold and comprehensive reform agenda of which fiscal issues were a key part, was presented and passed in parliament. The index highlights elevated uncertainty in 1994q1, when Minister of Finance Marek Borowski resigned (see e.g. Gazeta Wyborcza, 1994), as a result of which Poland had no finance minister for almost four months. Fiscal policy uncertainty increased again in 1994q4 when Poland's president, Lech Wałęsa, vetoed the tax bill and sent it to the Constitutional Court (Dąbrowski, 1994; Jankowiak, 1994). Following a period of relative calm, the fiscal uncertainty index peaks again in 2001q3, when the government disclosed that the budget deficit in 2001 would be significantly higher than foreseen in the budget act for that year (Gazeta Wyborcza, 2001). Fiscal policy uncertainty peaked again amid the global financial crisis and remained elevated in the following years. In particular, a spike in the EPU-fiscal index can be observed in 2011q4 when elevated fiscal uncertainty manifested itself in the Polish government preparing as many as 3 budget drafts for the following year (Skwirowski, 2011). The index remains elevated until 2013q4 when long-debated and highly controversial changes to the pension scheme[17] were passed in parliament, which, according to some commentators (see. e.g. Gadomski, 2013), opened the door for fiscal easing in the following election years of 2014 and 2015, and when Finance Minister Jacek Rostowski resigned after an unprecedented six years in office. The EPU-fiscal index peaks again in 2015q2, coinciding with Andrzej Duda's victory in the Polish presidential election after a campaign in which he made several promises with potentially significant fiscal implications[18]. Significant upward movements in the index can also be observed in 2016q1 when rating agency Standard and Poor's unexpectedly cut Poland's credit rating a notch[19], in 2016q4 when the government majority passed a highly controversial bill lowering the retirement age in Poland (Skwirowski, 2016), and in 2017q4 when a significant cabinet reshuffle took place, including the change of Prime Minister. It is also worth noting that the EPU-fiscal and the EPU-broad indices display very similar behaviour, peaking and troughing in more or less

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[16] More details about the plan can be found e.g. in Adam (1994).

[17] The changes consisted in the transfer of treasury bonds and bonds guaranteed by the State Treasury, from open pension funds (OFE) to the Social Security Institution (ZUS).

[18] These included: lowering the retirement age, changes to the tax-free threshold, and the introduction of a supermarket tax and a bank tax (Samcik, 2015).

[19] S&P subsequently upgraded the Polish long-term government bond rating back to pre-2016 status (A-) in October 2018.

the same periods, although in some periods one index is relatively more elevated than the other. As can be seen in Figure 5, adding a 'Polish' filter in the search process for the EPU-fiscal index does not seem to make a big difference to the results.

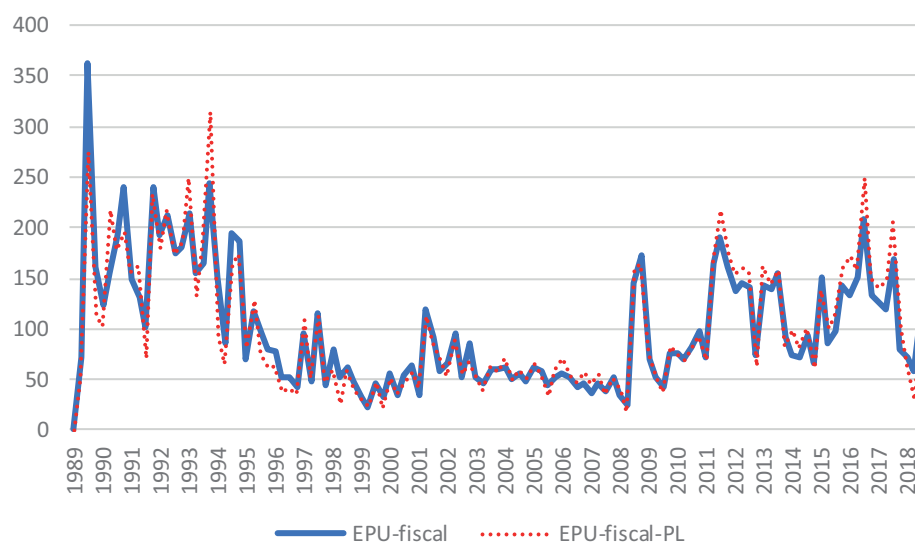**Figure 5.** Index comparison: EPU-fiscal vs. EPU-fiscal-PL.

Figure 6 shows the evolution of the 'narrow' and 'broad' versions of the monetary policy uncertainty index. Both versions generally tend to move together around events important from a central bank perspective. In particular, they spike in 1989q4 when the 'Balcerowicz plan' was approved (the plan included significant measures affecting the central bank and the Polish currency[20]). Another sharp increase in the value of the indices can be seen in 1992. This rise coincides with a 12% devaluation of the Polish zloty and some difficulties with appointing a new NBP governor (Jankowiak, 1992) in 1992q1. The European Exchange Rate Mechanism (ERM) crisis was another likely factor behind elevated monetary policy uncertainty in this period (see e.g. Gazeta Wyborcza, 1992). The indices spike also around the time of the Asian financial crisis and the '9/11' terrorist attacks which generated significant amount of exchange rate volatility. Another pronounced rise in the indices can be seen around Poland's accession to the European Union (in May 2004), which was followed by a significant rise in inflation. The indices also spike in 2010q2 when the NBP intervened in the foreign exchange market for the first time in 12 years (see e.g. Maciejewicz, 2010) and

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[20] These were the Banking Act, the Act on the National Bank of Poland and the Foreign Exchange Act. Among the more important changes introduced by these laws were the ban on central bank financing of government deficits and the introduction of internal exchangeability of the Polish zloty.

when the Smolensk air crash took place killing Poland's president Lech Kaczyński, National Bank of Poland governor Sławomir Skrzypek, and many other senior officials.

Figure 6. Monetary policy uncertainty indices.
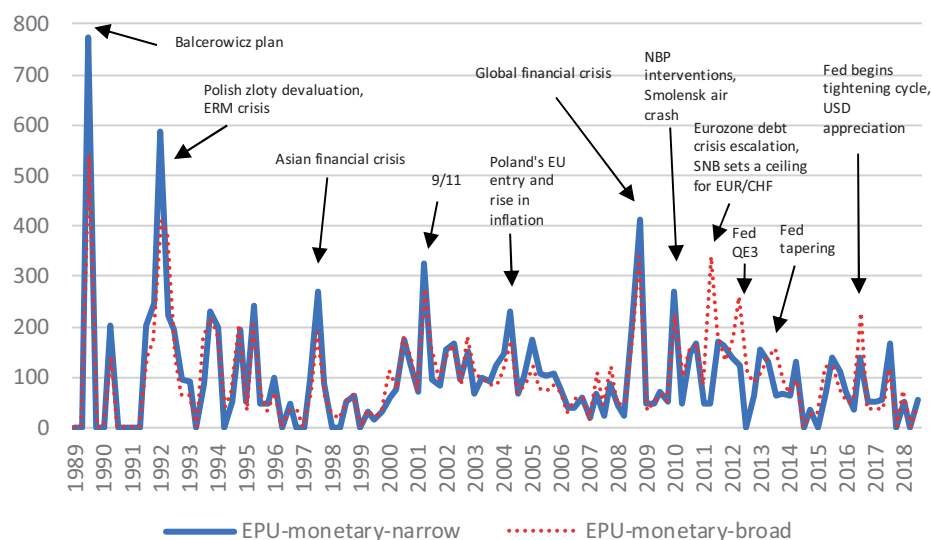
After the year 2010 the EPU-monetary-narrow index tends to register rather moderate or low levels of uncertainty. On the other hand, the EPU-monetary-broad index, which by construction (Table 3) can be expected to reflect uncertainty related to foreign monetary policy as well, spikes in 2011q3, around the time the Eurozone debt crisis escalated (Rosati, 2011) and the Swiss National Bank stunned the markets by setting a ceiling for the Swiss franc against the euro to prevent further franc appreciation. Another spike can be seen in 2012q3, which was the time when European Central Bank President Mario Draghi delivered his "whatever it takes" speech and the Fed announced the third round of quantitative easing, this time of open-ended nature. Finally, a pronounced rise in the index can be seen in 2016q4 when the Fed began a monetary tightening cycle after a year had passed since the previous fed funds rate hike in December 2015.

Figure 7 shows a comparison of the monetary policy uncertainty (EPU-monetary-narrow) index with the fiscal policy uncertainty (EPU-fiscal-PL) index. We also present their 3-quarter centred moving averages for better visibility. The two measures often peak and trough at the same time but there are also periods when they diverge significantly. For instance, the indices' values would tend to suggest that in the post-2010 period there has been more fiscal-policy-related uncertainty and less monetary-policy uncertainty.

Figure 7. Fiscal policy uncertainty vs. monetary policy uncertainty (raw indices and their 3-quarter centred moving averages).
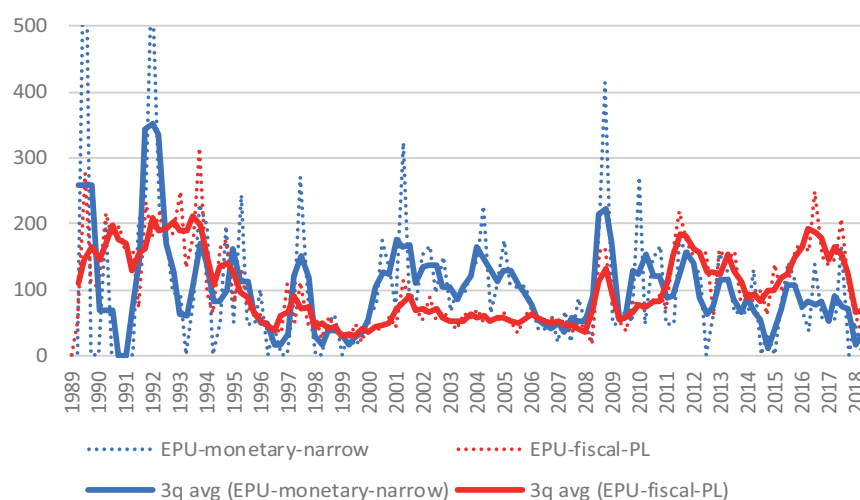
3.3. Category-specific economic uncertainty indices

In this section we present three category-specific economic uncertainty indices designed to capture stockmarket-, banking-crisis-, and China-related economic uncertainty. The indices are based on the relative frequency of articles containing words from the 'economy' (E) and 'uncertainty' (U) sets, as well as from extra category-specific word-groups described in Table 4. Thus this time instead of a 'policy' (P) set we have special 'stockmarket', 'banking', 'crisis', and 'China' sets. We also check whether adding a 'Polish' filter makes a material difference to the results. As before, search platform limitations unfortunately prevent us from including certain groups of words or phrases in the category-specific sets. For instance, we are not able to use such compound words as 'share price' or full forms of names such as 'Warsaw Stock Exchange' (we have to use the abbreviation 'WSE' instead).

Table 4. Term set for the category-specific economic uncertainty indices, with English translations.

| Index	Term set	English translation	Implementation in Polish
EU-stockmarket[-PL]	S	stockmarket, WSE[21]	giełd*, *GPW
EU-banking-crisis[-PL]	B	bank, banking	bank, bankow*
	C	crisis	kryzys*
EU-China[-PL]	C	China, PRC[22]	Chin*, chiń*, CHRL

[21] Warsaw Stock Exchange.
[22] People's Republic of China.

Stockmarket-related economic uncertainty

As can be seen in Figures 8 and 9, the stockmarket-related economic uncertainty index highlights many of the events reflected by spikes in the EPU indices discussed earlier. For instance, the Polish minister of finance resignation in 1994q1 resulted in a strong share price correction (Kubala, 1994), and stockmarket-related uncertainty spiked in 1995q1, in the aftermath of the Mexican 'tequila crisis', the failure of Barings bank and the resignation of Prime Minister Waldemar Pawlak's government (Jakubowski, 1995). Similarly to the EPU indicators, the EU-stockmarket index spikes around the 2006q1 parliamentary crisis in Poland, the outbreak of the global financial crisis and the European debt crisis, as well as around the time of the Brexit referendum and the 2016 US presidential election.

Figure 8. Stockmarket-related economic uncertainty index (EU-stockmarket).
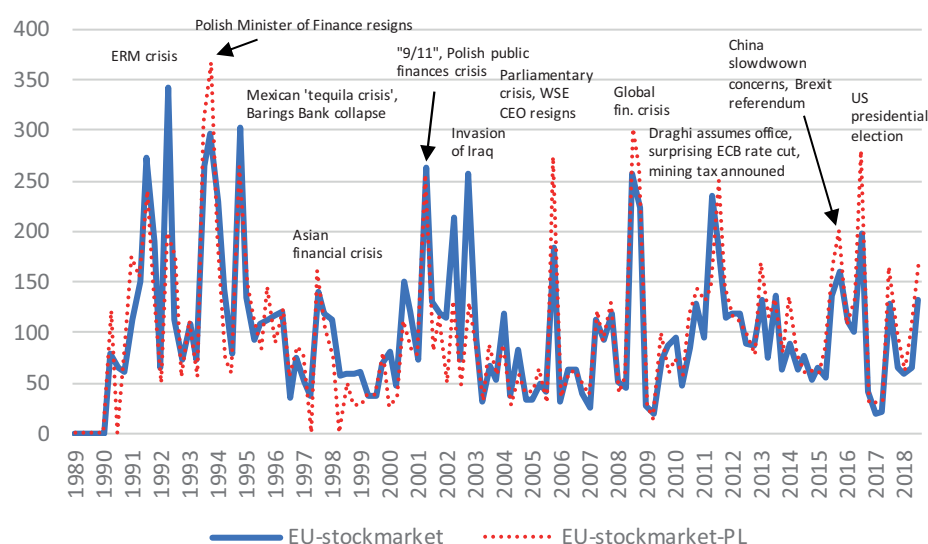
But in some periods the EU-stockmarket index behaves differently than the other indices discussed so far. For instance, it responds more strongly than the EPU-broad to the events of 2000-2003 (the bursting of the dot-com bubble in the year 2000, '9/11', Argentina's economic crisis, the stockmarket downturn of 2002, and the invasion of Iraq in 2003). And while the EPU-monetary-broad index spikes in 2010 (global 'currency war', NBP's currency interventions), this is hardly the case for the EU-stockmarket or the 'general' economic policy uncertainty (EPU-broad) index (Figure 9). Another period of notable discrepancy between the EU-stockmarket and the EPU-broad is the year 2017, which was a time of relative calm and share-price growth on the global stock exchanges against the background

of numerous uncertainty-generating events with potentially international implications (e.g. Trump's tax policy, Fed policy, French and German elections or the UK triggering Article 50 of the Treaty on European Union, which formally began 'Brexit').
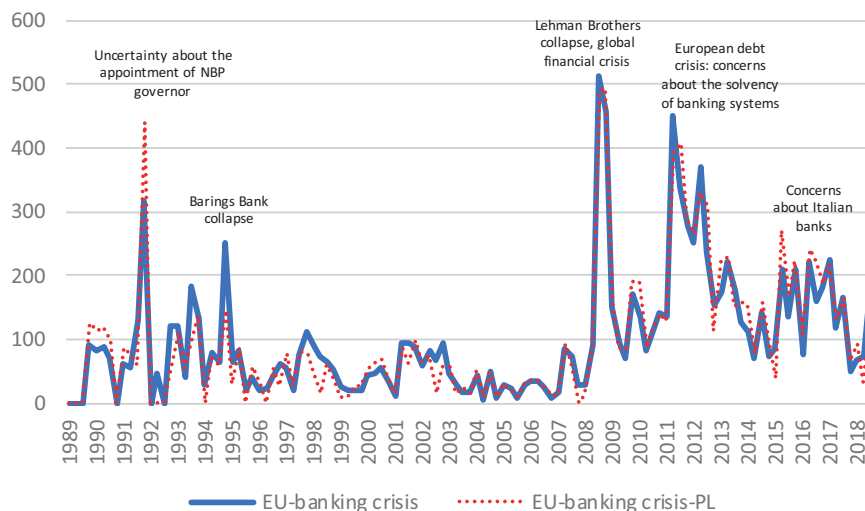
Figure 9. The stockmarket-related economic uncertainty (EU-stockmarket) index versus the economic policy uncertainty (EPU-broad) and monetary policy uncertainty (EPU-monetary-broad) indices.
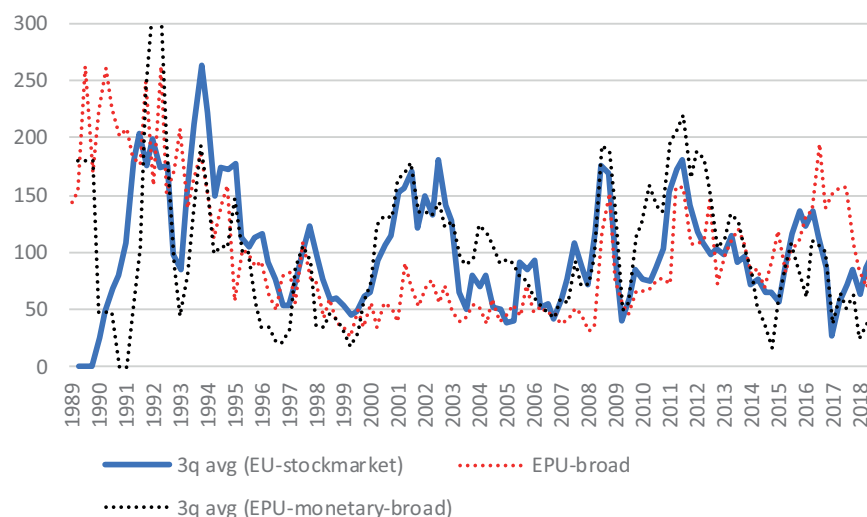
Note: the EU-stockmarket and EPU-monetary-broad indices have been smoothed out with a 3-quarter centred moving average for better visibility. The low level of the EPU-stockmarket index in 1989-1990 is due to the fact the Warsaw stock exchange began activity only in April 1991.

Banking-crisis-related economic uncertainty

The banking-crisis-related economic uncertainty ('EU-banking crisis') index is presented in Figure 10. It tends to be elevated in the first half of the 1990s, in 2008-2009, 2011-13 and 2015-16. All of these periods happen to be marked by banking-sector problems in Poland or abroad. The early 1990s were marred by a banking crisis in Poland, connected with a strong rise of doubtful and bad debts, particularly in state-owned banks, as the financial position of companies suddenly deteriorated due to the ongoing radical transformation of the entire economic system (NBP, 2011). It is worth mentioning that except Poland several other economies also experienced banking-sector difficulties in the early 1990s, for instance Norway, Sweden, Finland or Japan.

Figure 10. Banking-crisis-related economic uncertainty index.

Figure 11. The banking-crisis-related economic uncertainty (EU-banking crisis) index versus the monetary policy uncertainty (EPU-monetary-broad) and stockmarket-related economic uncertainty (EU-stockmarket) indices.
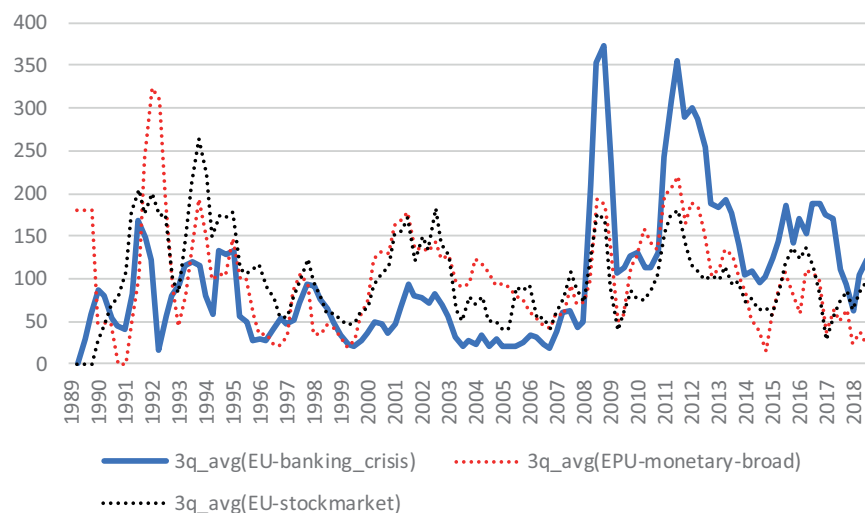
Note: for better visibility the indices have been smoothed out with a 3-quarter-centred moving average

As regards the 1990s, two notable spikes in the index can be observed (Figure 10), one in 1992q1, during a period of uncertainty about the appointment of a new National Bank of Poland governor and when important legislation regulating the functioning of the Polish

banking sector was passed[23]. Another spike, in 1995q1, coincides with the collapse of Barings Bank (see e.g. Wujec, 1995). The index rises strongly again in 2008q4-2009q1, around the time of Lehman Brothers' collapse, and during the European debt crisis in 2011-2013, characterized by elevated concerns regarding the solvency of European banking systems. It is also elevated in the years 2016-2017, marred by concerns about the high level of nonperforming loans in Italian banks and the possibility of 'spillover' effects on other euro area economies.

In Figure 11 we contrast the EU-banking crisis index with the monetary-policy and stockmarket-related economic uncertainty indices. All the indicators tend to rise and fall in similar periods but with different magnitude. It is interesting to note that after 2007 banking-sector-related uncertainty has been much more 'acute' relatively to its 1989-2018 average than the other two subtypes of economic uncertainty.

China-related economic uncertainty

China's weight in the global economy has grown substantially since the reforms of Deng Xiaoping in 1978. Recently, however, economic growth in China has slowed down markedly, leading to concerns about a potential 'spillover effect' on the rest of the world, and to a growing literature attempting to estimate the magnitude of this impact (e.g. Dieppe et al. 2018, Dizioli et al. 2016). At the same time concerns have been voiced that China's economy and economic policy are not entirely transparent, as exemplified by the questionable quality of China's official national accounts data (see e.g. Rabinovitch 2010 or Wildau 2019). Under these circumstances an increase in uncertainty about the condition of the Chinese economy and its influence on the rest of the world would not be surprising.

Our newspaper-based index shows[24] that China-related economic uncertainty has indeed been increasing in Poland in the last few years (Figure 12). A marked increase in the index can be observed in 2011q1, when, tellingly, data was released that in the previous year China had officially overtaken Japan as the world's second largest economy (Dickie, 2011). In 2011q1 the 12th five-year-plan for the years 2011-2015 was also officially approved. This was

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[23] Including the amendment to the Act on the National Bank of Poland of 14 February 1992 (Dz.U. No 20, item 78) and the amendment to the Banking Act of 14 January 1992 (Dz. U. of 1992 No 20, item 78) (see: NBP, 2001). The Banking Act itself, which laid the foundations for the market-oriented transformation of the Polish banking system, was passed on 31 January 1989.

[24] The results need to be interpreted with caution as our index is based on 578 articles only.

the first plan that prioritized the task of speeding the pace of economic restructuring over the pursuit of economic growth. It signalled that Chinese authorities were getting serious about rebalancing the economy even at the cost of lower GDP prints. It seems natural that, given China's weight in the global economy, such a change of economic-policy paradigm would lead to an increase in China-related economic uncertainty perceived elsewhere.

As the economy slowed down in the following years, concerns escalated about a potential 'hard landing' (see e.g. Rapoza, 2019). The general perception of uncertainty was compounded by reports of growing debt, property bubbles and 'faking' GDP data. A further marked shift upwards in our China-related economic uncertainty index can be observed in the years 2015-2018. This period was fraught with such China-related uncertainty-generating events or initiatives as: the 2015-2016 Chinese stockmarket turbulence, the yuan (CNY) devaluation and introduction of a new fixing regime in August 2015, CNY weakness and intense capital outflows in 2016q4-2017q1, 'deleveraging' efforts in 2017-18, and trade tensions with the United States in 2018. The uncertainty effect was sometimes intensified further by Chinese authorities' confusing communication.

Figure 12. The China-related economic uncertainty (EU-China) index vs. the overall economic uncertainty (EU) index.
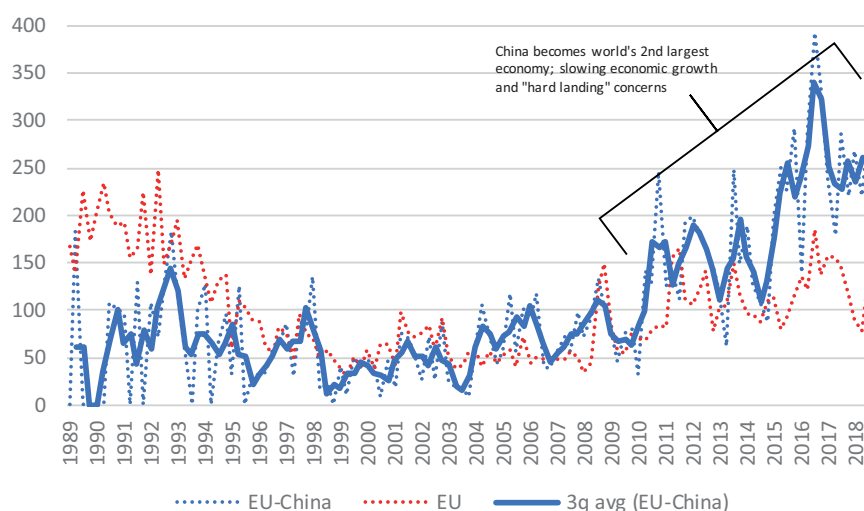
4. Evaluation: newspaper-based indices vs. other data

Using the frequency of newspaper articles as a measure of economic uncertainty raises potential concerns about newspaper reliability, accuracy, bias and consistency. In order to shed some light on these issues we compare the performance of our indices with other measures of economic uncertainty available for Poland: surveys and financial-market data. We also contrast our newspaper-based indicators with an alternative uncertainty index based on other Polish textual data, namely minutes of the Monetary Policy Council. In order to assess the potential bias resulting from the political slant of the newspaper articles used in the construction of our indices we compare them with an index based on articles published in another major Polish daily, *Rzeczpospolita* (*RP*). Finally, we compare our indices with the EPU-indices published by Baker, Bloom and Davis (2016).

4.1. Corporate surveys

We use data from two quarterly surveys conducted by the National Bank of Poland: *NBP Quick Monitoring*[25], a survey of non-financial corporations, and the *Senior loan officer opinion survey on bank lending practices and credit conditions*[26], a survey of banks.

NBP Quick Monitoring

NBP Quick Monitoring is designed to gauge the current and future economic climate in the Polish corporate sector. It is conducted among non-financial firms, both private and state-owned, based in all regions of Poland, and representing all types of economic activity except agriculture, forestry and fishing. The sample[27] covers enterprises of all sizes but, admittedly, small firms are relatively under-represented. Since the second quarter of 2011 the survey has contained a question regarding the respondent's perceived level of uncertainty about its own future economic situation which the firm can answer by choosing among five options: *very low*, *low*, *moderate*, *high* and *very high*. If one discards *moderate* answers, the difference between the percentage of firms indicating a *very low* or *low* level of uncertainty and the percentage of firms that answered *high* or *very high* can be used as an indicator of

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[25] An English-language summary of the survey results is available on the NBP website at: https://www.nbp.pl/homen.aspx?f=/en/publikacje/inne/condition.html (access: 2 April 2019).
[26] An English-language version is available at: https://www.nbp.pl/homen.aspx?f=/en/systemfinansowy/kredytowy.html (access: 2 April 2019).
[27] In the December 2018 edition 2730 companies took part in the survey.

the firms' perceived level of uncertainty about their economic prospects. Figure 13 compares such a survey-based uncertainty indicator using data from a recent National Bank of Poland (2019) *Quick Monitoring* survey with our newspaper-based economic-policy uncertainty indices. The survey-based firm economic uncertainty indicator and our newspaper-based indices generally tend to move together, with the caveat that the available survey time series is, admittedly, short (2011q2-2018q4). The coefficient of correlation between the survey-based indicator and either the EU or EPU-broad index is 0.52[28], statistically significant at the 1% level.

Figure 13. Survey-based firm economic uncertainty indicator vs. newspaper-based indices (2011q2-2018q4).
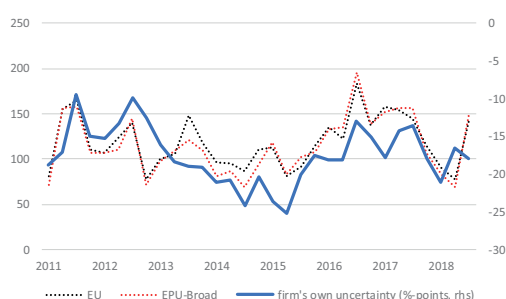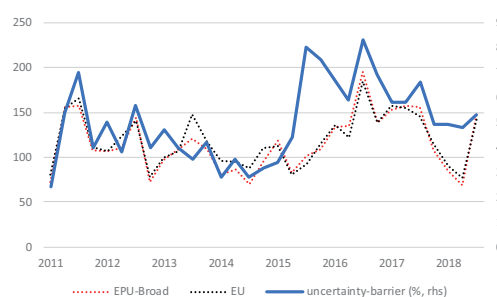

Figure 14. The percentage of surveyed firms listing uncertainty as a barrier to development vs. newspaper-based uncertainty indices.

Note: the survey-based indicator in Figure 13 is calculated as:
-1*[(*low + very low*) – (*high + very high*)], where *low*, *very low*, *high*, *very high* are percentages of firms who chose the respective answer to the multiple-choice question: *How do you assess the level of uncertainty about the future economic situation of your company?* The indicator takes values from -100 (all firms judge uncertainty as low or very low) to +100 (all firms judge uncertainty as high or very high). Thus an increase in the indicator's value represents an increase in the perceived level of uncertainty.

The *Quick Monitoring* survey also contains an open-ended question in which the respondent is asked to describe shortly (in no more than 10 sentences) the issues that the company expects to be barriers to expansion over the next 6 months. Figure 14 shows the percentage of firms that listed 'uncertainty' as such a barrier. One can see that this percentage also tends to move in tandem with our newspaper-based uncertainty indices. The coefficient of

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[28] It is slightly lower for the PL-suffixed indices, 0.51 for EPU-Broad-PL and 0.49 for EU-PL (both coefficients statistically significant at 1%).

correlation with the EU and EPU-broad indices is 0.56 and 0.67, respectively, in both cases statistically significant at the 1% level[29].

Senior loan officer opinion survey

The National Bank of Poland conducts quarterly surveys of chairpersons of credit committees in the largest Polish banks. As defined on the NBP website, *the objective of the survey is to define the direction of changes in the lending policy, i.e. the standards and terms of granting loans as well as changes in the demand for loans in the Polish banking system*[30]. The survey asks, among other things, about the reasons for changes in banks' credit policies with respect to corporate, housing and consumer loans[31]. Among the provided answers/reasons[32], one is of particular interest to us, namely: *risk related to the expected general economic situation*. The respondent is asked to indicate[33] the way and the degree to which this factor affected the changes to the bank's lending policies in the previous three months. The difference between the number of responses in which *risk related to the expected general economic situation* was indicated as a factor behind the easing of lending policies and the number of responses in which it was indicated as a reason for the tightening of lending policies can be used as an indicator of the direction and strength of this factor's influence. It could thus be interpreted as a proxy for economic 'uncertainty'[34] perceived by the banking sector, with negative values corresponding to an increase in uncertainty (see also the Note under Figure 15).

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[29] It is slightly higher for the PL-suffixed indices: 0.64 for EU-PL and 0.68 for EPU-Broad-PL.

[30] The standards of granting loans are understood as the minimum standards of creditworthiness, set by banks, that the borrower is required to meet to obtain a loan. The terms of granting loans are the features of the loan agreement agreed between the bank and the borrower, including spread, non-interest loan costs, maximum loan size, collateral requirements and maximum loan maturity.

[31] The relevant question is formulated as follows: *If your bank's lending policies (credit standards or terms) applied to corporate/housing/consumer loans and credit lines have changed over the last three months, please indicate how the following factors have influenced the changes*, respectively for corporate/housing/consumer loans.

[32] The full text of the survey is available in English at:
https://www.nbp.pl/en/systemfinansowy/ankieta_en.pdf (access: 3 April 2019).

[33] On a scale of 1-5, where 1 means the factor *contributed <u>considerably</u> to the <u>tightening</u> of lending policies*, 2 – *contributed <u>somewhat</u> to the <u>tightening</u> of lending policies*, 3 – *did not influence the changes in lending policies*, 4 – *contributed <u>somewhat</u> to the <u>easing</u> of lending policies,* and 5 – *contributed <u>considerably</u> to the <u>easing</u> of lending policies*).

[34] For a moment we put Knight's (1921) distinction between 'risk' and 'uncertainty' aside, as the two are often conflated in non-academic contexts.

Banking crises and economic crises often coincide. A banking crisis could result in a credit crunch, i.e. a sudden tightening of lending policy. Credit restrictions could in turn have a recessionary effect on the whole economy, via a mechanism described for instance in the Kiyotaki-Moore (1997) model or the 'financial accelerator' model of Bernanke, Gertler and Gilchrist (1996), and lead to a wider economic crisis, which could then exacerbate the banking crisis, and so on. For these feedback-loop reasons, and without getting into the issue of precedence or causality, we would expect to see correlation between a measure of banking sector's uncertainty about the economy and a good measure of banking-crisis-related economic uncertainty. Figure 15 and Table 5 show that the NBP survey-based indicator of how the economic-outlook risk affects banks' decisions to tighten housing lending standards is strongly correlated with our banking-crisis-related economic uncertainty index. In particular, periods when risk about the economic outlook contributed to the tightening of lending policies broadly overlap with periods when our EU-banking crisis index is above the 100 mark. The highest (in absolute terms) coefficients of correlation can be observed between the EU-banking crisis(-PL) indices and the net percentage of banks indicating the risk related to the expected general economic situation as a reason for easing their policies with respect to housing and corporate loans, the most important categories of loans in terms of asset value[35].

Table 5. Matrix of correlations between selected newspaper-based economic uncertainty indices and the net percentage of banks indicating the *risk related to the expected general economic situation* as a reason for easing their lending policies with respect to housing/corporate/consumer loans.

	EU-banking crisis	EU-banking crisis-PL	EU	EPU-broad	EPU-monetary-broad
housing loans	-0.65***	-0.60***	-0.39***	-0.37***	-0.31**
corporate loans	-0.56***	-0.53***	-0.33***	-0.35***	-0.26**
consumer loans	-0.37***	-0.36***	-0.16	-0.16	-0.07

Note: *** and ** denote statistical significance at 1% and 5%, respectively.

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[35] As of the third quarter of 2018 housing and corporate loans represented, respectively, 38% and 34% of the Polish banking sector's loan book, while consumer loans accounted for 16% (KNF, 2018).

Figure 15. Net percentage of banks indicating *risk related to the expected general economic situation* as a reason for easing their policies with respect to housing loans vs. newspaper-based index of banking crisis-related economic uncertainty (EU-banking crisis), 2003q4-2018q4.
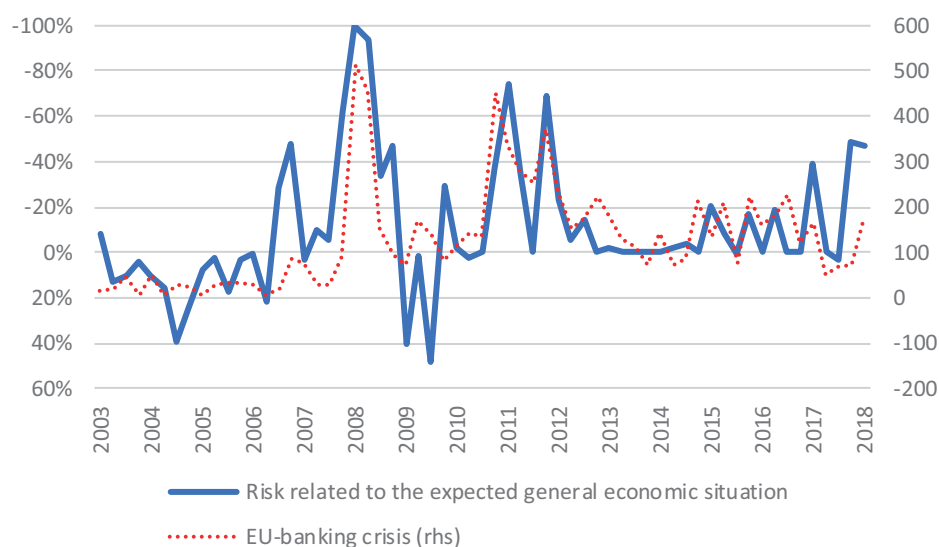
Note: The 'net percentage' indicator is calculated as the difference between the number of banks who indicated *contributed <u>considerably</u> to the <u>easing</u> of lending policies* or *contributed <u>somewhat</u> to the <u>easing</u> of lending policies* and the number of banks who marked *contributed <u>considerably</u> to the <u>tightening</u> of lending policies* or *contributed <u>somewhat</u> to the <u>tightening</u> of lending policies* as an answer to the question: *If your bank's lending policies (credit standards or terms) applied to housing loans and credit lines have changed over the last three months, please indicate how the risk related to the expected general economic situation has influenced the changes*. A negative value means that this risk on balance contributed to the tightening of lending policies.

4.2. Financial market data

Financial market indicators are often used as proxies for different types of risk. We use government bond yield spreads and credit default swap (CDS) spreads as measures of fiscal risk[36] and contrast these data with our EPU-fiscal index. The EPU-monetary index is then compared with option-implied exchange rate volatility of the Polish zloty, while the EU-stockmarket index – with the VIX-EM indicator.

Bond-yield and CDS spreads

The spread between the yield on a country's government bonds and the yield on a relevant 'risk-free' benchmark, usually government bonds of equivalent maturity issued by a country

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[36] Fiscal risk can be defined as the possibility of deviations of fiscal outcomes from what was expected at the time of the budget or other forecast, see e.g.
https://www.imf.org/external/pubs/ft/dp/2009/dp0901.pdf

with a strong credit rating, is sometimes used as a measure of sovereign fiscal risk. Typically, the higher risk a bond carries, the higher is its yield spread over the benchmark. Perhaps the most commonly used benchmarks are the United States Treasury and German government bills and bonds. One would thus expect a widening of the yield spread between Polish and German government bonds of equivalent maturity during times of increased fiscal risk (e.g. sovereign default risk) in Poland. One could also expect to see an increase in this spread during episodes of elevated fiscal-policy uncertainty. But identical behaviour of these two measures should not be expected as except policy uncertainty bond yields can be affected by numerous other factors, for instance the level of money market interest rates, market liquidity, supply conditions or contagion fears.

In Figure 16 one can notice that the fiscal policy uncertainty (EPU-fiscal) index and the yield spread between Polish and German long-term government bonds often display similar behaviour. For instance, they move in tandem around the outbreak of the global financial crisis (2008/2009) or in the years 2011-2017. But in some periods the EPU-fiscal index signals below-average uncertainty while the yield spread is elevated, e.g. in 2004, 2010 or 2017. The coefficient of correlation between the EPU-fiscal and the yield spread is 0.67 for the period 2004q1-2018q4, and it is slightly higher than for the economic-uncertainty or 'general' economic-policy uncertainty (EPU-broad) indices (Table 6).

Figure 16. The fiscal policy uncertainty (EPU-fiscal) index vs. the spread between the yields on Polish and German 10-year government bonds (2004q1-2018q4).
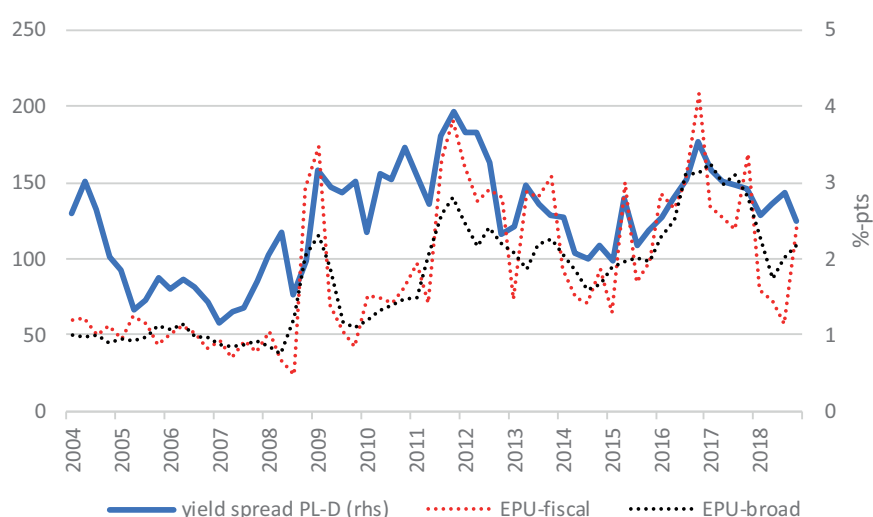
Source: Datastream data.

Table 6. Matrix of correlations between selected newspaper-based uncertainty indices and bond-yield (2004q1-2018q4) or CDS (2008q1-2018q4) spreads.

|	EPU-fiscal	EPU-fiscal-PL	EU	EPU-broad	EPU-monetary-broad
PL-DE bond yield spread	0.67***	0.62***	0.61***	0.65***	0.45***
CDS 5Y EUR	0.32**	0.25	0.16	0.03	0.67***
CDS 5Y USD†	0.36**	0.29*	0.20	0.08	0.68***
CDS 10Y EUR	0.44***	0.37**	0.28*	0.17	0.71***
CDS 10Y USD	0.49***	0.42**	0.33**	0.23	0.71***

† Most liquid contract.
Note: ***,** and * denote statistical significance at 1%, 5% and 10%, respectively.
Source: Datastream data.

Sovereign credit default swap[37] (CDS) spreads are also sometimes regarded as a measure of sovereign credit risk (see e.g. Rodriguez et al. 2019). Hence we would expect them to be somehow correlated with our fiscal-policy uncertainty index, with periods of elevated fiscal-policy uncertainty being characterized by generally higher CDS spreads. We would not expect strong correlation, though. For instance, sovereign default risk may go down when taxes go up, but higher taxes can affect corporate or household decisions by generating fiscal-policy-related economic uncertainty for them. As shown in Table 6 and Figure 17, the correlation between our EPU-fiscal index and four types of CDS spreads is indeed not very strong. It is strongest (0.49) for the CDS spread where the underlying instrument is a 10-year bond issued in US dollars. Nevertheless, it is stronger than correlation with the 'overall' economic uncertainty and the 'general' EPU indices, which would suggest that the EPU-fiscal index does contain more fiscal-policy-related information than the other two indices. Interestingly, the CDS spreads show strong correlation with our monetary policy uncertainty index. A possible explanation could perhaps be the fact that the underlying instruments in the CDS contracts are bonds issued in foreign currencies (USD and EUR) and hence the spreads could be sensitive to Polish zloty exchange rate movements, which in turn would be expected to react to monetary policy uncertainty as measured by our indices.

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[37] A credit default swap is similar to an insurance contract, providing the buyer with protection against specific risks. Most often, investors buy credit default swaps for protection against a default, and CDS contracts can be used to mitigate risks in bond investing.

Figure 17. 10-year USD CDS spread for Poland vs. newspaper-based uncertainty indices.
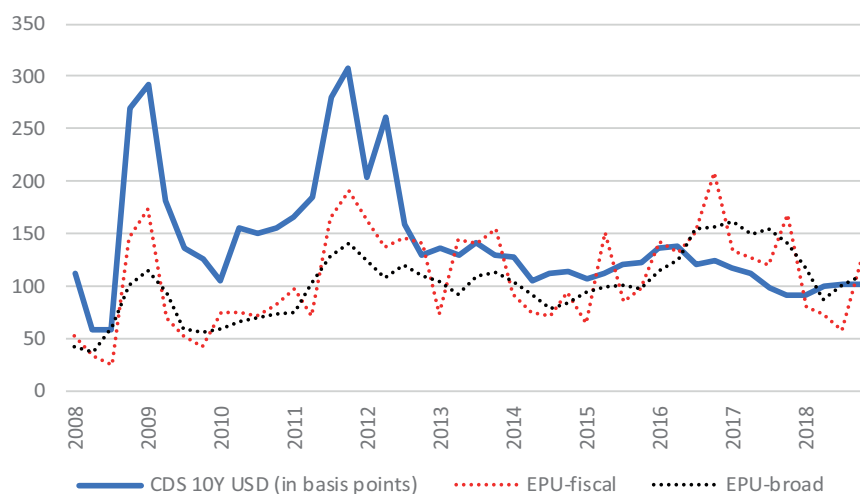
Source: Datastream data

Option-implied exchange rate volatility

Data on currency options prices make it possible to extract expected future volatility of the underlying currency pair, which can be thought of as a measure of the uncertainty that the market attaches to future developments in the exchange rate. The uncertainty about future developments in the exchange rate would in turn be expected to be in some way correlated to monetary policy uncertainty as inflation and interest-rate differentials are among the key exchange-rate determinants. Of course, the two uncertainties are not the same thing. Figure 18 and Table 7 demonstrate that there is a significant amount of correlation between option implied EUR/PLN exchange rate volatility and our monetary policy indices at quarterly frequency.

Table 7. The coefficient of correlation between option-implied 3-month and 1-year EUR/PLN volatility and selected newspaper-based uncertainty indices (2001q4-2018q4).

	EPU-monetary-narrow	EPU-monetary-broad	EPU-monetary-broad-PL	EU	EPU-broad	EPU-fiscal
3m vol	0.63***	0.55***	0.56***	0.09	-0.02	0.21*
1y vol	0.63***	0.60***	0.59***	0.11	0.01	0.24**

Note: ***,** and * denote statistical significance at 1%, 5% and 10%, respectively.
Source: Datastream data.

Figure 18. Option-implied 3-month EUR/PLN exchange rate volatility vs. indices of monetary policy uncertainty (3-quarter centred moving averages), 2001q3-2018q4.
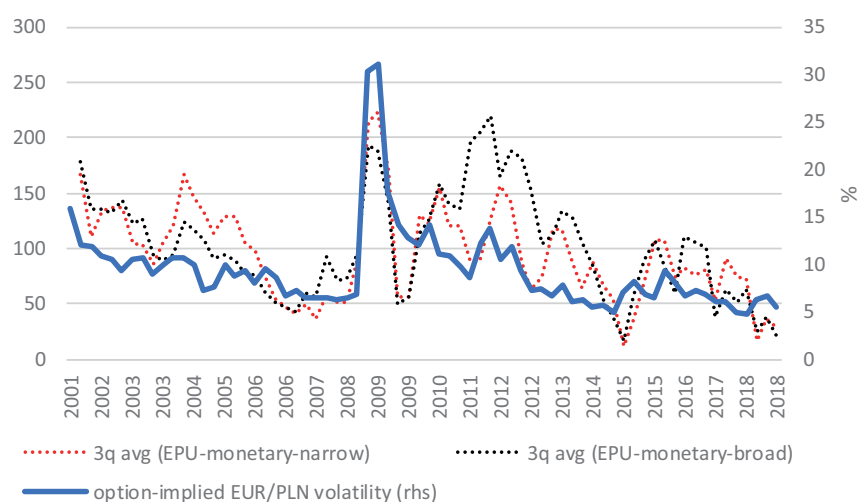
Source: Datastream data.

Share price volatility

One of the more often used proxies for risk, stress or fear in the stockmarket is the VIX, an index of 30-day option-implied volatility in the S&P500 equity index. Since this is a good measure for the United States and no 'off-the-shelf' measure of expected volatility in the Polish stockmarket is available, we use an 'emerging markets' (EM) version of the VIX, as Poland is usually included in the EM 'basket', and compare it with our EU-stockmarket newspaper-based index (Figure 19, Table 8). The coefficient of correlation between VIX-EM[38] and the newspaper-based stock-market-related-economic-uncertainty index for Poland is 0.61 for the period[39] 2011q2-2018q4. This is much more than in the case of the 'basic' EU uncertainty and EPU-broad indices, and would tend to suggest that the EU-stockmarket index does capture stockmarket-specific uncertainty. By comparison, Baker et al. (2016) report a correlation coeffcient of 0.73 between the VIX and their stock-market-related economic uncertainty index and of 0.58 between the VIX and their 'benchmark' EPU index for the United States, calculated on monthly data.

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[38] The CBOE Emerging Markets ETF Volatility Index (ticker VXEEM) reflects the implied volatility of the EEM ETF, the iShares MSCI Emerging Markets Index. According to www.ishares.com this index seeks to track the investment results of an index composed of large- and mid-capitalization EM equities, and, as of February 26, 2019, it had a 1.16% (in terms of market value) exposure to Polish stocks.
[39] The VIX-EM index data are available only from March 10, 2011 onwards.

Table 8. Matrix of correlations between the VIX and selected newspaper-based economic uncertainty indices (quarterly data from 2011q2-2018q4).

	EU-stockmarket	**EU-stockmarket-PL**	**EU**	**EPU-broad**
VIX-EM	0.61***	0.38**	0.13	0.01
VIX	0.33*	0.36**	0.02	-0.02

Note: ***,** and * denote statistical significance at 1%, 5% and 10%, respectively.
Source: Datastream data.

Figure 19. VIX-EM vs. newspaper-based stockmarket-related economic uncertainty index for Poland.
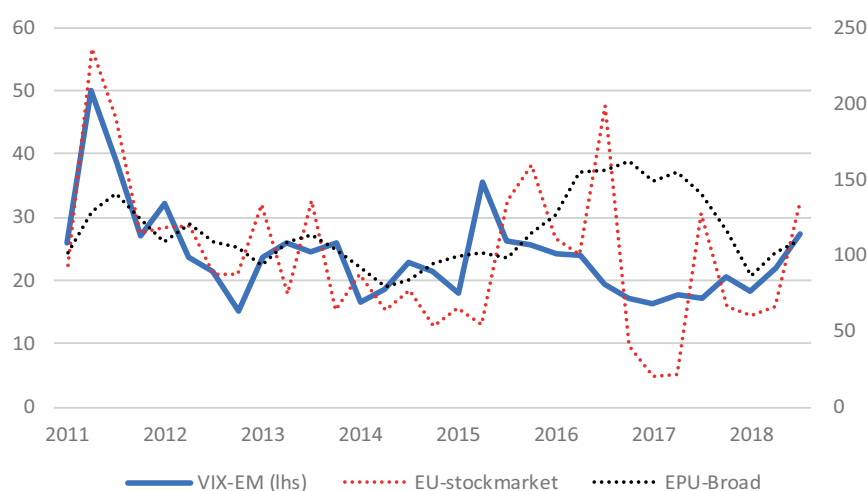
Source: Datastream

4.3. Other textual data

The fact that our uncertainty indices are based on articles from one newspaper only could raise concerns about the reliability, accuracy, consistency and potential bias in the results. In order to assess whether this could be an issue, we construct uncertainty indices based on alternative textual data: articles from the daily *Rzeczpospolita* and minutes of the Polish Monetary Policy Council decision-making meetings.

"Rzeczpospolita" articles

We search *Rzeczpospolita*'s (*RP*) own online archive for articles published in the period 1993-2018 using the same term sets as for the *Gazeta Wyborcza (GW)*-based EU index (Table 1), and build the uncertainty index using the same methods as described in Section 2.

Unfortunately, the search results for the years 1993-2001 turned out to be rather unreliable in that we obtained puzzlingly low or zero total-article counts for certain quarters (Figures A1, A2 in the Appendix). Therefore we decided to develop the index using data from 2002 onwards only. Our practical experience with *RP*'s online search platform has been such that using more than two search terms in the query also resulted in unreliable article frequency counts. Therefore we settle for a simple economic uncertainty (EU) index, based on a search for articles containing just the Polish equivalents of the words 'economy' and 'uncertainty'[40].

Figure 20. Comparison of economic uncertainty (EU) indices based on articles published in *Gazeta Wyborcza* (*GW*), *Rzeczpospolita* (*RP*), and in both newspapers (*GW+RP*) in 2002q1-2018q4.
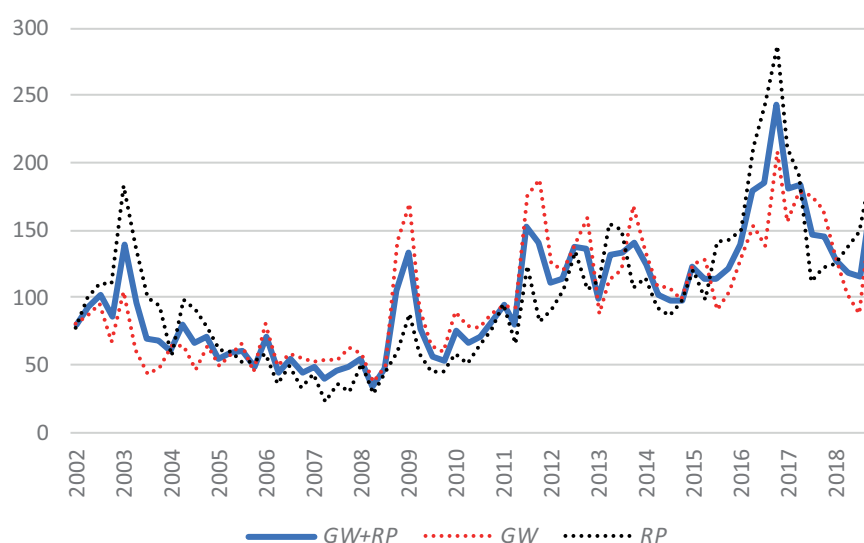
As can be seen in Figure 20, the *RP*-based EU index generally tends to behave similarly to the *GW*-based one. In particular, it trends upwards following the outbreak of the global financial crisis and spikes around 'uncertain' periods, such as 2003q1 (Gulf War II), 2011-2013 (European debt crisis) or 2016 (Brexit referendum and US presidential election). The coefficient of correlation between the two indices is 0.67 (statistically significant at the 1% level) for the period 2002q1-2018q4. The rather high level of similarity between the two indices does not seem to suggest that our benchmark *GW*-based indices suffer from significant bias, consistency or reliability problems.

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[40] 'Niepewność' and 'gospodarka' in Polish.

MPC minutes

We consider an additional uncertainty indicator based on the minutes of the Polish Monetary Policy Council (MPC) decision-making meetings. The minutes summarize in roughly 1000-1500 words the discussion held at those meetings. Our presumption is that MPC members' perception of uncertainty would be reflected by the frequency with which 'uncertainty' is mentioned in the text summarizing the discussion.

MPC minutes have been published since April 2007, every month until the end of 2009, and 11 times a year since 2010, typically except for one of the summer months (Table 9). We work with the original, Polish-language, version of the minutes but an English translation is also available on the NBP website. For each minutes release we count the frequency of 'uncertain*' (Polish: 'niepewn*') as well as the total number of words. We then aggregate both of these counts by quarters[41], and divide the raw frequency count by the total word count in the quarter to obtain a scaled-frequency time series for the period 2007q2-2018q4. The series is then standardized and normalized in the same manner as described in Section 2 in order to obtain the final minutes-based uncertainty index.

Table 9. Months when no decision-making MPC meeting took place in the years 2010-2018.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Month	Jul	Feb, Aug	Aug	Aug	Aug	Aug	Aug	Aug	Jul

As shown in Figure 21, the minutes-based indicator tends to locally peak and trough around the same time as the economic uncertainty indices based on articles from either *Gazeta Wyborcza* or *Rzeczpospolita*. In particular, it is elevated after the outbreak of the global financial crisis (2009), during the European debt crisis (2011-2012) and in 2016 when the Brexit referendum and US presidential election took place. But there are also periods when the minutes-based index deviates significantly from the newspaper-based ones, for instance in 2014q3, when, as the analysis of the text of the minutes reveals, the MPC was highly concerned about the impact of the Russian military intervention in Ukraine.

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[41] Due to the fact that there were no decision-making MPC meetings in July or August in the years 2010-2018, the aggregate counts for the third quarter are on average smaller than those for the other quarters.

Figure 21. Minutes-based uncertainty index vs. economic uncertainty (EU) indices based on *Gazeta Wyborcza* (*GW*) and *Rzeczpospolita* (*RP*)
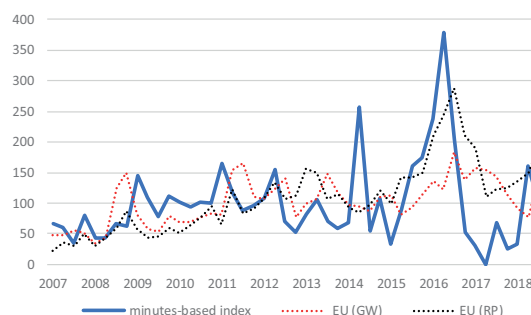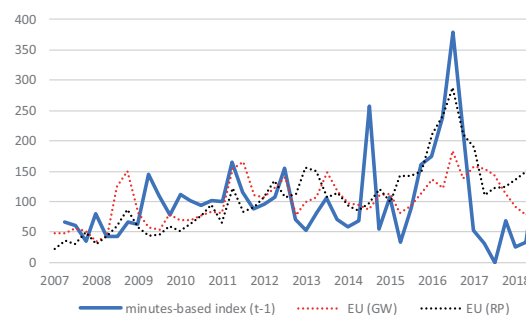
Figure 22. Minutes-based uncertainty index lagged by one quarter vs. economic uncertainty (EU) indices based on *Gazeta Wyborcza* (*GW*) and *Rzeczpospolita* (*RP*)

Of the two newspaper-based economic uncertainty indices, the *RP* one seems to visually match the minutes-based indicator better, which is confirmed by a higher coefficient of correlation (Table 10). It is interesting to note that lagging the minutes-based index by one quarter leads to higher correlation with the newspaper-based economic uncertainty indices (Table 10, Figure 22). A possible explanation could be the forward-looking nature of monetary policymaking, whereas newspaper journalism probably tends to concentrate more on current events. Another one could be that the MPC is composed of professional economists who have better access to information than journalists or the general public.

Table 10. The coefficient of correlation between the minutes-based and newspaper-based uncertainty indices (2007q2-2018q4).

	EU (*GW*)	EU (*RP*)	EU (*GW+RP*)
minutes-based index	0.13	0.44***	0.32**
minutes-based index (t-1)	0.36**	0.53***	0.49***

Note: *** and ** denote statistical significance at 1% and 5%, respectively.
Source: Datastream data.

4.4. EPU indices for other countries

In the previous sections we could observe that newspaper-based uncertainty indices for Poland tend to peak around uncertainty-generating events of international importance (e.g. the global financial crisis, Brexit, '9/11'). As Poland is a small open economy it seems natural to expect that it will be affected by the transmission of global or European uncertainty shocks.

Figure 23. *Gazeta Wyborcza*-based EPU-broad index (left axis) vs. The EPU-Europe index of Baker, Bloom and Davis (right axis)
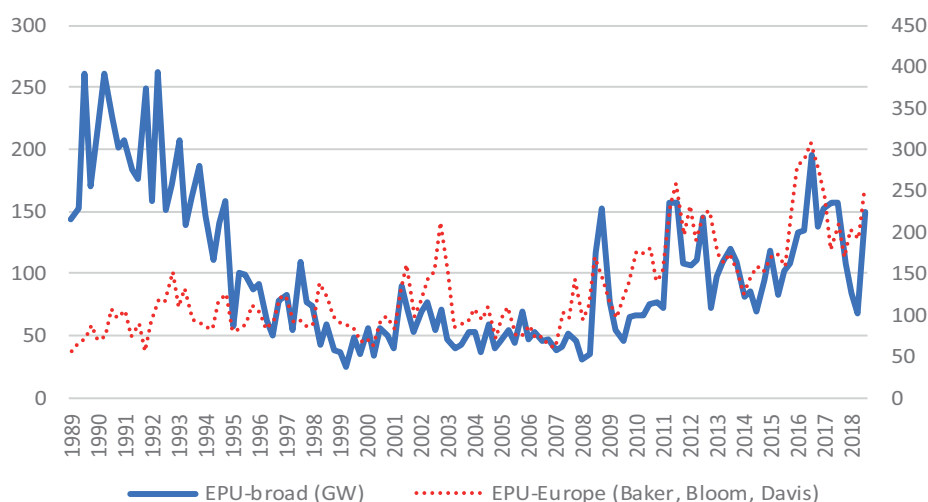

Table 11. Matrix of correlations between the EPU indices developed for selected economies by Baker et al. (2016), and the economic uncertainty (EU) and economic policy uncertainty (EPU) indices for Poland (based on quarterly data ending in 2018 q4).

Indices for Poland	Indices developed by Baker, Bloom and Davis (2016)				
	EPU-Europe	EPU-Germany	EPU-Global	EPU-China	EPU-US
EU (*GW+RP*) since 2002q1	0.89***	0.80***	0.85***	0.72***	0.64***
EU (*GW*) since 2002q1	0.82***	0.78***	0.78***	0.62***	0.66***
EU (*RP*) since 2002q1	0.81***	0.69***	0.77***	0.70***	0.51***
EPU-broad since 1997q1	0.81***	0.74***	0.77***	0.66***	0.60***
EPU-broad 'full sample'	0.17	0.50***	0.77***	0.63***	0.28**

Note: *** and ** denote statistical significance at 1% and 5%, respectively. The EU (*GW+RP*) index is based on articles published in *Gazeta Wyborcza* and *Rzeczpospolita* since 2002q1. 'Full sample' in the first-column-last-row cell refers to the longest period for which the EPU indices of Baker et al. (2016) developed for economies other than Poland were available. Thus it refers to the period starting in 1989q2 in the case of the EPU-Europe and EPU-US indices, 1993q1 for EPU-Germany, 1995q1 for EPU-China and 1997q1 for the EPU-Global index.

In Figure 23 and Table 11 we compare our Polish newspaper-based economic uncertainty indices with selected uncertainty indices developed by Baker, Bloom and Davis (2016) using newspapers from other countries. One can see that from the mid-1990s onwards, that is after the tumultuous, initial post-communist transition period in Poland, our Polish EPU-

broad index and the European EPU index of Baker, Bloom and Davis, tend to move closely together. This is confirmed by a high (0.81) value of the correlation coefficient for the period 1997q1-2018q4 (Table 11). Our 'basic' (i.e. after dropping the 'policy' requirement) economic uncertainty indices based on either *Gazeta Wyborcza* or *Rzeczpospolita* are also highly correlated with the European EPU index in 2002q1-2018q4, even more so when they are merged into one 'composite' indicator (Table 11, third row).

5. Conclusion

Using text mining and web scraping techniques we develop newspaper-based economic uncertainty measures for Poland following the approach of Baker, Bloom and Davis (2016). We build 'general' economic and economic-policy uncertainty indices, as well as category-specific ones designed to capture e.g. the economic uncertainty related to fiscal policy or to stockmarket movements. Several types of evidence suggest that these indices do proxy for economic uncertainty. In particular, our measures spike around significant uncertainty-generating events. These include, for instance, the initial phase of Poland's post-communist economic and political transition, the global financial crisis or the ensuing European debt crisis. Our indices also exhibit a fair amount of correlation with a variety of other indicators of economic uncertainty, such as financial-market data or uncertainty expressed by respondents in corporate surveys. The indices perform well when compared with other textual data and we do not find strong reasons to believe that the political slant of our benchmark newspaper is a source of significant bias. Lastly, the indices are strongly correlated with the index of European or global economic policy uncertainty developed by Baker, Bloom and Davis (2016), broadly in line with expectations given that Poland is a small open economy and a member-state of the European Union.

Our results suggest that following the stormy period of the early 1990s, overall economic uncertainty in Poland was generally relatively 'subdued' for at least a decade. The situation changed after the outbreak of the global financial crisis, and economic uncertainty started climbing reaching levels close to those last seen 25-30 years ago. The strong level of correlation between the economic uncertainty indices for Poland and those for Europe or the world could suggest that except for the early 1990s the level of uncertainty in Poland has to a large extent been driven by international events. Our results would also tend to suggest that economic uncertainty in Poland has been mostly policy-related, although caution is warranted as the results are based on one newspaper only.

The results confirm that newspaper archives are a source of valuable data that can be used to construct measures of interest to economists or economic historians. They can be particularly useful for countries undergoing significant economic and/or political transformation, such as Poland following the fall of communism, when other uncertainty

indicators are unavailable or unreliable. To some extent a topical decomposition of the subject of uncertainty can also be achieved by means of a proper selection of search terms.

We see at least two broad avenues for further research. A natural next step would be to employ our indices in an investigation of the impact of uncertainty on the Polish economy (e.g. corporate investment or financial assets), a line of research we are currently pursuing. Our indices could also be refined further. Due to search platform limitations we were not able to search for articles containing specific compound words (e.g. 'interest rate') or full forms of names (e.g. 'National Bank of Poland'). Further work could concentrate on finding ways to bypass these limitations.

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Appendix

Figure A1 Total number of articles returned by search queries in the online archives of *Gazeta Wyborcza* (GW) and *Rzeczpospolita* (RP); 1989q2-2018q4.
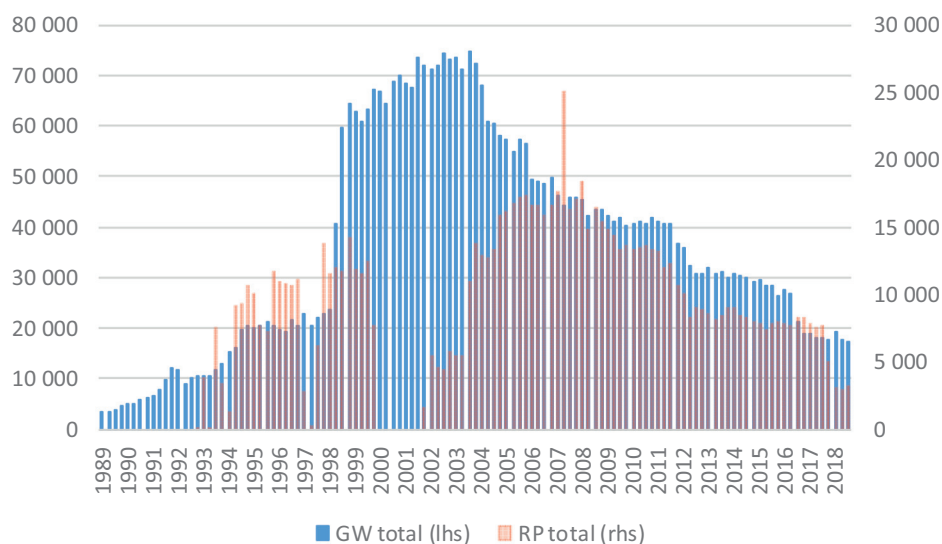

Note: Due to search platform limitations the total number of articles published in *Gazeta Wyborcza* has been obtained by searching for articles containing the Polish word 'i' (English: 'and'). The total number of articles published in *Rzeczpospolita* was obtained by running an 'empty string' search.

Figure A2. The scaled frequency of the number of articles containing the word 'niepewność' (English: 'uncertainty') and its variants, calculated from "raw" search results; 1989Q2-2018Q4
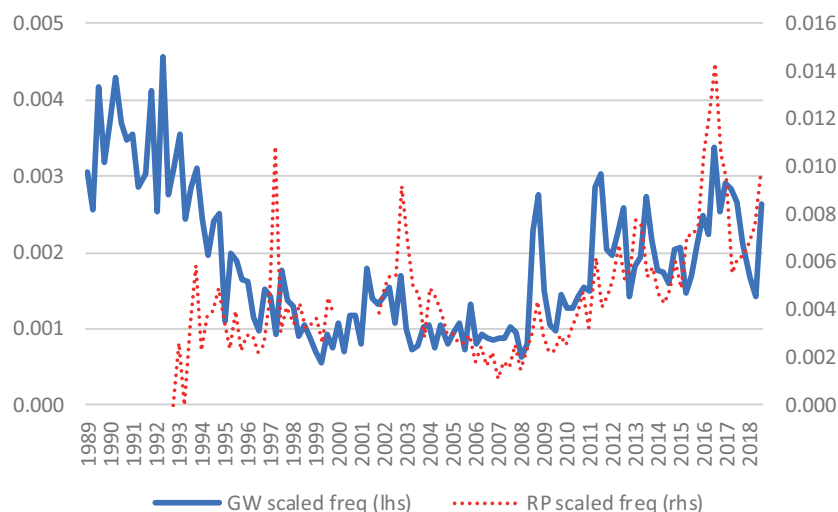
Note: Scaled frequency calculated as the number of articles containing the word 'niepewność' divided by the total number of articles published in each quarter.

Figure A3. EPU-broad index with and without 'foreign central banks' included in the policy (P) term set
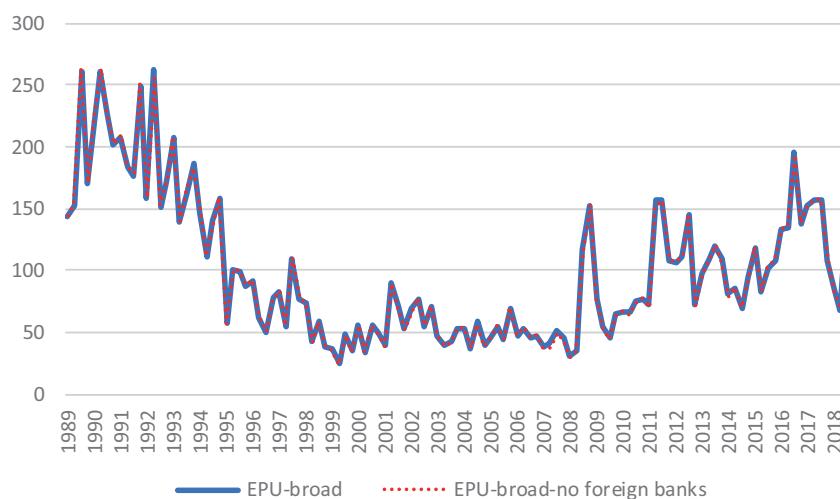
Note: the 'foreign central bank' group is comprised of the following terms: 'ECB', 'Fed', 'SNB',

'Bundesbank'.

Table A1. The number of *Gazeta Wyborcza* articles used in the development of uncertainty indices.

Index	article count	as % of total	as % of EU
total	4 282 375	100%	-
EU	6 139	0.143%	100%
EPU-broad	5 266	0.123%	86%
EPU-fiscal	2 694	0.063%	44%
EPU-monetary-broad	1 087	0.025%	18%
EU-stockmarket	1 088	0.025%	18%
EU-banking crisis	922	0.022%	15%
EU-China	574	0.013%	9%

Note: the percentages in the last column do not sum to 100 because certain category-specific terms are used in the construction of more than one index, and a single article can refer to more than one category (e.g. it can be about both monetary and fiscal policy).

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