ECONOMIC POLICY UNCERTAINTY AND BANK RISKS IN THE EUROPEAN UNION

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ABSTRACT

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Abstract

Using data for 45 European banks from 2000 to 2015, this master's thesis examines the effects of economic policy uncertainty (EPU) on banks' credit risks, measured as credit ratings, with panel data estimations. The results indicate a significant negative relationship between EPU and the ratings inside the Eurozone. The relationship is estimated to be higher in market-based countries compared to bank-based countries. Further research also suggests that banks' ratings in Europe outside the EU borders are not affected by the level of uncertainty in the EU and may also benefit from increasing uncertainty in the EU. Furthermore, the findings imply that banks in countries with their own currency are more resistant to the effects of uncertainty changes. Banks can reduce the negative effects of EPU on the ratings via increasing capital or reducing loan sizes.

Key words
Economic policy uncertainty, Credit risk, The EU

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TIIVISTELMÄ

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Tiivistelmä

Käyttämällä 45 eurooppalaisen pankin tietoja vuosilta 2000-2015, tämä pro gradu -tutkielma käsittelee talouspoliittisen epävarmuuden (TPE) vaikutuksia pankkien luottoriskeihin luottoluokituksilla mitattuna. Paneelidatasta saadut tulokset osoittavat merkittävän negatiivisen suhteen TPE:n ja euroalueen sisäisten luottoluokitusten välillä. Suhteen arvioidaan olevan korkeampi markkinaperusteisissa maissa verrattuna pankkipohjaisiin maihin. Jatkotutkimukset viittaavat myös siihen, että Euroopassa kasvanut talouspoliittinen epävarmuus ei vaikuta pankkien luottoluokituksiin EU:n ulkopuolella ja kyseiset pankit voivat hyötyä myös tästä EU:ssa lisääntyvästä epävarmuudesta. Lisäksi havainnot viittaavat siihen, että maissa, joissa on käytössä oma valuutta, pankit ovat vähemmän alttiita epävarmuuden muutoksista johtuville vaikutuksille. Tulokset myös osoittavat, että pankit voivat vähentää TPE:n kielteisiä vaikutuksia luottoluokituksiin lisäämällä pääomaa tai vähentämällä lainojen määrää.

Asiasanat
Talouspoliittinen epävarmuus, Pankkiriski, EU

Säilytyspaikka
Jyväskylän Yliopiston Kirjasto

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1 INTRODUCTION

The Great Recession and the global financial crisis have majorly contributed to the increased discussion of macroeconomic uncertainty shocks and their effects on the real economy. Uncertainties towards future prospects have negative effects on the functionalities of the market. This thesis focuses on the role of economic policy uncertainty shocks since its importance has been increasingly debated over the last 10 years in the literature after an introductory article from Bloom in 2009. The economic policy uncertainty (EPU) relates to an inability to forecast future regarding policies made by the policymakers for a matter of concern. According to Bloom (2014), uncertainty increases during recessions as future forecasts become weaker and therefore even has the potential to prolong the recession effects (growth, unemployment, etc.). The pattern of uncertainty movement seems highly correlated with real activity indicators and it is characterized by a countercyclical movement. The nature of uncertainty in the literature therefore could either be exogenous if it is reasoned to drive the business cycle or it could be an endogenous response to other shocks, implying that it can be observed as a cause or as a consequence of changes in the business cycle. The importance of uncertainty relies on the assumption that it tends to delay investments (see, e.g. Bloom 2009) as it increases risk-aversion (increasing also risk premia for financial products) and reduces consumption as individuals seek to save income for the unforeseeable future (see, e.g. Caballero 1990). In addition to the reduced spending, uncertainty also induces hiring activity of firms according to Caggiano et al. (2016) during recessions.

As investors, firms and individuals become more risk-averse, they reduce investments or seek to shift targeted purchases, such as mortgage loans which usually require external financing, to the future for more certain times. When the demand of loans declines, the economy's banking sector is majorly influenced as banks are depended on the loans/deposits -ratio. Furthermore, as firms reduce hiring activities, and uncertainty usually occurs during economic stress, debt obligations of economic agents may be difficult to meet (such as monthly payments of mortgage loans) leading to bad loans in the banks' portfolios, usually called non-performing loans, which have not received required payments on time, for example, for at least 90 days. Banks could therefore face income and liquidity difficulties, which in turn could lead to difficulties with other agents in financial markets in the form of obtaining external financing. The companies that are highly dependent on external finance are most vulnerable to uncertainty as tightening credit conditions may lead to a need for refinancing options. Hence, the banking sector as such, influences the transmission of uncertainty as the credit conditions tend to channel the impact, also confirmed by Gilchrist et al. (2014), and it seems that uncertainty shocks have even enlarged effects in times of higher financial stress (Alessandri & Mumtaz 2019). In addition to the fact that the uncertainty shocks tighten the credit conditions as shocks reduce bank lending, they

seem to reduce the magnitude of how short-term interest rates influence banks' behavior, making monetary policies less effective (see, e.g. Alessandri & Bottero 2016, Chi & Li 2017).

Uncertainty has a tendency to spread across integrated areas such as between the European countries. For example, the Brexit referendum in 2016 has already affected other countries as the free trade is speculated to be weakened and firms operating in the UK-EU area seek to prepare for other strategies and refinancing options. In Europe, uncertainty has hit its historical high in recent years, gradually rising after 2007 and peaking an all-time high in 2016 (Baker et al. 2016) caused by turbulences after the Brexit vote and presidential election of the United States. The European Union is still in a crisis due to political interventions and the Eurozone Crisis. The accumulated debt in the member countries of the European Union has led to debates of debtors and creditor countries about the share of responsibility; the countries have incentives to shift the costs of the crisis elsewhere. The European integration has enlarged the risk of spillover effects of shocks in European countries leading to an even wider debate. The Brexit vote in 2016 was historically the first major setback towards the integration mission of the EU. The vote and the debt crisis have led to the discussion of the future of the EU. The EU, in addition to the challenges ahead, also faces today's political challenges; the recent popularity of populist parties in the participating countries has increased, meaning negativity towards the union integration. Furthermore, unemployment and migration concerns have increased, affecting the political debate. The unemployment crisis has occurred merely in all of Europe, when migration problems have mostly affected the Eastern Europe countries as wells as Italy and Greece in particular.

The purpose of this thesis is to identify the characteristics and impacts of economic policy uncertainty on banks' credit risks in the European Union area by using panel data estimation methods, hypothesizing that EPU has a significant effect on banks' credit ratings, due to a country heterogeneity market-based countries are more affected by increasing EPU than bank-based countries, and countries outside the EU borders are less affected by changes of the European EPU. First, the literature section begins with a background clarification, followed by explaining, what economic policy uncertainty is, its nature and impacts in the Europe with the recent concerns relating European policies. Then, the focus shifts on possible channels in which the economic policy uncertainty might affect the risks in the banking sector and why it is important. After this, credit risks are defined, and their determinants are identified according to the literature. The literature section is followed by a data explanation and the construction of hypotheses based on the literature. In the methodology section, an estimation model with fixed effects and Driscoll-Kraay standard errors due to an estimated potential for errors (Driscoll & Kraay 1998) is derived and tested for robust estimates from a data that includes 45 European banks from 15 different countries. The model is then applied to test the significance of the European economic policy uncertainty on banks' credit ratings in the EU.

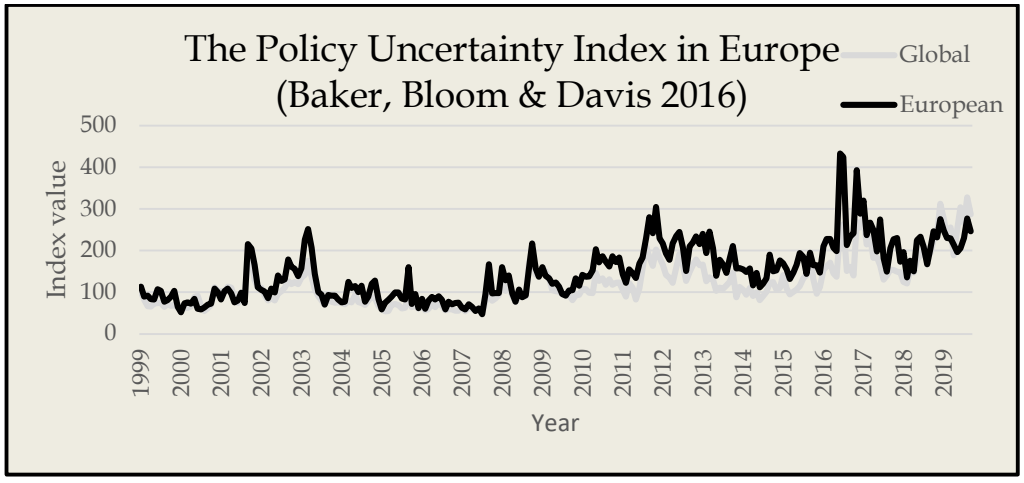
The results show that the European economic policy uncertainty has significant effects on the banks' credit ratings in the EU area for both market and bank-based countries in the whole observation period, but not for five countries outside the Eurozone. After the period of 2007, the EPU alone, explains around a one grade downward change in the banks' credit ratings in the Eurozone. EU membership indicates higher credit ratings for banks as well as being a market-based economy; these characteristics also however enhance uncertainty effects. By also controlling for capital ratios, net loan sizes and the real interest rate, these results also indicate that the unwanted effects of uncertainty on ratings may be reduced by banks via increasing capital and reducing loan sizes or via interest rate relating monetary policies executed by the central bank.

2 LITERATURE AND HYPOTHESES

2.1 Institutional background

The crisis of 2007-2008 was followed by a series of economic policy actions (i.e. regulations, reforms, monetary policies) implemented by the major economies to prevent economic downfalls, to reduce uncertainty and to improve the economic outlook for the future. These policies worked partially, however the volume of economic uncertainty remained high and has been increasing ever since. In periods of financial distress economic policy uncertainty (EPU) increases as negative news tend to lower future expectations of the overall economic performance. The "World Economic Outlook" released by IMF in 2012 took concern of this level of economic policy uncertainty (EPU) which grew strongly after 2008 and has remained, extraordinary high ever since. The EPU has, according to the paper, a significant inhibiting impact on employment, investment and consumption, thus preventing economic recovery (confirmed also by Bloom 2009) and therefore capabilities to intensify recession effects. Uncertainty in Europe has received a great interest due to the European sovereign debt crisis and the future state of the European Union, the decision of the United Kingdom to leave the EU, migration and unemployment crises and their possible impacts on the economy. Monetary policies by the European Central Bank (ECB), government bailouts and interventions have raised concerns over uncertainty effects on the economy and the business environment. Policy uncertainty is an unobservable measure, which makes the empirical analysis of its effects challenging. However, the following literature in the section 2.2.2 offers noteworthy alternative ways to approximate EPU. The following graph shows the current movement of the EPU index calculated by Baker, Bloom and Davis (2016):

FIGURE 1 The policy uncertainty index in Europe



Source(s): policyuncertainty.com

As the graph shows, the EPU curve in Europe has been on an upward trend over a twenty-year period, the highest growth period taking place in 2007 and lasting to this day. The crises have revealed vulnerabilities in the financial sector and in the structures of monetary union, hindering future forecasts and inducing uncertainty. The increasing trend is not unique just in Europe; the global EPU index acts similarly. Throughout the observation period, both indices are closely related while the European index moves marginally higher, with the only exception in 2019. Tendencies, such as the Greek crisis, and heterogeneities between countries in an unfinished integration project in the European market could explain a little higher EPU curve in Europe. The policy uncertainty index tends to have a volatile nature, as it is based on monthly recorded events reported by the major newspapers in a particular country or a region. The volatility is reasoned as it tends to sharply peak during major economic events. The largest single impacts on the EPU index in the observation period have been the US presidential election and the Brexit vote in 2016; uncertainty, however halved in six months. The following events can also be identified from the table:

TABLE 1 Past events that have increased EPU

Year	Event	Year	Event
2001	The dot-com bubble	2010	The Greek crisis
2002	9/11	2011	Italy rating cut
2003	The Gulf War II	2012-	Eurozone stress
2005	The German election, Merkel becomes chancellor	2016	The US presidential election and the Brexit vote
2007	Bear Sterns, Northern Rock	2018-	The United States – China trade war
2009	Lehman Brothers		

2.2 Defining EPU, measurement and impacts

2.2.1 Defining EPU

EPU can be defined as the unpredictability of the forthcoming economic state, which is affected by political interventions, the current economic status and stochastic events, also involving non-economic variables such as terrorism and natural disasters, that economic agents are attempting to forecast. Thus, every aspect that might involve decision-making and have economic effects is included in the concept and therefore is a sub-category of the overall uncertainty in the economy and itself has sub-categories such as monetary policy uncertainty or financial policy uncertainty. By this, it is noted that there are many types of uncertainties and occurrence of the types may take place simultaneously in the economy. The ECB's article from 2016: "The impact of uncertainty on activity in the euro area",

represents three forms of uncertainty: (1) unresolvable uncertainty, which refers to a situation of predicting outcome such as tossing a coin, (2) epistemic uncertainty, which occurs when no assumptions can be made due to lack of empirical data of earlier incidents and lastly, (3) ontological uncertainty, which refers to a complete ignorance, meaning that agents lack of the knowledge about what they don't know. For example, the Brexit and the UK resignation from the EU can be identified as epistemic uncertainty due to the non-existence of precedents, whereas ontological uncertainty may rise for instance from new unexpected and unexplainable events in estimation models, which have worked with previous information.

The economic literature usually distinguishes uncertainty and risk; for example, when the risk of losing in a card game can be calculated, uncertainty adds a dimension of when that loss occurs. A coin tossing bet supposedly has a risk of fifty percent failure, whilst uncertainty assumes unknown probabilities of outcomes or even if that bet is taken. Knight (1921) represents definitions as follows: uncertainty is the inability to forecast likelihoods, whereas risk has a known probability distribution. Uncertainty related forecasting is challenging, as EPU is an intrinsically unobservable measure, which means there exists no universal, commonly accepted definition of the measure. It also moves along with the business cycle, making it difficult to distinguish the impacts of the EPU from other factors in the economy. Several literary methods use time series of macroeconomic variables, newspapers, policy announcements, financial data and surveys to derive approximations about the current status of uncertainty. Volatility of equity prices, exchange rates and bond yields are often measured to derive approximations of uncertainty (see, e.g. Bloom, 2009); low volatility reflects expectations of a stable economic state, whereas increasing volatility reflects forecasts of unstable economic conditions.

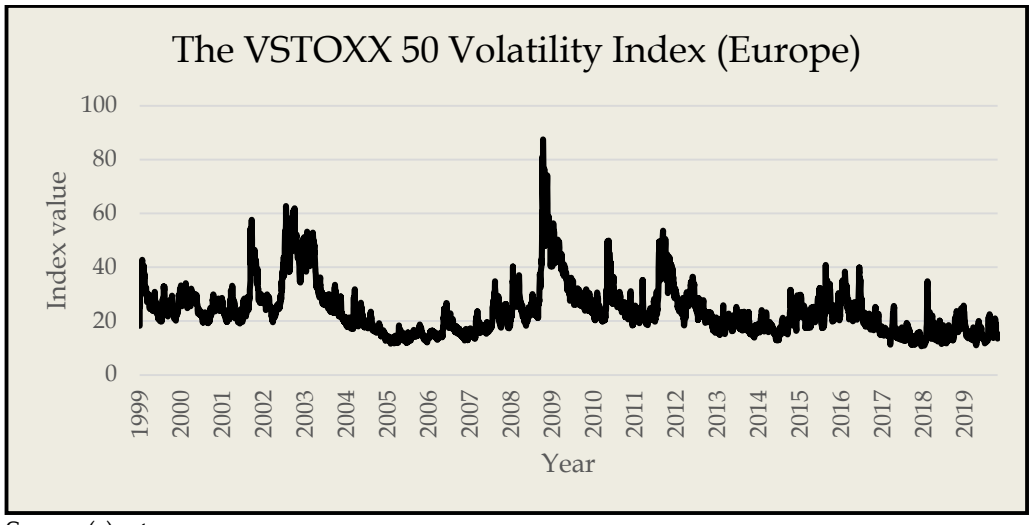
2.2.2 Estimating EPU

As identification of the current uncertainty status is difficult, researchers have proposed several approximation techniques in recent years; Baker, Bloom and Davis (2016) propose a method, the BBD approach, which utilizes media speculation as a measurement of uncertainty in a specific area. The EPU index is drawn from a monthly volume of articles that include specific terms about the economy (E), policy (P) and uncertainty (U). The terms are searched with the country's native language and the words used to measure EPU in Europe are: "uncertain(ty)", "economic" or "economy", and one or more of the following: "tax", "policy", "regulation", "spending", "deficit", "budget", or "central bank". The raw counts are then scaled, the variation of every newspaper is standardized, the counts are then averaged across the papers in a specific country, and normalized. In a European-wide calculation, the counts are equally averaged across all countries. The benefit of this method is that uncertainty is not necessary to be distinguished from other data, such as financial or macroeconomic; as uncertainty moves along with the economic cycle, it may be difficult to separate from other

variables in research models. In the European-wide index, two newspapers per country are used: Le Monde and Le Figaro for France, Handelsblatt and Frankfurter Allgemeine Zeitung for Germany, Corriere Della Sera and La Repubblica for Italy, El Mundo and El Pais for Spain, and The Times of London and Financial Times for the United Kingdom. Further developments of EPU calculations, which utilize media data, introduces the Azqueta-Gavaldón (2017) machine learning technique (LDA), which further identifies the source of uncertainty (i.e. fiscal, monetary, domestic regulation or trade policy uncertainty) by allocating words to topics based on how often those words occur together in the same document. The advantage of this method is that it is not dependent on ex ante given keywords yet utilizes the same idea behind the BBD method. For comparison, Azqueta-Gavaldón et al. (2019) suggests that there exists a correlation of 0.85 between the BBD approach and the LDA method (Latent Dirichlet Allocation).

The most used financial market strategy in the estimation of uncertainty in markets utilizes the VIX, or a similar index, from which EPU can be evaluated. The VIX is an index measuring 30-day option-implied volatility of the S&P500 stock index. While the VIX measures uncertainty 30-day ahead, the EPU index is more forward looking. The EPU index contains also a much larger view of the economy; the index gives information about policy uncertainty, while the VIX measures uncertainty in equity returns, and only for publicity traded firms. In Europe, a similar index compared to the VIX index is the VSTOXX 50 Europe volatility index, which measures the volatility of the EURO STOXX 50 option prices. The VIX index and the VSTOXX 50 index (Figure 2) have a very similar movement pattern.

FIGURE 2 The VSTOXX 50 volatility index



Source(s): stoxx.com

As seen from the graph, the VSTOXX index has a different pattern compared to the (BBD) EPU index. As the EPU index shows an increasing movement pattern

since 2007, the VSTOXX index shows a downward trend since 2009. Still, concerns of a high uncertainty period prevail in the economy, encouraging speculation for the difference of the indices. The difference here relies on the question of how large the stock market is compared to the whole economy; it does not contain all information about overall uncertainty and thus the difference between financial market uncertainty and economic policy uncertainty can be identified. Furthermore, it seems that monetary policies (interest rate cuts encouraging investments) after the Great Recession have had volatility lowering market properties even in the presence of uncertainty. This would indicate that investors have a strong belief to the financial market despite the uncertainty. Across history, the VSTOXX index and the EPU index have been highly correlated and this separate movement of the recent times has been exceptional. An article from Antonakakis et al. (2013) studied policy uncertainty, implied volatility and stock market returns, with the VIX index, S&P returns and the BBD uncertainty index. They found that uncertainty and volatility decrease the stock market returns, but after 2007 crisis the implied volatility has decreased while the EPU has increased, with no explanation found. The separation presented has a complex nature since a period of high uncertainty has occurred simultaneously with the introduction of unconventional monetary policies (2007-). The recent articles about uncertainty and zero interest rates, such as Basu and Bundick (2017), Fernandez-Villaverde et al. (2015) and Caggiano et al. (2017), suggest that the impact of uncertainty shock is more severe at the zero-lower bound. Chi and Li (2017) and He and Niu (2018) suggest that the negative effects of economic policy uncertainty shocks may be, in some levels, countered via interest rate policies and the availability of these policies is greatly reduced at the zero-lower bound, thus uncertainty could have larger impacts on the economy.

Baker, Bloom and Davis (2016) also used the daily stock market jumps as a comparing measurement of EPU to evaluate the performance of their developed EPU index. All jumps greater than 2.5% in the S&P stock index were recorded; next-day NY Times and Wall Street Journal are used to get more information about the jumps to determine if they are policy-related. The correlation between the annual frequency count of daily stock market jumps triggered by policy news and the annual version of the EPU index is approximately 0.78. If one would utilize other financial data and add macroeconomic parameters together, approximations of uncertainty can, for example, be made with vector autoregression models. Caggiano et al. (2017) use a nonlinear VAR approach to estimate uncertainty as well as Ludvigson et. al (2019) use a SVAR model on estimating uncertainty with a series of macroeconomic and financial indicators.

The textual analysis strategies mentioned in the literature (Baker, Bloom & Davis 2016) include a textual analysis of Beige Book (BB), which is published eight times a year by the US Federal Reserve Bank, and 10-K, which is published annually about firm's performance required by the SEC (the Securities and Exchange Commission) and especially an analysis of the risk factors section. The correlation (measured quarterly time series) between the EPU index and the BBD

policy uncertainty indicator is approximately 0.54 according to Baker, Bloom and Davis (2016).

The variance of future economic forecasts can also be used in predicting uncertainty (see, e.g. Zarnowitz & Lambros, 1987) as disagreements among forecast professionals indicate difficulties in predicting future incomes. This theory is basically behind why the VIX index implied volatility acts as an uncertainty measure; if uncertainty rises, future prices become volatile. More recent literature has utilized this assumption; Rossi and Sekhposyan (2015) developed a macroeconomic uncertainty model constructed of unexpected mistakes in forecasts compared to their historical distributions. The benefit of this method is that it accounts upper and lower distributions of uncertainty, where the upper indicates that the realized value was higher than expected and lower the opposite. In addition, Bachmann et al. (2013) proposed a model in which survey data ex ante disagreements were compared to post forecast errors in the US and Germany.

2.2.3 Effects of EPU

Economic policy uncertainty is of a counter-cyclical nature; on average peaking at times of economic crises and decreasing at an expansionary state. However, it tends to be volatile and has also risen during more stable economic periods of growth. The EPU has various channels to impact the economy as it encourages to a risk-averse behaviour. Risk-aversion relates to a situation where individuals seek to preserve capital if the volatility of the expected return on the investment increases. Therefore, the risk-aversion encourages market participants to withdraw from decision-making and to protect investments with creating capital buffers for the future. According to Bloom (2009) uncertainty shocks have a major impact on real options in the short term as investment and hiring activities decrease as businesses and households wait for more secure times so that the costs of investments are more predictable. Firms also face higher costs of capital as creditors expect higher returns from loans in more turbulent times to balance their balance sheets leading to higher risk-premia for loans and diminishing the desire of firms to invest. The uncertainty related risk might also push investors to give up their riskier investments. This is confirmed by Gourio et al. (2016) as uncertainty shocks tend to increase capital inflows and decrease capital outflows, which might be caused by expropriation channels as foreign investors sell domestic assets to local investors because foreign investors are more prone to a local risk. Increasing risk premiums also have potential effects on the bond markets. According to the Deutsche Bank's (2018) research, EPU alone, explains a third of corporate bond yield variation. An effect of this magnitude can be questioned; because the EPU moves along with business cycles as stated, there might exist other factors that contribute to the development of the EPU and bond yields simultaneously overstating the correlation. Gulen and Ion (2013) noticed that the correlation of EPU and capital investments is higher when faced by higher financial constraints, a less competitive environment and with a stronger irreversibility of

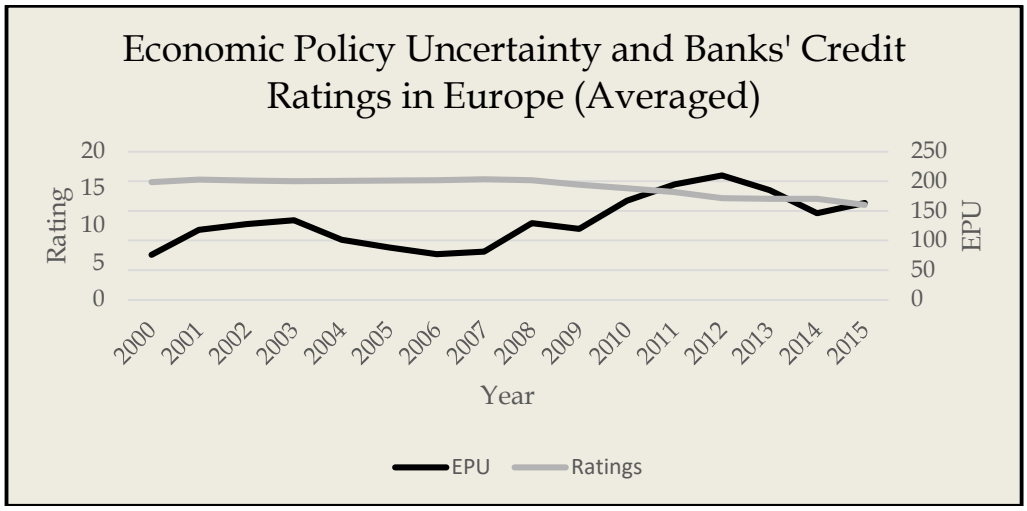
investments. The financial constraints restrict investors' range of investment opportunities, implying unwillingness to invest in times of uncertainty if a proper option is not available. Competition encourages firms to invest in order to be able to perform in a competitive environment. If there is no external pressure for investing, such as the competition, firms are more likely to withdraw from investment-decisions in times of a higher uncertainty. Similarly, the irreversibility of investments increases risk-aversion if overall profits are not predictable.

Even though it is theorized that in the short term, managers may become more risk-averse, thus withdraw from investment decisions and postpone current investment plans, this is not necessarily always the case; according to Jia (2016), firm level micro data suggests that innovative and productive firms tend to increase investments as uncertainty rises. This effect seems however to deteriorate as productive firms' opinions about the future differ. To conclude the effects mentioned in the literature, at least the following channels of how EPU influences the economy can be identified: (1) the real options effect as risk-aversion increases, (2) the savings effect (capital buffers) to prepare for the uncertainty and (3) the existence of financial frictions (Bloom 2009). In the short term, uncertainty has adverse effects on the economy, but the medium- or long-term effects can be either positive or negative depending on whether the impact of news affecting investment profits are either positive or negative.

2.3 The effects of uncertainty on banks' credit risk

As uncertainty can be defined as a risk with an unknown time period, it is assumable that increasing uncertainty could be a worthy predictor of increasing risks in the economy. This assumption is also tested in the literature and the theoretical framework suggests strongly that EPU has increasing effects on risks in the banking sector. In the next Figure 3, both movements, risk and uncertainty are compared together; no significant similarities between the two curves, except the two seem negative correlated to some extent after 2009.

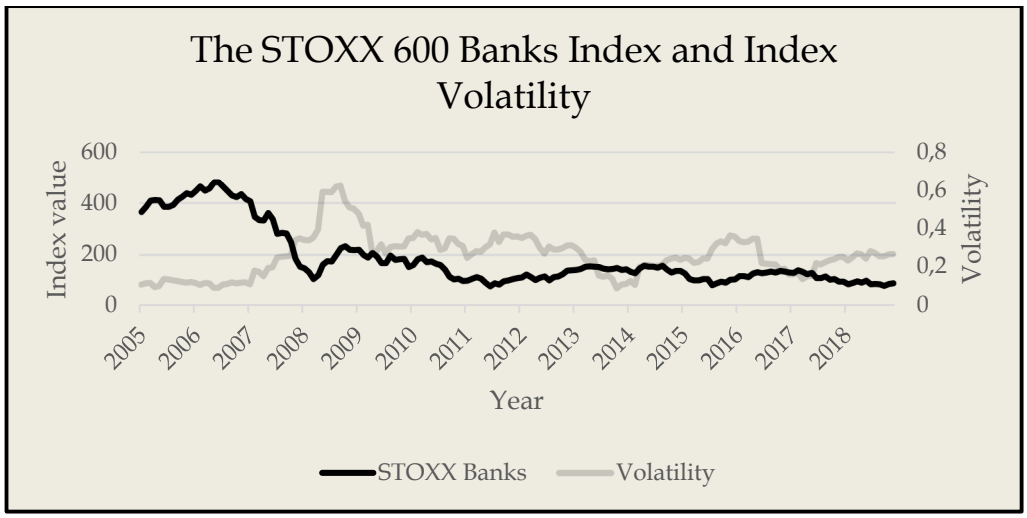
FIGURE 3 EPU and credit ratings in Europe



Source(s): policyuncertainty.com, Thomson Reuters Datastream

The banking sector has not performed well in the post-crisis period, indicating problems in the business environment, such as a growing market share of other financial institutions in the loan markets and zero interest rates affecting net interest margins. The following Figure 4 shows the European STOXX index of banks, its decreasing performance and increased instability:

FIGURE 4 The STOXX 600 banks index and index volatility



Source(s): stoxx.com

Figure 4 shows that before the Great Recession, the banking sector performed well due to a strong growth period in the economy and the spread of asset securitization business. The realization of risk misvaluations in these securitized assets were a large part of why the economy fell into a crisis in 2007 when housing markets weakened in the United States, affecting assets based on mortgages. The

fall in the banking sector due to securitized assets caused bankruptcies, insolvencies and bailouts of major financial intermediaries which peaked volatilities extraordinary high. After the crisis, banks' market values have not strengthened as the graph indicates in a way that the overall economy has recovered in terms of market values (see Figure 5) in Europe. The integration project of the EU increases interconnections of banks making the system more volatile against national crises such as the Greek crisis. After 2008 interest rates were majorly cut by the ECB and reached zero in 2012 and further, negative levels in 2014, lessening net interest margins and thus incomes in the European banks everywhere.

Chi & Li (2017) studied EPU effects on bank-level risks and banks' lending decisions of Chinese commercial banks from 2000 to 2014. According to the paper, increasing economic policy uncertainty increases the bank's credit risks through various channels and negatively affect loan sizes. The decreasing effect on the loan sizes was also confirmed by Gissler et al. (2016) who found that during regulatory changes in 2011-2013, banks exposed to higher EPU, decreased especially mortgage lending. The reducing loan size effect can be explained by banks' self-insuring behavior towards increasing uncertainty, which could predict future credit losses. In Germany, France, Spain and Italy alone, a ten percent increase in EPU decreases bank lending to non-financial corporations by up to one billion euros and to households 0.5 billion euros in monthly loan flows, estimated by Deutsche Bank (2018). The loan reduction effect seems to be higher in southern Europe (not significant in Germany, whereas non-financial corporate lending shows a -0.3 correlation in Italy, -0.44 in Spain; correlations being -0.24 and -0.32 in household lending). The smaller effect on household loans can be explained by a high share of mortgage loans in banks' balance sheets which are considered low risk due to collateralization and standardization, therefore less prone to EPU. The loan rate of mortgage loans ranges usually around 60-75%. The evidence also shows that SME loans are more affected by EPU compared to large company loans. This is explained by the fact that SMEs are more constrained, dependent on loans and find it harder to find desirable investment financing options (the SMEs might also be more risk-averse as EPU increases), as larger companies in international trade are less vulnerable to local EPU shocks. (Deutsche Bank 2018)

Gulen and Ion (2013) noted that the EPU positively affects cash holdings, as the holdings have protective properties towards future credit losses, and negatively affects net debt issuance. According to them, two thirds of the decline during the 2007-2009 crisis could be explained by the increase in the EPU. Banks have various possibilities to prepare for and to reduce uncertainty effects, such as restructuring balance sheets of liabilities and assets or asset securitization etc. The balance sheet restructuring could change interbank trading volumes as asset demand and the demand of loans change the short-term loan net positions between banks. According to Lucchetta (2007), investing in liquid assets corresponds positively to interbank interest rates while investing in loans corresponds negatively, while the risk-free interest rate has the opposite effects. Without the balance sheet restructuring, to raise capital, banks are due to reduce costs and decrease lending.

As uncertainty rises, the banks prepare for different scenarios through increasing capital buffers, meaning decreased leverage ratios. Valencia (2016) found that uncertainty has a significant impact on the bank leverage in the US as higher uncertainty contributes to higher capital-to-assets ratios. This concludes a self-insurance mechanism against future shocks when external finance is influenced by financial frictions. Overall, as Valencia pointed out, uncertainty explains approximately 50 percent of banks regulatory capital buffers on average. The paper also suggests that uncertainty has a large influence on changes in the capital ratio; as uncertainty variation drops to its lowest level from the baseline approximation, capital ratios fall by nearly two percent. A decrease in loan sizes via EPU growth, also have a negative effect on bank valuations according to He & Niu (2018). These bank valuations are negatively also affected by an increasing unemployment rate and decreasing GDP, which seems rational as EPU inhibits GDP growth and increases unemployment as firms reduce hiring during periods of high uncertainty.

In addition to reduced loan sizes, uncertainty has a positive impact on non-performing loan ratios as uncertainty tends to create payment difficulties by slowing down the economy, and loan concentrations (Chi & Li, 2017). The loan concentration is a percentage of how concentrated a bank portfolio is to a single territory, such as a certain sector and an increasing concentration may indicate a profit motive and may also reduce the risk of default. As loan sizes decrease and the amount of non-performing loans increase due to EPU, banks tend to increase risk-premia of loans to prepare for future possible losses. The loan spreads are one of the channels through how EPU is affecting the real economy. According to Gong, Jiang et al. (2018) research, borrowers on average, pay an extra 12bps as EPU increases by a one standard deviation. The borrowers are also punished on loan markets as EPU decreases loan availability.

Wang et al. (2019) studied uncertainty effects on CDS spreads in the United States and found a positive connection as uncertainty was found to have a negative connection on the amount of liquidity providers in the CDS market. As uncertainty increases 10%, CDS spreads grow by 8.4% and the amount of liquidity providers drop by 4%, meaning that in periods of higher EPU, credit protection costs increase and availability decreases. The CDS spread effect was also verified by Baum & Wan (2010). Liu & Zhong (2017) concluded using a difference-in-differences approach that EPU raises firms' credit risk through idiosyncratic volatility and debt rollover, or debt refinancing channels. The refinancing and a reduced bank supply causes liquidity rebalancing. Berger et al. (2018) found that this banks' liquidity hoarding during uncertainty periods has real effects on the economy. Uncertainty seems also to have a reducing effect on bank's credit scale, which is the quality variation of loans in the banks' loan portfolios. The research paper of Tao & Xu (2019) in the Chinese banking sector, including data from 2007 to 2016, shows that EPU has a reducing effect on banks' credit scale with a higher effect on non-state-owned and non-listed banks.

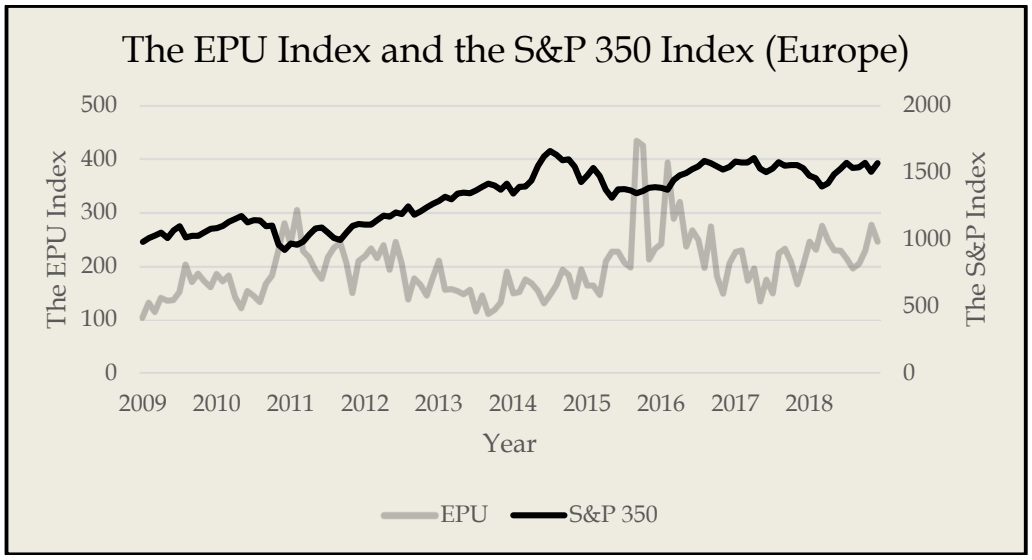
2.4 EPU in Europe

Europe has been in a turmoil of uncertainty since the Great Recession. Heightened uncertainty has led to policies affecting all aspects of the European markets. Policymakers' statements and actions regarding to fiscal policies, structural and regulatory reforms have had effects on financial markets, uncertainty risen from the Brexit and domestic political risks have had an impact on economic policy consensus in Europe. Economic policy uncertainty has a nature of spreading across borders as union integration has united decision-making and heterogeneity of countries in the Europe. This nature is further braced as financial markets have become more globalized, enhancing the spillover-effect of such as an uncertainty over the Brexit. This heightened uncertainty has encouraged financial products and loans to include additional risk-premia which has caused corporate bond spreads to rise due to higher loan costs. The uncertainty in Europe spreads heterogeneously; the impact of EPU varies across countries. For example, Brexit-induced EPU has had a significant impact on Germany and France, but less on Spain and Italy. Loan risk-premiums suggests that banks may be the central channel of how the EPU is affecting the real economy, which is observable in Spain and Italy in particular. (Deutsche Bank 2018)

Unconventionalities in markets have disturbed uncertainty characteristics in the EU; EPU and financial market uncertainty have recently parted as they usually have had a close co-movement and the difference can be observed through the VSTOXX and the EPU index comparison. Similarities can be found via global EPU and the VIX index comparisons. The VSTOXX is an index, which measures the implied volatility of the Euro STOXX 50 options having a one month to expiry. The comparison is relevant as according to Kelly et al. (2016), political uncertainty is priced in the option market because of prior major events, which are estimated to have an impact on the economy, financial markets or such, investors seek to hedge their investments from turbulences or a fall in value leading to higher option prices. Due to a weakened state of the economy and uncertainty over the future, financial intermediaries seek to price these investment protective financial products higher, meaning that risk premiums are found to be larger in times of a high uncertainty or weak economy. Identifying risk-premia changes could lead to important information about the current uncertainty. However, approximations of the level of uncertainty through the VSTOXX index might be inaccurate as compared to the EPU index, the VSTOXX index does not weight long-term risks in calculation, therefore these two indexes can differ over short periods of time. The negative correlation of indices seems to be higher when affected by shocks and seems to separate during times of economic growth. The recent divergence is estimated to be only temporary; no structural changes have occurred between the linkage of these two, at least there is no evidence (Deutsche Bank 2018). The purpose of the following Figure 5 is to illustrate a possible mechanism behind the separation; while uncertainty increases simultaneously with

economic growth, the growth reduces market volatilities (such as the VIX volatility index) as seen in the Figure 2.

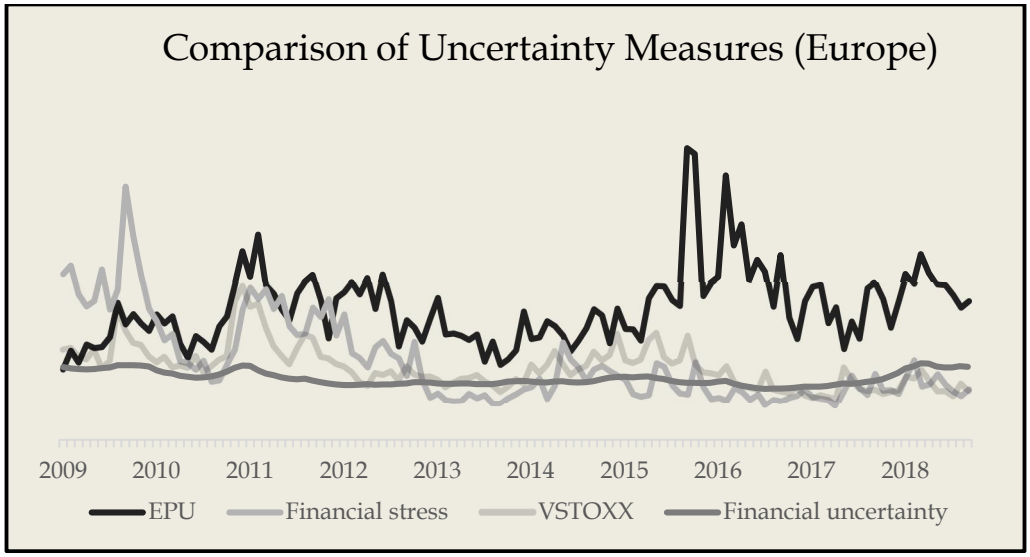
FIGURE 5 The EPU index and the S&P 350 index



Source(s): policyuncertainty.com, us.spindices.com

As seen, while both indices increase through the observation period, uncertainty negatively correlates with the stock market movement and periods of high uncertainty occur simultaneously as stock returns induce, such as in 2011, 2015 and 2016. Stock markets have increased until 2014 followed by an uncertainty shock in 2016 after which, according to this graph, stock market growth has stagnated in Europe to this today. In the United States, the S&P 500 index has in contrast, increased considerably despite the US EPU index has acted similarly as the European EPU index, which might be explained by differences in interest rate policies between the monetary regimes. The stagnated growth period after 2016 uncertainty shock in the Figure 5 suggest real effects of uncertainty on the European economy. Multiple uncertainty measures are utilized in the literature to approximate the real effects of uncertainty on the European economy and to predict the movement of the EPU index. Degiannakis and Filis (2019) compared different variables, indices and combinations to predict the movement of the European EPU index (BBD). The data included implied volatility indices of the following variables: the FTSE100 (a European stock market index), Euro STOXX 50 (VSTOXX), GBP/USD exchange rate, EUR/USD exchange rate, S&P500 index (VIX), US 10 yr T-bills, WTI crude oil (OVX), Brent crude oil (VBRENT) and global EPU index (BBD). Not surprising that the global EPU index showed the most predictive power followed by the VSTOXX index. Also, they found that Jurado et al. (2015) model was rather weak in predicting the European EPU. To support their findings and to further compare uncertainty approximations, the following Figure 6 illustrates different uncertainty measures mentioned in the literature:

FIGURE 6. Uncertainty measures



Source(s): policyuncertainty.com, ecb.europa.eu, stoxx.com, sydneyludvigson.com

Where EPU refers to the BBD EPU index (2016), the financial stress indicator is a stress index of the ECB, the VSTOXX index is a volatility index of the EURO STOXX 50 option prices and financial uncertainty is approximated by Jurado et. al. (2015). After 2015, the EPU index diverges, while the financial uncertainty index remains steady through the observation period, which confirms the findings of Degiannakis and Filis (2019). The financial stress indicator shows approximated financial stress calculated by the European Central Bank (ECB), averaged total across the 28 EU countries included. The ECB utilizes the method introduced by Dubrey et al. (2015). As well as the VSTOXX index, the financial stress indicator measures also uncertainty. The stress indicator measures a total of 3 sub-categories: equity, bonds (government and sovereign) and FXs, volatilities and their pairwise correlations. The financial stress indicator moves along the same manner as the VSTOXX 50 index, with the only exception in 2011, when the Black Monday hit stock markets after the US sovereign debt credit rating fell from AAA to AA+ as a result of prolonged financial market stress. The graph illustrates the uncertainty in banking and financial sectors. Like the VSTOXX 50 index, the financial stress indicator does not predict the current movement of the BBD EPU index.

The Figure 6 might suggest that the BBD EPU index firstly overstates current uncertainty over the markets, secondly the EPU might have properties to lower market volatilities in both stock markets and financial markets or thirdly, both the EPU and volatility may have a common factor affecting the difference. There is a lack of research on this subject. The indices do not measure the same exact thing, but it is noticeable that the correlation has been declining. One major factor is that financial market-based uncertainty measures do not capture measures such as political polarization. If uncertainty is overstated, it might be

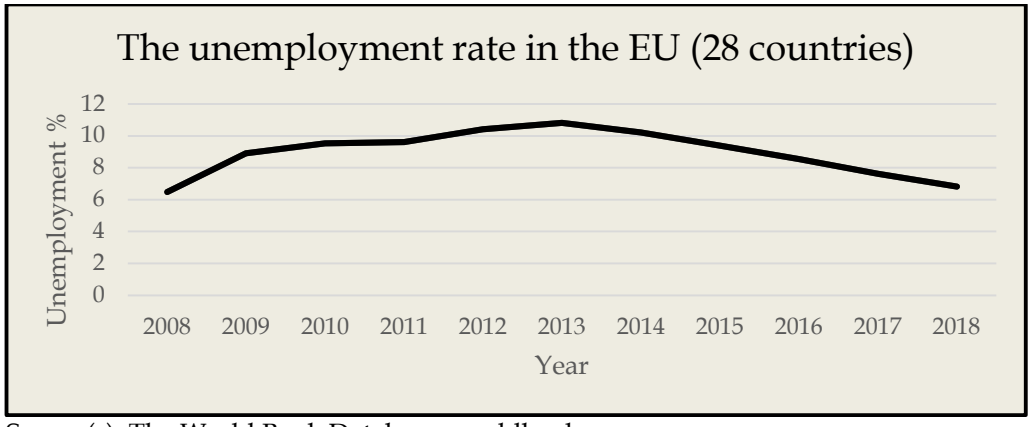
due to uncertainty being a rising discussion topic, a trend, both in the news and in the literature and research. If the EPU has volatility lowering effects, uncertainty lowers the amount of riskier investments, thus bank credit qualities improve and loan quantities and leverages decrease resulting into lower market reactions to shocks, lowering volatilities. Stock markets and their volatilities are inversely related; as the markets currently stands at all-time high, the volatility should be very low. Therefore, even though economic policy uncertainty remains high, the stock market effect dampens the volatility in amounts that the BBD EPU index separates from the financial stress indicator and the VIX index movements even if the historical co-movement pattern has been similar until recently. It should not be neglected that the unconventional monetary policies from recent years have had effects on bank's assets and balances and on stock markets as the unconventional policies encourage firms to safe investments as interest rates reach to zero levels, therefore lessening overall costs of loan leveraged purchases.

2.5 The recent concerns in the EU increasing EPU

The European Union is a European integration project including economic and political collaboration consisting of 28 sovereign states, of which 19 have accepted the euro as a currency referred as the Eurozone. First time in its 60-year history, the European Union integration has faced drawbacks by a reason of issues that emerged as a result of crises leading into debates on the future course of the EU development. Possible scenarios are either more integration or a looser, reversed integration, more intergovernmental scenario or something between the two. The EU area is still confronted by the remains of crises, high public debts, high unemployment and exiguous growth. These shared concerns have provoked a discussion over the functionality of the EU. In recent years, the EU has witnessed increased support of populist and nationalist parties referred as "euroskeptics" due to parties concerns over excess concentration of political and economic decision-making shifting towards Brussels decreasing the identity and independence of governments. Stagnant growth and migration politics have increased tensions and views between political parties. These populist parties support either looser EU policies and regulations or the concrete end of the EU, and partially affected for example, to the Brexit referendum. (Archick 2016)

Concerns regarding to future economic growth affected by uncertainty shocks rises from the questions of EPU affecting negatively to investment rates (source of productivity) and employment (source of volume). The financial state of the union after 2007 drastically forced companies to lower costs and to inhibit hiring activities in order to balance the negative effects of the recession. The uncertainty over forecasts of the economic future prolonged hiring activities resulting into unemployment spikes. As the following Figure 7 demonstrates, the unemployment peaked after 2012 but has then declined into the same levels as before the Great Recession.

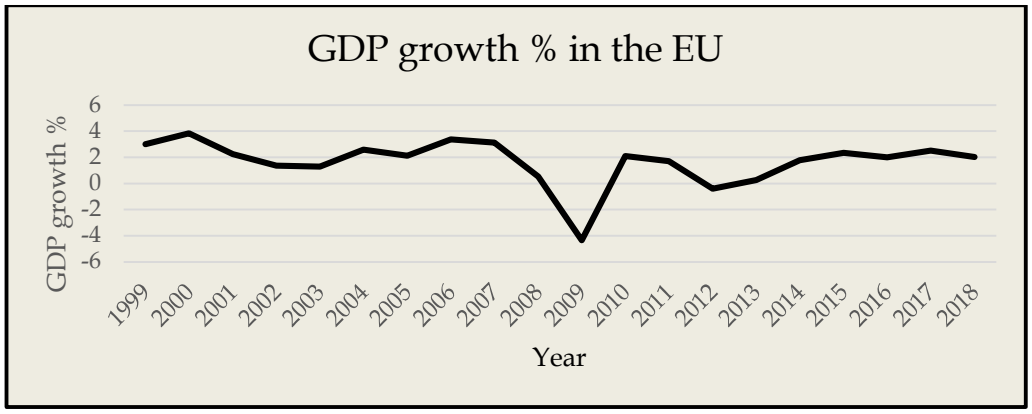
FIGURE 7 The unemployment rate



Source(s): The World Bank Database, worldbank.org

According to the World Bank database, it took nearly ten years for the EU area to balance unemployment ratios after the crisis. The largest impact of the recession to unemployment was found in Southern Europe where the worst situation occurred in 2013, where the unemployment in Italy was over 15% and in Greece over 26%. As the EU is troubled with accumulated debt burdens and leftovers from the crises still exhausting the economy, uncertainty over the future should be reduced for increased growth as investors' environment become more trusting. Born et al. (2018) used different measurements of policy uncertainty mentioned in the literature to identify the effects on the economy and GDP growth. They used the following uncertainty measures to analyse the impacts: Jurado et al. (2015), Ludvigson et al. (2017), stock market volatility, corporate bond spreads, Bachmann et al. (2013), and the BBD approach. From the UK data (1985-2015) can be identified that uncertainty shocks of different measures were able to explain up to a 10 percent decline in GDP during the peak of the Great Recession. However, if assumed that investments and hiring activities are reduced for a period of uncertainty and continued and executed after, then the uncertainty would only have short-term effects. If this uncertainty period is prolonged, as it has been since 2007, then it would assumable have adverse effects also in the long run. The ECB's article (2016) used granger causality tests to identify that uncertainty measures have a significant impact on future GDP. As shown in the following Figure 8, GDP growth has been steady, excluding the crises of 2007 and 2012 in the EU. Even the strikes of uncertainty shocks in 2016 are not directly observable from the graph.

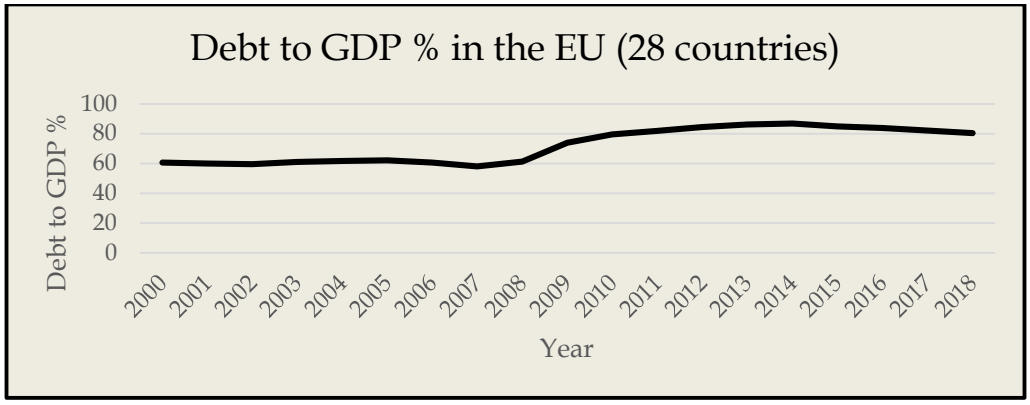
FIGURE 8 GDP growth in the EU



Source(s): The World Bank Database, worldbank.org

Low growth in Europe has forced countries to increase debt burdens to maintain social obligations and other necessities. As confirmed by Cooper & Nikolov (2018), overburdened government debt has an enormous impact on banking stability as the financial sector holds large amounts of government debt obligations on domestic banks. If the price of government debt falls, for example, due to a fall in credit ratings caused by increased government debt ratios, bank solvency decreases. During the period after the 2007 crisis, in some European countries (i.e. Ireland & Spain), governments bailed out domestic banks to prevent bankruptcies, which led to the transmission of financial sector risk to sovereign risk as financial sector debt was shifted to the government. In Ireland, for example, where the financial sector per capita is significantly higher compared to the EU average due to large companies holding their headquarters in the country in order to access Ireland's low tax rates, where when the financial crisis struck, the 27% debt to GDP ratio in 2006 rose to a record of 131.6% in 2013 (World Bank data), which led to major problems for national banks. As bank solvency declines, it affects government debt again, leading to which is in literature called "the diabolic loop". During recessions bank lending and tax incomes decrease, affecting the real economy. Increased uncertainty inhibits investments and spending, therefore leading to difficulties from escaping the loop. According to Pan et al. (2019) an increase in uncertainty of one percent leads to an 0.86% increase in sovereign debt spreads. The following graph illustrates the averaged, not weighted, growing debt burden in the European Union:

FIGURE 9 Debt to GDP in the EU



Source(s): The World Bank Database, worldbank.org

The graph illustrates that the European average debt to GDP ratio has grown by 33% after 2008. The European Stability and Growth pact, established in 1997 due to the emergence of European Monetary Union, enforces that each member state should target that the debt to GDP remains below 60%. This has not been the case over most states in the EU after the crisis of 2007. Of the most concerned PIIGS countries in the sovereign debt crisis, Greece, holds currently debt ratio of 180%, Italy 135%, Portugal 122%, Cyprus 100%, Spain 98% and lastly, Ireland with only 64% ratio (ECB database 2018).

While the European economy is slowly recovering from the recent crises, the next setback is just around a corner; the Brexit will leave an enormous mark on the European Union as London can be defined globally as the leading financial center, meaning that the Brexit will affect tremendously financial markets worldwide, meaning banking, capital markets, foreign exchange, insurance, securities and all related services. The current agreement is still under a negotiation which began as early as in June 2017. The delay of negotiation agreement and surrounding uncertainty has lasted currently over two years. The first phase, including individual rights, the Irish border and financial obligations concluded in December 2017 and the current phase two deals with transition contracts and future relations. The reason behind why the Brexit will influence markets so vastly is that the EU single market allows financial institutions to offer services with one license, no other permits required. As the Brexit, in theory, will prohibit the single market access, depending on the final contract negotiations, the resignation from the EU will have a major impact on British imports and exports. In 2018, according to Ward (2019), the UK imports accounted for €403 billion and exports €329 billion (53% and 45% of the UK imports and exports respectively); the trade deficit lies therefore in -€74 billion (€32 billion trade surplus of services was swept by the deficit of goods, €106 billion). The banking related activities: financial services, insurance and pension accounted for €34 billion in exports €7 billion in imports. Business and financial services overall account for just over half of the

UK's exports and €31.5 billion in imports (Ward 2019). Uncertainty over the scenarios creates pressure on the economy even before the final Brexit contract; the effects of the Brexit have already started to show. Firms are forced to forecast refinancing options if their debt obligations are affected by the Brexit. It may not be possible for agents in the financial sector to wait for the execution of the Brexit contract. Furthermore, according to Alvarez-Diez et al. (2019), the euro and the British pound correlation has declined after the referendum and a research done by Fernández et al. (2019) indicates that the efficiency of the banking sector has dropped 5,6% since the referendum (2007-2016 data) in the United Kingdom.

Furthermore, in recent years, Europe has confronted increased migration leading to political concerns in the EU. The Middle East and North Africa have been the sources of migration as conflicts and poverty have led to mass escapes of refugees. The World Bank accounts over the net border movement of the EU in five-year intervals, which have recently been 4,677,494 in 2008-2013 and 5,584,898 in 2014-2017. The pattern of cross-border movement has diminished until recently as conflicts and political tensions provoked migration rates to rise. The Mediterranean Sea has been an access-point for refugee arrivals into Europe through Greece and Italy. From the south, the movement of refugees goes mostly through Western Europe to Northern Europe, where individuals frequently enjoy better welfare benefits and increased chances of receiving asylum. In 2015 the EU approved controversially the distribution of immigrants from Greece and Italy to other EU countries, and in 2016 made an agreement with Turkey to reduce the movement of Syrian immigrants, one EU resettlement for one Syrian returned. Turkey also received three billion euros in assistance. This action has partially provoked parties of human rights in Europe. There are also growing concerns of reports regarding criminal activities and sexual assaults caused by migrants and the recent terrorism associated with a Muslim background. Economic profits of immigration are relying on how these migrants are integrated to countries' customs and environments. Archick (2016)

2.6 Banking sector stability

2.6.1 Credit ratings and banking stability

As uncertainty disrupts economic performance, analyzing banking stability and risks requires appropriately measured variables. For banks, the literature suggests non-performing loans (NPLs), credit default swaps (CDS) or credit ratings as a suitable measure for credit risks. The NPLs are loans that have not received payments timely, whereas the credit default swaps are protective instruments against a default of an investment. Credit ratings are ratings that account for the probability of a default, provided by credit rating agencies by using various risk modeling techniques. Credit risks can be distinguished from overall financial risk; as the credit risk implies potential financial losses of a company forecasted in

financial markets, the financial risk comprehends every aspect of the credit risk, market risk, liquidity risk, operational risk and business risk (Klieštik & Cúg 2015). The credit risk is one of the main risks that banks are exposed to and defined as an exposure to a risk of inability or willingness from a borrower to pay a loan. In addition to the individual perspective of a single borrower, the credit risk can be divided into two categories, which are systematic and unsystematic risk. The systematic credit risk accounts for all major economic variables, such as political changes (or changes in interest rates, markets, exchange rates etc.), that affect all financial markets and their securities. Therefore, the systematic credit risk of banks' can be explained mostly by macroeconomic variables. Unsystematic on the other hand refers more to an industry or firm specific approach, such as a development of an innovation. Credit risk models are used in forecasting capital requirements for estimated losses related to risks surrounding lending activities of financial intermediaries. The models account if debtor is estimated to be credit loss or not in the end of a forecast horizon, or the debtors are allocated into defined grades indicating failure probabilities. The approaches are generally called "default-mode" and "mark-to-market". (Klieštik & Cúg 2015)

Credit risk models are further utilized in forming credit ratings for financial instruments, firms and countries to ensure financial stability and predictability. Regulations, such as the Basel contracts, establish requirements for banks to hold certain amounts of high-grade safe assets in their portfolios and minimum amounts of capital to secure the financial sector from turbulences in the economy. The banks are given 20% risk-weight if the external rating varies between AAA and AA-, 50% if between A+ and A-, and 100% otherwise according to Basel II requirements in determining the minimum capital requirements. The crisis of 2007 was partially caused by the inability of credit rating agencies to predict credit risks associated with new and complex financial products based on housing markets, meaning that credit ratings at the time were inaccurate and resulted into a crash when losses realized. The credit rating agencies have improved their credit risk models throughout the history to match their estimated credit ratings on constantly evolving financial products. Even though ratings are highly based on statistical models, the final ratings also include analysts' own views. Development of credit risk models has witnessed the transition from structural models introduced in the 1970s towards value-at-risk models emphasized by the Basel II. Different credit risk models and development are presented in the Appendix 3. Credit grades derived from these models are highly utilized in portfolio strategies, asset management and investment option valuations.

Credit risk modeling and rating for banks consist primarily of three components: 1. macroeconomic and sector specific factors (such as trends, dynamics, regulation and structures), 2. bank-specific factors and 3. external factors. The bank-specific factors focus mostly on market and risk positions, structure and ownership, interdependence, ESG and overall management and balance sheet variables such as income, capital, asset quality, leverage, funding and liquidity. The business model examination explains detailed risk factors and protective

functions. External factors contain such matters as relations, financial and other protective support from groups, the government and the central bank. Gaganis, Pasiouras, Doumpos and Zopounidis (2010) establish four determinants of banking stability, which can be seen as the basis for risk modeling: regulation (entry and activity restrictions, state ownership), other banking and financial sector attributes (liquidity, competition), institutional environment (private property rights, political openness, GDP per capita) and macroeconomic variables (GDP growth, inflation rate etc.).

2.6.2 Regulatory framework and institutional environment

The banking industry is heavily regulated as it is a key channel of financial stability. The regulation supports the financial stability in turbulent times and protects financial market participants through standardization, increased transparency and liquidity. Financial market regulation also restricts excessive risk taking in the banking sector suggesting a more stable business environment. However, according to Barth et al. (2004) restrictions of banking activities have a negative impact on financial stability and bank development as restrictions inhibit income diversification. These restrictions of bank activities though, however, are not positively connected to overhead costs or non-performing loans. Barth et al. (2004) found also other regulatory restriction effects of entry, capital deposit insurance, supervisory indicators, private ownership and government ownership on bank performance. Restrictions regarding market entries of banking are less important for the bank's performance; there is no strong linkage between bank entry and bank efficiency. However, foreign bank entry restrictions seem to affect positively on bank fragility as domestic banks may execute riskier investments in order to compete with foreign banks. Capital regulations on the other hand are not associated with bank performance, but they may reduce the need for deposit insurance schemes. The deposit insurance schemes protect depositors' wealth in a case of bank insolvency or default supposedly promoting financial stability. Generous deposit insurance schemes, however, are strongly and negatively connected to bank stability because they may induce moral hazard problems leading to risk-taking related threats in the banking sector.

Barth et al. (2004) also suggest that supervisory indicators do not affect stability or performance except for diversification via risk management. Through reducing riskier loans and making bank level data more comparable, transparent and reliable, private monitoring regulations seem to improve bank development and reduce the amount of non-performing loans on balance sheets, however reducing also banks' net interest margins. Government ownership seems to have a negative impact on bank performance and is positively related to corruption, suggesting that the protective properties of the government ownership reduces incentives to perform in competitive markets. The government ownership is related to political connections; Cheng et al. (2019) studied how the political connections and their interactions with EPU affects banks' risk-taking and found that in a stable economy, political connections do not add additional benefits. During

high uncertainty, politically connected banks are less vulnerable to the risks of introducing unfavourable policies, meaning that unconnected banks should raise capital ratios in order to compete in liquidity with politically connected banks. Capital ratios are proven to an effective tool against turbulences in the economy and are emphasized in the regulative framework of the banking sector. The most important regulatory directions in the European banking sector are established in the Basel agreements (Table 2).

TABLE 2 A summary of the Basel framework

	(IBM Knowledge Center & BIS)
Basel I (1988)	- 30 pages, 5 weight buckets determine the capital requirements equal to 8 % of the risk-weighted assets
Basel II (2004)	- 347 pages containing more developed models and is divided to three pillars - **Pillar 1**: introduces the minimum capital requirements for covering credit risk, operational risk and market risk. The *Credit risk* is calculated with one of the following measurement options: - The standardized approach, where corporate debt has 100 percent weight - The Foundation Internal Rating-Based (IRB) approach, where banks estimate PD, individual risk weight to all loans using Probability of Default (PD), Loss given Default (LGD), (Exposure at Default (EaD) and Maturity (M) - The advanced IRB Approach, where banks estimate all parameters) and the *operational risk*, with the following measurement options: - The Basic Indicator Approach (BIA), which utilizes the total gross income averaged from the three previous years, operational risk capital 15% - The Standardized Approach (STA), which calculates total gross income and the risk capital is determined by the betas of eight business lines - The Internal Measurement Approach, an advanced form of which is the Advanced Measurement Approach (AMA), which refers to banks' own measurement methods and finally, the *market risk*, which is measured by Value-at-Risk-methods - **Pillar 2**: is a supervisory review containing: Residual risk (Pension Risk, Systemic Risk, Concentration Risk, Strategic Risk, Reputational Risk, Liquidity Risk, and Legal Risk) - **Pillar 3**: is about market discipline, which encourages banks to share relevant information

(continues)

TABLE 2 (continues)

Basel III (2010-2011)	- 616 pages and continuing reliance on complex models - Introduces the common equity buffer 4.5%, the 2.5% capital conservation buffer and the countercyclical capital buffer of 0-2.5%, while the minimum total capital ratio remains at 8%. - The leverage ratio of 3% (2013 the US Federal Reserve Bank announced 6% for the 8 systemically important banks and 5% for their holding companies) - Introduction of: Liquidity Coverage Ratio (LCR) Net Stable Funding Ratio (NSFR) The capital requirements for credit value adjustment risk and higher requirements for securitization products

Source(s): ibm.com, bis.org

The attributes of banking and the financial sector refer mainly to the nature of market competition and liquidity. Literature suggests increasing competition has a competence to lead to more accelerated innovation, product differentiation and price competition. Market competition also has several channels contributing to the financial stability of banking. First, according to the literature, increased competition encourages managers to more risk-taking (see, e.g. Keeley 1990). This view is counter-affected by the research of Boyd & Nicolo (2005). According to their paper, a market expansion could lead to decreased interest lending rates; through moral hazard, borrowers seem to decrease risk-taking on investments as the rates decrease. Therefore, risks are reduced as competition increases. This risk lowering effect was also confirmed by Anginer et al. (2014) as more diversified risk across market participants seems to lead to increased stability. Jiménez et al. (2007) argues that a market contraction, or competition itself is not the risk affecting variable, at least if determined by changes in non-performing loan (NPL) ratios. Their article identifies the loan market power in the banking sector, instead of the competition, to be the determining factor in lowering the NPL ratios.

Liquidity management protects banks from failures to meet their debt obligations. Excess liquidity, however, has the properties to counter-effect as it may lead to excess risk taking by bank managers, even more if exposed to uncertainty (Acharya & Naqvi 2012). Furthermore, the managers tend to misprice risk if liquidity is high. Rajan's (2006) research shows that during times of excessive liquidity, bank managers have incentives to rely on riskier, more correlated investment opportunities, as low interest rates tend to offer lower returns on safer investments. If the managers are rewarded according to yields, this effect increases. Khan et el. (2017) confirms this finding; higher deposit ratios, denoting lower funding liquidity risk, increase risk-taking. The risk-taking is reduced as bank sizes and capital buffers increase even if exposed to low funding liquidity. Calem

& Rob (1999) studied capital-based regulation and the effects on banks' risk-taking. They concluded that the relationship of banks' risk-taking and capital position is U-shaped as low capitalized banks tend to favor risk-taking as well as high capitalized. The risk-taking of low capitalized banks, which is caused by moral hazard, declines with an increase in capital as the research shows. When the regulatory requirements of capital are met, the banks again increase the risk-taking because the possibilities of insolvency decrease significantly.

Institutional environment refers to regulations, norms and customs admitted by an organization. Being one of the largest financial intermediaries and one of the most important channels of influencing in the systemic European economy, banks, and the financial sector overall, are heavily regulated for guaranteeing financial stability. The institutional environment usually varies across countries and monetary regimes as policy-making and regulation related activities centralize on different institutions. In Europe, in addition to national decision-making, the banking sector is influenced by monetary policies executed by the independent European Central Bank in Frankfurt and by regulations to ensure stability provided by the EU legislative institutions. By managing the financial sector by these policies, policymakers believe that the economy becomes more resistant against the negative impacts economic shocks. The globalization has also put pressure on the market characteristics and has allowed financial institutions to diverse income sources and increased price competition on markets suggests a reduction in financing costs.

According to Kapounek (2016), globalization (economic, social) and freedom (monetary, investment, financial) increase lending activities of banks. Anginer et al. (2014) examined the institutional and regulatory impact on systemic stability and found bank supervision, private monitoring and capital buffers to lead to reduced systemic risk. They also found that government ownership and regulation of bank restrictions have adverse effects on banking stability. The government's protective ownership might encourage banks to higher operative risk-taking and regulating banks' restrictions might reduce income diversification, which is associated with less risk. Kapounek (2016) suggests that, in Europe, regulation and government size have corruption reducing effects through the information channel maintained by credit bureau registries. The regulation also lessens the principal-agent problems in the market. Barth et al. (2004) found that private property rights and political openness lessens the effects of moral hazard and reduce banking fragility. This is confirmed by Johnson et al. (2000), who noted that institutions with higher property rights also led to higher investment rates of firms. The higher investment rates seem to increase bank loan rates, generating income and balancing economic stability via increasing economic growth. The development of regulation that protects financial market participants has brought several different features to markets. For example, creditor rights protection (Qian & Strahan 2007) is found to positively affect loan ownership concentrations, long-term lending, to decrease interest rates and seems to lead to an increase in the participation of foreign banks. As creditors are more protected

from the moral hazard issues and credit losses, they are more willing to accept longer loan contracts and as lending risks shrink, risk premia in loan interest rates reduce. The increased safety in lending activities attract foreign banks. Furthermore, Laeven and Majnoni (2005) found that juridical efficiency and enforcement lower credit costs through the interest rate effect.

2.6.3 Economic policy uncertainty and the central bank

In every monetary regime, monetary policies are executed by the central bank. Central banks control primarily, according to the mandates, money balances, interest rates, inflation and overall financial stability through transactions through markets. In Europe, the European Central Bank is the centre of monetary policy in the EMU area, thus largely responsible for controlling the economic environment. Taking economic policy uncertainty in consideration, actions taken by the ECB majorly influence future movements of the economy after shocks and turbulent times, determining in some perspective, the nature of uncertainty surrounding future economic forecasts. However, concerns over the Brexit or political elections for example, increasing economic policy uncertainty, are not necessarily preventable via political interventions of the ECB, as the central bank's legislative power only primarily focus on controlling inflation. While the uncertainty is generally referred to as being disadvantageous considering from an economic point of view, uncertainty in Europe has interesting characteristics; according to Hefeker (2011) EPU may have also positive effects in the EU. This assumption can be reasoned as follows: In a closed economy, as uncertainty increases, the central bank, the government or other institution that holds a legislative power, tend to implement new policies, regulations and structural reforms to make the economy less vulnerable to EPU shocks. The increasing amount of regulation directs the union towards homogeneity of countries in the EU, which is usually considered to be desired. In the monetary union, smaller countries have incentives to create more flexible economies leading to heterogeneity of countries as monetary policies are based on helping usually larger, more significant economies. Increased EPU therefore countereffects this heterogeneity effect.

Economic policy uncertainty creates pressure towards the legislative power and the institutions of the EU, as uncertainty threatens union's functionality. While the institutions work towards lowering uncertainties over certain matters such as the Brexit or other related issues, which affect markets through risk-aversion, the central bank has monetary policy related tools against the effects of uncertainty via reducing risk-aversion. Bekaert et al. (2013) measured the effects of risk, monetary policy and the uncertainty with the VIX index, where the index presented the uncertainty and risk-aversion. Looser monetary policy increased risk-taking in the future, lasting for over two years and being significant after nine months. Loose monetary policies lower short-term interest rates, which have impacts on bank valuations and income and thus might alter banks' view on risks.

Also, the lower interest rates indicate lower net interest margins, dampening bank income, which could lead to excess risk-taking in seeking profits. The lower short-term interest rates seem to reverse the effects of uncertainty via reducing risk-aversion. According to Bekaert et al. (2013), both uncertainty and risk-aversion led to looser monetary policies in the near-term future, but not always significantly. They also noted that monetary policies and risk-aversion have larger impact on each other than that of uncertainty.

In recent times (2007-), central banks worldwide have executed unconventional monetary policies, such as quantitative easing (QE) and lowered interest rates to near zero to revive the economy from the recent economic crises. The purpose of these actions was to lower the interest rates in order to stimulate investment rates to stabilize the economy and accelerate growth in order to balance future prospects and reduce economic uncertainty. The policies implemented have increased lending activities of European banks as confirmed by Kapounek (2016). The stimulated activity on lending intensity is determined by the magnitude of inter-banking market dependency of banks, meaning that the effect on lending activity is estimated to be larger for smaller banks, which are more relied on inter-banking markets (Kapounek 2016). In addition to other activities, the European Central Bank promised to provide limitless liquidity for banks to meet their debt obligations during the recession. Liquidity provision helped in balancing financial stability and without interfering with liquidity, interbank spreads would have been two percent higher whereas the negative impact on investments would have been twice as large (Quint & Tristani 2017). While these recent activities seem to have balanced the economic outlook, incorrectly executed policies may countereffect; Ulrich (2012) documents that uncertainty over the fear of incorrectly defined policies, economic or central bank policies explain 45% in interest rate and bond option implied volatilities.

Not only direct actions reduce uncertainty in the economy; transparency of future actions and targets reduce the uncertainty in reviving markets. Jitmaneeroj et al. (2019) studied the impacts of central bank's forward guidance, inflation targeting and transparency on uncertainty, the forecast disagreements of inflation expectations and interest rates. The inflation targeting had the greatest effect on uncertainty as it is the primary mandate of the ECB in stabilizing the economy, while the forward guidance, which refers to ECB's announcements about the current and future state of the economy and most likely course of the monetary policy, had impact on interest rates, but unclear effects on inflation uncertainty. The purpose of the forward guidance is to affect investment decisions of households, firms and other investors by clearing the future course of the economy. Other research suggests that the effect of forward guidance depends on its nature. For example, according to Ehrmann et al. (2019), the effect of forward guidance on how of bond yields respond to macroeconomic news depends on the type of forward guidance. They propose that time-contingent forward guidance eliminates the response on long horizons, but in the short-term it could prove to be ineffective or even worse the level of uncertainty if it is left open-ended. In contrast,

state-contingent forward guidance reduces the bond yield effect, but not in its entirety. It is noted that central bank transparency has increasing benefits on uncertainty up to a threshold and seems to have a greater effect when inflation target is not adopted in the economy. After the threshold, overly excessive transparency could countereffect as data and publications are usually created for professional use and thus overly complex information could confuse other information users. The greatest uncertainty reducing effects are achieved as forward guidance, inflation targeting and transparency strategies are all used simultaneously. (Jitmaneeroj et al. 2019)

2.7 Summary of the related literature and hypotheses

The literature section strongly supports that economic policy uncertainty (EPU) has real effects on the economy (Bloom 2009, Deutsche Bank 2018). The EPU rises in the needs of political interventions to stabilize the economy. Uncertainty in Europe has risen due to the Brexit, weakened growth, EU opposition, accumulated debt burdens, the recent crises and migration politics. As EPU is an undetectable measure, the literature suggests several approximation techniques (see, e.g. Born et al. 2018) to identify the impacts. The research suggests that uncertainty provokes risk-aversion, thus implying reducing investments and hiring activities, increased risk premia, and has properties to lengthen recessions. Furthermore, according to Gourio et al. (2016) uncertainty shocks tend to increase capital inflows and decrease capital outflows. The overall effects are estimated to be negative on the short-term, but they may have positive impacts in the long run (see, e.g. Hefeker 2011).

The banking sector is affected as well as uncertainty reduces loan sizes (Chi & Li 2017) of banks. If the central bank is forced to take monetary actions to reduce uncertainty, interest rate policies may affect bank's net interest margins. Gulen and Ion (2013) noted that EPU positively affects cash holdings which implies a self-insurance system towards uncertainty in forms of capital buffers. If the uncertainty affects through countries' economic states, then a change in credit ratings of government bonds channels to banks' balance sheets as banks usually hold large amounts of government debt. The impact on banks' credit risks depends on regulation (restrictions and ownership), other sectorial attributes (liquidity, competition) , institutional environment (private property rights, political openness, GDP per capita) and macroeconomic variables (GDP growth, inflation, interest rates etc.) according to Gaganis, Pasiouras, Doumpos and Zopounidis (2010). The overall effects may be identified from banks' credit ratings, which are based on credit risk models (see, e.g. Klieštik & Cúg 2015). Based on He and Niu (2018) and Chi and Li (2017) about the effects of economic policy uncertainty on bank risks, the following hypotheses are tested for the EU area:

$\boldsymbol{H_1}$: The economic policy uncertainty negatively affects bank' credit ratings in the EU

Due to heterogeneity of the European countries, it is assumed that uncertainty does not appear similarly in everywhere. As uncertainty spreads through financial markets, the countries in the EU can be divided by the characteristics of their markets. Banks in market-based countries are expected to be more vulnerable to changes in markets (macroeconomic conditions).

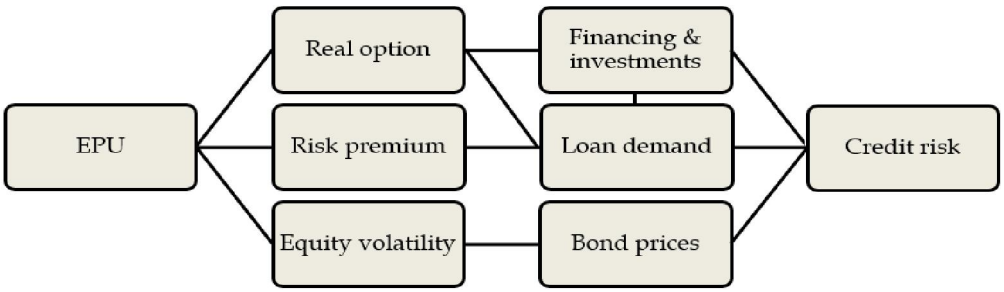
$\boldsymbol{H_2}$: Banks' credit ratings in market-based countries are more affected by EPU shocks

Further, the estimation model is used capture how disturbances in the EU area is different to member countries compared to other countries in Europe as European EPU is expected to spread more inside the EU borders due to the integration of the union and systems, elevating the systemic effects in the banking sector. Therefore, the following hypothesis is tested:

$\boldsymbol{H_3}$: Banks outside the EU borders in Europe are less vulnerable to changes in the levels of European EPU

The data and the methodology to test the hypotheses are described in the next chapter. A summary table of the literature is provided in the Appendix 1 as the risk channels of uncertainty on credit risk is summarized with the following illustration:

FIGURE 10 The uncertainty channels of credit risk

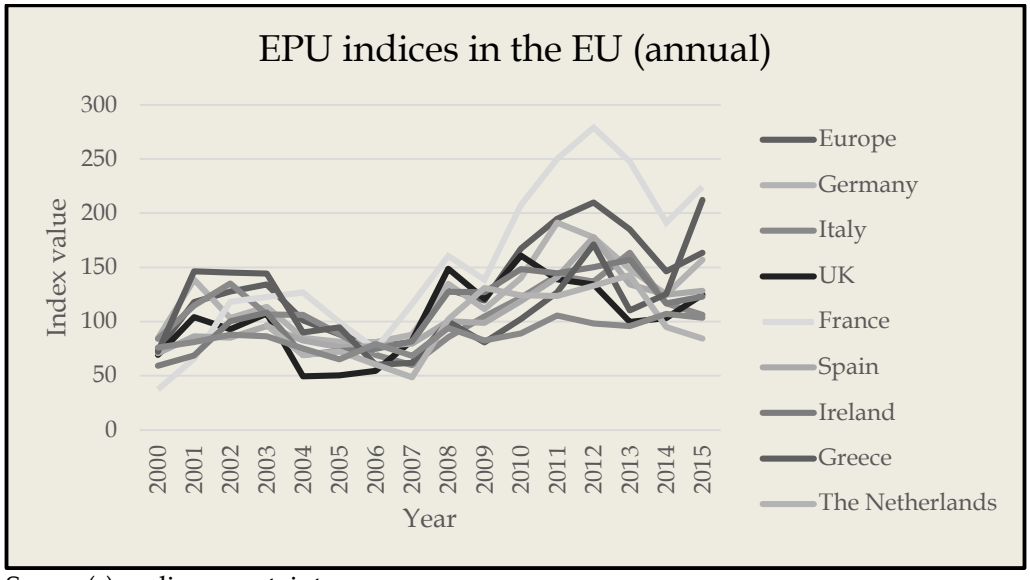


3 DATA AND METHODOLOGY

3.1 Data

In this thesis, the mechanism of interest is a transmission of economic policy uncertainty on bank's credit balances via credit and balance sheet observation. In total, the unbalanced panel data includes 669 observations from 45 European banks (14 countries) through the observation period 2000-2015 (T = 16) from Datastream, provided by Thomson Reuters. All observations of the bank-specific data outside [1, 99] percentile, are removed from the data to reduce distortions. In addition to bank specific indicators, the research data includes macroeconomic variables to separate the impact of economic cycles from uncertainty, measured as the BBD EPU. By this, the aim is to identify the overall effect of introducing economic policy uncertainty shock on banks' credit risks in the area of the European Union. The BBD index is chosen as a measure for uncertainty as it does not reflect the current lowered volatility in asset markets, which other indexes currently are exposed to; asset indexes, such as the S&P 500 index and the S&P 350 index show a lowering trend in the volatility (meaning the downsizing effect on asset-based uncertainty indexes), whereas the BBD index has an increasing trend over the past years. Totally, the data supports individual country data from nine countries, provided by policyuncertainty.com. For the other countries, the European EPU index is used in estimation. The different BBD based EPU indices are shown in the Figure 11.

FIGURE 11 EPU indices in the EU



Source(s): policyuncertainty.com

The economic policy uncertainty data follows the papers of

- Greece: Hardouvelis, Karalas, Karanastasis and Samartzis (2018).
- Ireland: Zalla (2016).
- The Netherlands: Kroese, Kok and Parlevliet (2015)
- Spain: Ghirelli, Perez, and Urtasun (2019).
- Sweden: Armelius, Hull, and Köhler (2017).

For Germany, Italy, the United Kingdom and France, the data is provided by Bloom, Baker and Davis (2016). This Figure 11 illustrates that the European EPU index, which is an average of major economic newspapers in Europe, is higher due to the elevated index of France, suggesting that using only the European averaged index, the level of uncertainty could be higher than the real value. The indices for every observed country show similar movements over the whole observation period of 2000-2015. France, Germany and Greece show the highest indices, while Sweden and the Netherlands show the lowest EPU values.

Even though uncertainty moves along with cycles, it is still assumed have information value on banks' credit ratings, which is still a little studied topic in Europe. The microeconomic variables used in the regression model are derived from the papers of Chaibi & Ftiti (2015), Berger & DeYoung (1997) and Louzis et al. (2012). These papers highlight the role of non-performing loans (NPLs) as a risk measurement:

TABLE 3 Microeconomic variables of bank credit risk

Variable	**Variable**	**Effect channel**
Loan loss provisions	+	Banks, which anticipate large losses, tend to maintain high levels of loan loss provisions
Efficiency	-	Inefficiency may lead to low quality loans due to a low allocation of resources to loan evaluation. Inefficiency leads also to higher internal costs.
Leverage	+	Leverage increases financial risk
Solvency ratio	-	Low capitalized banks have incentives to take riskier loans, which in turn may lead to a greater amount of NPLs
Non-interest income	-	Is a sign of diversification, which indicates less risk

(continues)

TABLE 3 (continues)

Size	+ or -	"Too big to fail" refers to government bailouts, so banks have incentives to take more risk. However, big banks are usually more diversified on income.
Bank income	-	Performance is a sign of good management

Similarly, Chaibi & Ftiti (2015), Castro (2012), Nkusu (2011) establish the following macroeconomic variables to significantly affect the NPLs:

TABLE 4 Microeconomic variables of bank credit risk

Variable	**Effect on NPLs**	**Effect channel**
GDP growth	-	As a recession occurs, borrowers may face difficulties to maintain their debt obligations, therefore leading to a growing amount of NPLs
Interest rate	+	Interest rates increase debt burdens, therefore NPLs rise
Unemployment	+	Income disruptions lead to an inability to pay loan obligations
Exchange rate	+ or -	Depends on if debt obligations are foreign or domestic. Also, competitiveness affects if banks do business in foreign markets
Inflation	+ or -	May reduce the real value of loans or income of borrowers, also may affect unemployment as the Phillips curve suggests. Monetary policies may also have effects.

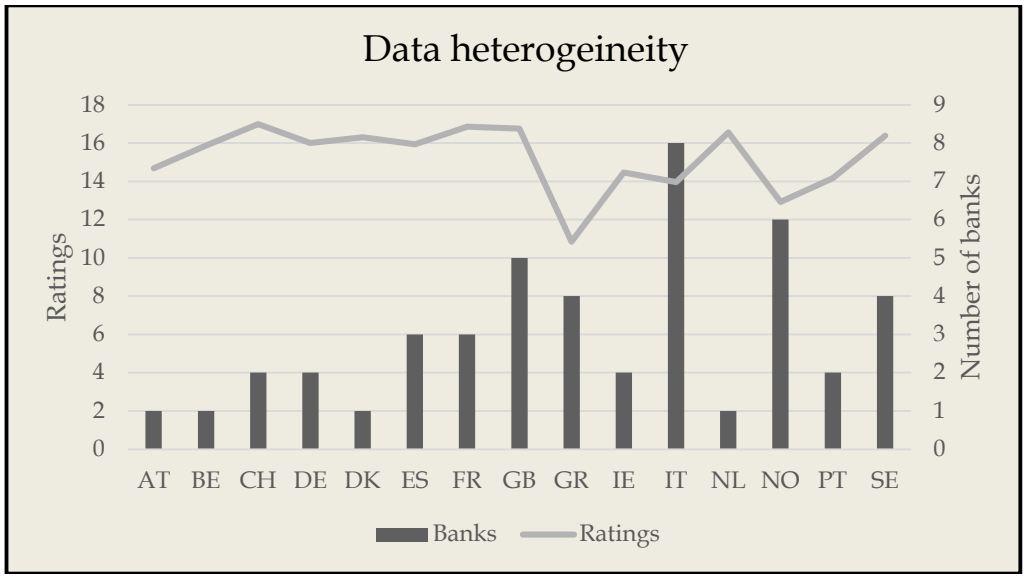
Even though these papers use the NPLs as a risk measurement, credit ratings provided by Fitch Ratings Inc. are used in the estimation to capture even larger effects discussed in the chapter 2.4.1. The regression model utilizes mostly the variables of Tables 3 and 4 with minor modifications due to data restrictions; the net loan ratio is also added (see, e.g. Chi & Li 2017 and He & Niu 2018). The following Table 5 describes the calculations for variables used in the regression model:

TABLE 5 A description of the variables

Variable and Definition
Credit risk Credit rating
Bank-Specific
Loan loss provisions - LLP/total assets
Net loan ratio - Net loans / total assets
Income ratio - Operating income / total assets
Leverage - Total liabilities / total assets
Capital ratio - Equity capital / total assets
Size - Natural log of total assets
Macroeconomic
EPU - Bloom, Baker, Davis (2016) index measure
GDP growth – Year-on-year growth rate of real gross domestic product, %
Inflation – Inflation rate, %
Interest rate – The real interest rate. The difference between the long-term interest rate and the inflation rate
Unemployment – Unemployment rate, %
Exchange rate – The real effective exchange rate

Full descriptive statistics of the variables are tabulated in the Appendix 4. The European countries are divided by market characteristics. The following Figure 12 illustrates heterogeneity between the country data (ratings are scaled as AAA = 20, AA+ = 19, AA = 18… see Appendix 2):

FIGURE 12 Heterogeneity of countries



Source(s): Thomson Reuters Datastream

As illustrated, the figure above shows the distribution of countries included in the panel data (the amount of banks in the data: AT = 1, BE = 1, CH = 2, DE = 2, DK =1, ES = 3, FR = 3, GB = 5, GR = 4, IE = 2, IT = 8, NL = 1, NO = 6, PT = 2, SE = 4). For comparison statistics, the data also contains European countries, which are not members of the EU. The observation distribution between countries is not identical in terms of the number of observation units in each country, which could lead to estimation bias, therefore indicating the need for further analyses of the estimation results. Due to heterogeneity of characteristics between countries observed, the countries are categorized by similarities in order to refine estimations. Bijlsma and Zwart (2013) used a principal component analysis (PCA) strategy followed by a cluster algorithm to categorize countries with similarities. In bank-based countries, banks are the largest operative financial intermediaries in the economy, allocating capital, savings and managing risks whereas in market-based countries, securities markets are more efficient in allocating capital. Ireland is controlled for being an outlier in terms of having a considerably large banking sector and credit amounts and Switzerland and Norway for being comparison countries against EU membership.

Bank-based countries – Austria (AT), Denmark (DK), Germany (DE), Greece (GR), Italy (IT), Portugal (PT), and Spain (ES)
Market-based countries - The Netherlands (NL), the United Kingdom (GB), Belgium (BE), France (FR), and Sweden (SE)
Outliers – Ireland (IE)
Others – Switzerland (CH), and Norway (NO)

Greece, Italy, Portugal, Spain and Ireland are categorized as a part of PIIGS-countries due to turbulences in their economies during the crisis period, indicating further estimation interferences at least in the bank-based group. Because the data is composed of countries whose distribution weights the crisis countries, to fully understand the dynamics, the assumed effect of the PIIGS countries should be distinguished in the estimation. Therefore, the PIIGS countries are also tested separately in addition to comparison between the bank-based and the market-based countries. Further, the data allows to explore effects on banks' ratings in countries that are not members of the EU (Switzerland, Norway) and those countries that have not adopted the euro as a currency (Switzerland, Denmark, Norway, United Kingdom, Sweden).

3.2 Methodology

3.2.1 Panel data

In econometrics and statistics, panel data combines the characteristics of cross-section and time-series data; individual, cross-sectional units, are observed

through multiple variables and time. A panel data analysis provides tools for more complex methods in observing effects not necessarily detectable compared to a cross-section and time-series analysis alone. The panel data methods propose three different approaches:

- **Independently pooled panels** (excludes the characteristics of individuals and universal effects)
- **Fixed effects models** (unit-specific attributes exist, which are not correlated with regressors)
- **Random effects models** (unit-specific attributes are time-invariant)

Usually, we would want to study the dynamics and effects between specific variables and dependent variables; therefore, the effects of individual attributes should be excluded from the regression. This can be achieved by taking the first difference and introducing lagged dependent variables into the regression equation, such as in Arellano and Bond (1991) who propose a GMM estimator, which provides a solution to this problem. In a case of fixed and random effects models, this however leads to inconsistencies and estimation bias as the lagged variables are necessarily correlated with the disturbance. Due to the data size, the time period (=16) compared to the observed unit (=45) size causes a proliferation of instruments in dynamic GMM-models, which causes estimation bias, therefore the use of other estimators is recommended. The fixed effects estimator (=within) eliminates individual effects by demeaning variables utilizing the within transformation, while random effects eliminate this effect by differencing the variables. The Hausman test is used to decide within estimator to study the economic policy uncertainty effects on credit ratings (Hausman 1978). The methodology section, tests for robust estimates and mathematical notations follow the instructions of Croissant and Millo (2008). Based on the Hausman test and the data section, the FE regression model is presented next.

3.2.2 The FE regression model and testing for estimation bias

To test the hypotheses the following model is proposed:

$$\begin{aligned} Credit\ rating_{it} = {} & \beta_1 EPU_{jt} + \beta_2 Loan\ loss\ provisions_{it} + \beta_3 Net\ loan\ ratio_{it} \\ & + \beta_4 Income_{it} + \beta_5 Leverage_{it} + \beta_6 Capital\ ratio_{it} \\ & + \beta_7 GDP\ growth_{jt} + \beta_8 Inflation_{jt} + \beta_9 Real\ interest\ rate_{jt} \\ & + \beta_{10} Unemployment_{jt} + \beta_{11} Exchange\ rate_{jt} + \alpha_i + \varepsilon_{it}, \end{aligned} \quad (1)$$

$t = 1, \ldots, T$, $i = 1, \ldots, N$, and where j reflects a specific country. A variable δ_t could be added to control for the time fixed effects. The derivation of the within estimator is provided in the Appendix 5.

Panel data estimations require the identification of possible bias concerning estimator fit, unobserved effects, variable suitability and the correlations between observations and residuals. Several tests are applied for appropriate and robust results as proposed by Croissant and Millo (2008). Firstly, as in the banking sector of the EU, banks and countries can be seen to be interconnected due to the union integration, it is assumable for example, that changes in the balance sheets of observed banks (individuals) have effects on assets of the other observed banks (cross-sectional dependence), thus individuals are not independent, suggesting bias in the long observation periods. The Breusch-Pagan (LM) Lagrange Multiplier (Breusch & Pagan 1980) and Pesaran (2004) CD tests are used to test for certain types of cross-sectional dependencies. The LM test provides results of a global dependency whereas the Pesaran CD test compares observations to neighbouring individuals. A scaled version of the LM test (SCLM) is used, as it is more accurate as n > t.

$$SCLM = \sqrt{\frac{1}{n(n-1)}}\left(\sum_{i=1}^{n-1}\sum_{j=i+1}^{n} T_{ij}\,\hat{\rho}_{ij}^{2} - 1\right) \tag{2}$$

where the correlation coefficient is defined as

$$\hat{\rho}_{ij} = \frac{\sum_{t=1}^{T}\hat{\varepsilon}_{it}\,\hat{\varepsilon}_{jt}}{(\sum_{t=1}^{T}\hat{\varepsilon}_{it}^{2})^{1/2}(\sum_{t=1}^{T}\hat{\varepsilon}_{jt}^{2})^{1/2}}$$

and j = observed explanatory variables.
In the CD test, if assumed that the neighbours are specified as $(p+1)$ and $(p-1)$, then

$$CD = \sqrt{\frac{1}{\sum_{i=1}^{n-1}\sum_{j=i+1}^{n} w(p)_{ij}}}\left(\sum_{i=1}^{n-1}\sum_{j=i+1}^{n} [w(p)]_{ij}\sqrt{T_{ij}}\hat{\rho}_{ij}\right) \tag{3}$$

where $[w(p)]_{ij}$ is a p-th order proximity matrix. See Pesaran (2004) for more details.

Secondly, the model is tested for heteroscedasticity. The heteroscedasticity refers to a situation where the variability or variance of variables are not equal, or constant over the observation period, meaning that as the dependent variable y increases, the overall variance increases or decreases. The OLS regression is still unbiased in the presence of heteroscedasticity, but an underestimation of variance and covariance may result into inefficiencies. The Breusch-Pagan LM (see, e.g. Woolridge 2013) is used for testing heteroscedasticities. Simply, the variance can be represented as

$$\sigma_i^2 = \delta_0 + \delta_1 X_{i1} + \ldots + \delta_k X_{ik}$$

Homoscedasticity is assumed with a null hypothesis

$$H_0: \delta_1 = \ldots = \delta_k = 0$$

An LM-test for testing heteroscedasticity can be calculated as $n\ x\ R^2 \sim X^2$, where n is the number of individuals, R^2 is the goodness of fit and X^2 is the chi-squared distribution. R^2 (the coefficient of determination) is simply the variance of a dependent variable than can be explained with independent variables. Thirdly, R^2 is further utilized to calculate variance inflation factor (VIF) values for multicollinearity.

$$VIF_i = \frac{1}{1 - R_i^2} \tag{4}$$

The VIF values being < 4 for every model variable. The values indicate how much the variance of a regression is affected due to collinearity (see, e.g. Woolridge 2013); in other words, how much independent variables are correlated. All values below 5 are desirable for estimations.

Fourthly, serial correlation, or autocorrelation suggests that observations of a given period are dependent on previous observation periods, thus not random. This causes problems in common estimation techniques if errors are correlated. If for example, earlier observations are overestimated, they might affect estimations over the following periods. The serial correlation Breusch-Godfrey test (see, e.g. Asteriou & Hall 2011) is similar to the BP test:

$$\varepsilon_t = \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \ldots + \rho_q \varepsilon_{t-q} + v_t$$

with a null hypothesis

$$H_0: \rho_1 = \ldots = \rho_q = 0$$

Applying the above tests, global cross-sectional dependence, heteroscedasticity and serial correlation are found to affect further estimations of the FE model. As suggested by Hoechle (2007), robust standard errors by Driscoll and Kraay (1998) are used to correct these estimations. Their work is based on Newey-West (1987) standard errors correcting heteroscedasticity and autocorrelation with taking cross-sectional dependence in consideration. According to Hoechle, the Driscoll-Kraay outperforms the Newey-West when the cross-sectional dependence is a concern in the estimation. The existence of the cross-sectional dependence exposes to estimation inefficiencies, which commonly applied covariance matrix estimation techniques are not able to solve, exposing to estimation bias. Driscoll and Kraay propose a nonparametric covariance matrix which yields robust

standard errors in the presence of heteroscedasticity and autocorrelation with common forms of cross-sectional dependence.

3.2.3 Fixed effects with Driscoll-Kraay standard errors

Regression variables are demeaned with the following specification (Hoechle 2007), where z represents all the variables in within estimation:

$$\tilde{z}_{it} = z_{it} - \bar{z}_i + \bar{\bar{z}}, \qquad \bar{z}_i = \frac{1}{T}\sum_{t=1}^{T} z_{it}\,, \qquad \bar{\bar{z}} = (\sum T_i)^{-1} \sum_i \sum_t z_{it} \tag{5}$$

then apply OLS for

$$\tilde{y}_{it} = \tilde{x}'_{it}\beta + \tilde{\varepsilon}_{it}$$

where

$$\hat{\beta}_{OLS} = (X'X)^{-1}X'Y \tag{6}$$

and X and Y are stacked observations of x and y.

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \text{ and } \quad X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1k} \\ x_{12} & x_{22} & & x_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nk} \end{bmatrix}$$

Driscoll-Kraay standard errors are square roots of diagonal elements of the robust covariance matrix

$$V(\hat{\beta}) = (X'X)^{-1}\hat{S}_T(X'X)^{-1} \tag{7}$$

where $\hat{\mathrm{S}}_T$ is based on the Newey-West (1987) model

$$\hat{\mathrm{S}}_T = \widehat{\Omega}_0 + \sum_{j=i}^{m(T)} w(m,j)\,\widehat{\Omega}_j + \widehat{\Omega}'_j$$

where m(t) defines the autocorrelation allowing lag length and Bartlett weights $w(j,m)$ are utilized to ensure semidefiniteness of $\hat{\mathrm{S}}_T$ with the following specification

$$w(j,m) = 1 - j/\{m(T) + 1\}$$

and $\widehat{\Omega}_j$ is a (K + 1)(K+1) matrix

$$\widehat{\Omega}_j = \sum_{t=j+1}^{T} h_t(\hat{\beta})\, h_{t-j}(\hat{\beta})' \,, \qquad \mathrm{h}_j(\hat{\beta}) = \sum_{i=1}^{N(t)} h_{it}(\hat{\beta})$$

The individual orthogonality functions are

$$h_{it}(\hat{\beta}) = x_{it}\hat{\varepsilon}_{it} = x_{it}(y_{it} - x_{it}'\hat{\beta})$$

The usage of cross-sectional averages allows standard errors to be consistent and independent despite the cross-sectional dimension.

4 RESULTS AND ANALYSIS

The Breusch-Pagan BP test (1980), introduced in the last chapter is used to test "individual" and "time" effects to determine between "individual" or "twoways" within models. The time effects are found to be insignificant whereas the individual effects are statistically significant. The within model is therefore specified with an individual demeaning, but also "twoways" (with both the individual and time-fixed effects) model is calculated for a comparison as is expected that multiple regulation changes during the observation period affect the results of the estimation. By comparing the two models, it is possible to identify which of the effects are caused by aggregate trends in time. The model assumes homogenous responses towards uncertainty shocks across banks by also controlling for the time fixed effects. The results imply that controlling for the time effects greatly improves the goodness of fit of our model by removing aggregate trends.

TABLE 6 The results

The Within Model with the Driscoll-Kraay (1998) Robust Standard Errors

Unbalanced panel: n = 45, T = 16, N = 669
The effects on bank's credit rating
Estimate
(Std. error)

Variables and their coefficients	"Individual"	"Twoways"
EPU	-0.0066831 ***	-0.0024040
	(0.0009779)	(0.0016531)
Loan loss provisions	-0.2556315	-0.1391167
	(0.2582292)	(0.2307975)
Net loan ratio	-0.0155094 **	-0.0132145 *
	(0.0054721)	(0.0058060)
Income ratio	0.5636312 *	0.5755448 **
	(0.2231716)	(0.1940696)
Leverage	12.5862018 *	5.5521014
	(5.5809809)	(6.2174318)
Capital ratio	0.0389669	0.0437594 .
	(0.0243908)	(0.0237859)
log(Total assets)	0.1721145	1.1013946 **
	(0.1996961)	(0.3367547)
GDP growth	-0.0587160 .	-0.0142779
	(0.0314701)	(0.0364126)
Inflation	0.2157774 .	0.1039018
	(0.1127344)	0.1039018

(continues)

TABLE 6 (continues)

Real interest rate	0.0533702 *	-0.0029453
	(0.0265172)	(0.0255256)
Unemployment	-0.2660251 ***	-0.2210694 ***
	(0.0318075)	(0.0267708)
Exchange rate	-0.0042464	0.0055478
	(0.0077114)	(0.0109269)
Signif. codes: 0 '***' 0.001 '**' 0.01 '*'0.05 '.' 0.1 ' '' 1'*'		
Model summary	**"Individual"**	**"Twoways"**
Total Sum of Squares	1926.1	1352.8
Residual Sum of Squares	982.99	891.52
R-Squared	0.48965	0.87641
Adj. R-Squared	0.44295	0.87431
F-statistics	p-value: < 2.22e-16	p-value: < 2.22e-16

Residuals

Residuals (individual)

Min.	1st Qu.	Median	3rd Qu.	Max.
-7.7101634	-0.6049784	0.0096841	0.6304609	9.3400067

Residuals (twoways)

Min.	1st Qu.	Median	3rd Qu.	Max.
-7.864244	-0.584226	-0.029246	0.589583	9.710375

Time-fixed effects "Twoways"

2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
-9.7107	-9.5278	-9.8667	-9.9349	-10.3186	-10.6248	-10.7667	-10.3216
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
-10.3880	-10.3316	-10.4670	10.9400	-11.2112	-11.3527	-11.3204	-11.5832

A group-specific table (market-based, bank-based, the Eurozone) is provided in the Appendix 6. Bank-level income ratio and country-specific unemployment are statistically significant in both models, while the effect of EPU is reduced as time effects are fixed. The results imply that depending on a country and the method, on average from 2007 to 2015 increased values of EPU explain around one grade change in banks' credit ratings and a change as large as the Brexit induced uncertainty spike (measured from BBD European index) could indicate of around a 0.5-1.8 rating downgrade in the EU area.

Within the Eurozone, banks' credit ratings are negatively and significantly associated ("twoways", bank-based . , market-based*) with the rising amount of economic policy uncertainty in the both models at least within a 95% confidence interval, except for bank ratings in the bank-based countries in the "individual" FE model, which might be explained by a strong bank sector performance before the 2007 crisis, so H_1 is not rejected. It should be highlighted that the significance of EPU in the market-based countries, especially in those that have adopted the euro as a currency, drops after controlling for the time fixed effects ("twoways"), suggesting that the significance depends on aggregate trends in time.

After the crisis and the implementation of Basel II, interestingly in Ireland, Norway, Switzerland, Denmark, the United Kingdom and Sweden the effect of EPU is found to be even positive, but not always significantly. For Ireland, a strong growth after the crisis lessens the impact of uncertainty whereas in Norway, Switzerland, the United Kingdom, Denmark and Sweden, local currencies seem to have reduced the adverse influence of European uncertainty and countries' banks have benefitted from the weakening of the euro. The finding suggests capital allocations from banks in Europe in times of economic stress into banks that are not heavily affected by the disruptions in the EU. This effect is higher for non-member countries Norway and Switzerland and slightly reduced for the EU countries the United Kingdom, Denmark and Sweden. H_3 is not rejected in terms that the European EPU does not weaken the banking sector in these five countries. This result leads to interesting questions related to the importance of currencies as uncertainty transmission channels. It seems also that the PIIGS countries are less affected by the EPU than others.

Overall, banks' ratings in the market-based countries are more affected by EPU shocks than in the bank-based countries as hypothesized, so H_2 is not rejected either. Banks in the bank-based countries are also less vulnerable to changes in the macroeconomic factors after Basel II; as significant change is not observed within the market-based countries due to the agreement. The results also show that the banks in the bank-based countries are less vulnerable to changes in macroeconomic conditions than banks in the market-based countries. After Basel II, net loan ratio also loses its significance in both the market and bank-based countries, suggesting that the minimum capital requirements introduced in the agreement have reduced the importance of loan ratios in determining overall credit ratings. The overall results are listed in the following Table 7 with literature comparisons + or -.

TABLE 7 A comparison of the results

The effects on bank's credit rating (positive + or negative -)		
Variable	**Results**	**Related literature**
EPU	-	-
Loan loss provisions	-	-
Net loan ratio	+	+

(continues)

TABLE 7 (continues)

Income ratio	+	+
Leverage	+	-
Capital ratio	+	+
log(Total assets)	+	+
GDP growth	-	+
Inflation	+	+ or -
Interest rate	+ or -	-
Unemployment	-	-
Exchange rate	+ or -	+ or -

The results for the other variables are compatible with Chaibi and Ftiti (2015), except for GDP growth, which seems controversial related to the existing literature, where the GDP growth is predicted to have a positive sign (+). If the data is sub-grouped to periods of before and after Basel II (2008), the data implies that the GDP growth has a positive impact on banks' credit ratings before 2008, such as expected, but negative after. The finding is not explained by observing the PIIGS and non-PIIGS countries separately, therefore the phenomenon applies to the whole European observation group. Chi and Li (2017) observed similar results with the same time period (with NPLs), in the Chinese banking sector.

The EU has, experienced a period after the 2007 crisis where growth and bank's credit ratings have decreased simultaneously, which could explain the correlation. A controversial result might also suggest that the GDP growth accelerates risk-taking in the period after recessions, to cover for earlier losses or tell something about the allocation of capital between countries after 2008 affecting growth. Another interesting point is that leverage has a positive sign (+). In the non-PIIGS countries, leverage is negatively associated with banks' credit ratings during before and after 2008, but in the PIIGS countries, the association is observed to be positive in the same observation period. Chaibi and Ftiti (2015) assumed that the positive relationship between leverage and credit ratings could indicate that leverage is not a significant factor for credit risk approximations. They also noted that the real interest rate increases non-performing loans ratios (a credit risk measurement) as interests increase debt burdens. However, the results show a positive relation between credit ratings and the real interest rate. This opposite effect is most likely explained by the fact that interest rates increase banks' net interest margins, thus improving the creditworthiness of the banks.

EU membership indicates greater banks' ratings in the sample. Supposedly, joining the EU will increase bank's credit ratings as liquidity increases due to a support from the central bank and financial options diverse considering accessibility to the EU internal market. On the contrary, the EU membership implies a partial responsibility for the functioning of the system and thus obliges itself to take a responsibility for the financial disturbances of other countries if necessary, suggesting a higher influence of uncertainty in the member countries. As anticipated, the member countries are more affected by European EPU than the non-

members (NO, CH), reinforcing conceptions about disruptions that elevate concerns regarding economic policies inside the EU borders to cover the whole banking sector in the union.

As the BBD EPU index does not behave similar as other uncertainty indexes, the model is also tested for a uncertainty measure validity; the VSTOXX50 index is used as a point of comparison. Compared to the VSTOXX50 index, the EPU index is found to be more significant and has more predictive power in this model in terms of banks' credit ratings, but results are in line, therefore the estimations hold. For policy recommendations, the overall results of the estimations are compatible with Chi and Li (2017) and He & Niu (2018) with policy related uncertainty significantly increasing banks' credit risks, reducing loan sizes and the negative effects of EPU may be counteracted by banks via increasing capital and reducing loan sizes and by interest rate relating monetary policies executed by the central bank. Further, the data suggests that after Basel II, the effect of the real interest rates on bank ratings has shown to largely grown, making interest rate related policies of the central bank even more effective. The results also provide insight of the characteristics of countries that greatly influence the ratings and the effect of EPU. Both, being a member of the EU and being a market-based economy significantly increases ratings (over one grade change), but both attributes also increase the effect of EPU on the ratings.

5 CONCLUSIONS

In recent times, the area of the EU has experienced large disturbances in the economy in forms of two major crises, the Great Recession and the Eurozone Crisis and other issues related to politics and global concerns, which have caused the level of economic policy uncertainty to rise. Turbulences or concerns in the economy causes policymakers to react in terms of economic policies. When the impacts of these economic issues or reactions cannot be forecasted, then the level of economic policy uncertainty rises (EPU), which can for example, be seen from a rising number of headlines of newspapers regarding economic policies or from financial markets in terms of option implied volatilities.

As uncertainties in markets grow, individuals, firms and other agents withdraw from investment related activities and begin to prepare for different scenarios, for example, in forms of discouraging individuals for taking mortgage loans, inhibiting firms' hiring activities, cutting other costs and creating capital buffers. This risk-averse behaviour channels through financial markets and financial intermediaries, and therefore the aim of this thesis is to capture the effect of how important the management of uncertainty is for the policymakers through the observation of bank sector risks and changes in banks' balance sheets, as banks provide a large proportion of financing in the economy for firms, individuals and other agents in the financial market.

In this thesis, as the overall uncertainty related investment rate drop reduces loan ratios of banks, reduced hiring activities increase unemployment, which predicts growing amount of non-performing loans (NPLs) decreasing banks' incomes, and the need for creating capital buffers decrease the capability of lending, it is hypothesized that EPU greatly affects the operative power and credit risk of banks. This hypothesis is confirmed by He and Niu (2018) in the United States and Chi and Li (2017) in the Chinese banking sector. As Europe and the EU have suffered from policy related issues severely regarding to financial and social concerns in the independent countries and from the recent major crises, the hypothesis testing is also applied for the EU. These issues contain themes such as the Brexit, accumulated debt burdens, weakened economic growth, unemployment, EU opposition, refugee and migration politics and the overall future of the EU.

A panel data estimation model with fixed effects and Driscoll-Kraay standard errors is derived and tested to estimate robust results with data including 45 European banks from a period of 2000-2015. The within estimator is then applied to test the significance of European economic policy uncertainty on bank's credit ratings in the EU. The results show that the European EPU has significant negative effects on the banks' credit ratings in the EU area for market and bank-based countries in the whole observation period, but not for European countries outside the Eurozone. Also, protective properties of a local currency against the European uncertainty is found, suggesting that the integration of Europe increases

uncertainty transmission at least in the banking sector. This does not imply that the union participation weakens the banking sector as the EU membership indicates higher credit ratings for banks. Higher ratings are also found in the market-based economies. These two characteristics also however enhance the uncertainty effects. The results also indicate that the harmful effects of uncertainty on ratings may be reduced by banks via increasing capital and reducing loan sizes or via interest rate relating monetary policies executed by the central bank. While the results suggest that the real interest rate has significant effects, the direction (+ or -) is not always certain, implying that the interest rate related policy effects on uncertainty depend on the economic cycles (a higher interest rate is frequently related with growth, while lowering rates to zero encourages investing in real options). When time fixed effects are introduced, this effect is always negative, which supports the findings of Bekaert et al. (2013), indicating looser monetary policies to lower interest rates during uncertainty periods.

Based on the results, it seems that monetary integration might worsen the effects of uncertainty in Europe as banks inside the Eurozone are more affected than other countries in the data. Uncertainty channels through a common currency, markets and the banking system and thus has capabilities to weaken the economic competence of the whole area. Therefore, when the level of uncertainty increases, the EU institutions and the ECB should provide transparent information about the future course of the economy in order to reduce the spreading of uncertainty effects. Due to its significance, the ECB and other EU legislative institutions should include stricter frameworks towards uncertainty related instability which emphasize proactivity in forecasting different possible and unexpected events in the EU. For example, because of the nonexistence of EU resignation guidelines, the prolonged Brexit negotiations have created unnecessary uncertainty in Europe, not forgetting the debt crisis.

In addition to transparency, forward guidance and inflation targeting as tools in reducing uncertainty (Jitmaneeroj et al. 2019), the ECB may also offer liquidity assistance in order to lower the uncertainty effects on banks' balance sheets as the uncertainty induces liquidity rebalancing (Berger et al. 2018). The results might also indicate that further regulation of securities markets might reduce the effects of uncertainty on banks' credit ratings in turbulent times as banks in market-based countries are more affected by increased uncertainty than banks in bank-based countries. Capital requirements related regulation especially may be utilized in fighting the uncertainty (Gulen & Ion 2013) as banks already seem to prepare for the uncertainty by increasing their reserves.

For further research, the impact on the recent Eastern European countries in the EU is suggested as the estimation model of this thesis suffers from data limitations. It also might be interesting to identify the spill-over effects between different monetary regimes, which based on this study might be small or insignificant, but harder to capture with the EPU index as indices between regimes are very similar. The importance of uncertainty as a transmission mechanism, for example, growing European debt related uncertainty on banks' credit ratings, is

still a little studied topic as well as separating uncertainty and risk-aversion effects from each other as in paper from Bekaert et al. (2013). The results also suggest a relation between the euro and the magnitude of uncertainty effects in Europe, which could be a relevant research topic. Economic policy uncertainty may also be decomposed, for example, to monetary policy uncertainty, regulatory uncertainty or fiscal policy uncertainty, however, such indices are not currently freely available for Europe. These notes are left for future work.

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APPENDIX 1

A summary of thesis' related literature in the order of appearance

Author(s)	Year	Topic	Data	Findings
Bloom	**2009**	Uncertainty effects	US Firm level data 1963-2005	Decreased investment and hiring, increased unemployment
Gourio et al.	**2016**	Uncertainty and capital	US state level data 1982-2014	Increased capital inflow, decreased capital outflow
Bekaert et al.	**2013**	Uncertainty, monetary policy and risk-aversion	1990-2010 VIX & FED rates	Uncertainty leads to higher risk-aversion and looser monetary policy
Ulrich	**2012**	Uncertainty, policies, implied volatility	1994-2010 US data	Uncertainty explains interest rate and bond option implied volatilities
Jitmaneeroj et al.	**2019**	Uncertainty, central bank forward guidance, inflation targeting, transparency.	1989-2013, 25 economies, G7, Europe & Asia Pacific	Inflation targeting having the largest impact on uncertainty
Chi & Li	**2017**	Uncertainty and banks' credit risk	Chinese banks 2000-2014, 1297 observations	Decreased loan sizes
Gulen & Ion	**2013**	Uncertainty and cash holdings	1987-2011, U.S. firm level data	Increased capital buffers
Valencia	**2016**	Uncertainty and bank leverage	U.S. commercial banks 1995-2005	Higher capital-to-assets ratios
He & Niu	**2018**	Uncertainty and bank valuations	U.S. banks 1990-2015	Lower bank valuations
Gong, Jiang et al.	**2018**	Uncertainty and bank loans	19 major economies 2000-2015	Higher loan risk premiums and decreased loan availability
Berger et al.	**2018**	Uncertainty and bank liquidity hoarding	US commercial banks 1985-2016	Uncertainty causes bank liquidity rebalancing
Tao & Xu	**2019**	Uncertainty and banks' credit scale	142 Chinese commercial banks 2007-2016	Uncertainty reduces banks' credit scales

APPENDIX 2

In this thesis, credit ratings are scaled to ease the estimations:

Credit rating	Scaled value
Investment grade	
AAA	20
AA+	19
AA	18
AA-	17
A+	16
A	15
A-	14
BBB+	13
BBB	12
BBB-	11
Non-investment grade	
BB+	10
BB	9
BB-	8
B+	7
B	6
B-	5
CCC	4
CC	3
C	2
RD	1

APPENDIX 3

Klieštik and Cúg lists the following models used in the literature for determining credit risk in their historical order:

Model	Model description
1. Structural models (first-generation)	- Assume firm credit losses and recovery rate (RR) to be endogenous, Probability of default (PD) and RR are negatively correlated - Structural models refer to capital structure - Default occurs as the capital level drops below a threshold, where debt obligations are not manageable
2. Structural models (second-generation)	- Similarity to first-generation models, but assume RR to be exogenous and defined as a ratio of the outstanding debt value; not related to PD
3. Reduced form models	- Default is an exogenous variable - Either based on intensity or credit migration - Defaults occur randomly in time - RR is either constant or stochastic; not related to PD
4. Hybrid models	- A combination of structural and reduced form models
5. Latest models emphasizing PD-RD relationship	- Systematic risk affects both stochastic variables PD and RR, which are inversely related
6. Value at risk models	- Have become more common after Basel II - Loss given default (LGD) either stochastic or constant - PD and RD not related

APPENDIX 4

Descriptive statistics of the data (variance and std. dev are calculated by omitting NAs)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Variance	Std. dev	NAs
Credit rating	1.00	14.00	15.00	14.82	17.00	20.00	10.03	3.17	0
EPU	37.60	84.96	107.40	116.80	138.68	279.15	1702.45	41.26	3
Loan loss provisions	-0.18	0.10	0.27	0.43	0.51	3.88	0.28	0.54	23
Net loan ratio	10.94	53.93	64.95	62.27	75.31	92.59	321.04	17.92	11
Income ratio	-2.41	0.36	0.67	0.61	1.00	2.62	0.43	0.65	9
Leverage	0.85	0.93	0.94	0.94	0.96	1.04	0.00	0.22	0
Capital ratio	5.06	12.69	19.60	21.12	28.39	56.81	105.90	10.29	6
log(Total assets)	13.95	17.79	19.35	19.17	20.78	22.58	3.36	1.83	0
GDP growth	-9.13	0.45	1.69	1.41	2.93	25.56	8.37	2.89	0
Inflation	-4.48	1.10	2.05	1.88	2.79	5.56	1.73	1.31	0
Interest rate	-5.63	1.8	3.34	3.37	4.84	10.58	8.96	2.99	20
Unemployment	2.12	4.75	7.54	8.05	9.43	27.47	22.34	4.73	0
Exchange rate	81.88	97.15	100.00	101.10	103.44	130.92	66.1	8.13	0

APPENDIX 5

The fixed effects estimator β_{FE} can be derived from a basic linear static model:

$$y_{it} = X_{it}\beta + \alpha_i + \varepsilon_{it}\,, \qquad t = 1, \ldots., T\,, i = 1, \ldots., N$$

where y_{it} is the dependent variable, X_{it} is the time-variant 1 x k regressor matrix, α_i unobserved time-invariant individual effect and ε_{it} is the error term. t is the time period in the T time horizon, whereas i refers to the observed unit in the N sized observation sample. In the next equation, regression is demeaned

$$(y_{it} - \bar{y}_i) = (X_{it} - \bar{X}_i)\beta + (\alpha_i - \bar{\alpha}_i) + (\varepsilon_{it} - \bar{\varepsilon}_\iota), \qquad t = 1, \ldots., T\,, i = 1, \ldots..N$$

by subtracting observations by their averages

$$\bar{X}_\iota = \frac{1}{T}\sum_{t=1}^{T} X_{it}\,, \bar{\varepsilon}_\iota = \frac{1}{T}\sum_{t=1}^{T} \varepsilon_{it}$$

The demeaning eliminates the individual effect (heterogeneity), which is necessary to receive consistent estimates of X. Ordinary least squares (OLS) regression is then applied to receive the FE estimator $\hat{\beta}_{FE}$. The OLS is a regression estimator that minimizes the sum of residuals between the dependent variable and the linear model ($y - \beta_{OLS}X = \rightarrow 0$).

APPENDIX 6

This appendix provides key group-specific results similarly as in the Table 6 for both estimation models (coefficients of time-fixed effects at the end):

Variables and their coefficients on bank's credit rating

Model (1) = "Individual
Model (2) = "Twoways"
Estimate
(Std. error)

Countries	Bank-based		Market-based	
Model	**(1)**	**(2)**	**(1)**	**(2)**
EPU	**-0.0029548 .** (0.0017174)	**-0.0050813** (0.0051582)	**-0.0069525***** (0.0013121)	**-0.0038218*** (0.0015739)
Net loan ratio	0.0057856 (0.0056512)	0.0070134 (0.0055064)	-0.0126053 (0.0088099)	-0.0143709 (0.0091172)
Loan loss provisions ratio	-0.4788503 (0.3842941)	-0.2763765 (0.2641167)	0.9753501 (0.3493392)	0.5674238 (0.3574362)
Income ratio	0.7311300** (0.2287437)	0.8211766*** (0.1681945)	0.2420653 (0.1904762)	0.1140047 (0.2454620)
Leverage	5.6559479 (5.6431042)	1.7635585 (6.1710814)	66.688997*** (14.8604696)	56.2462324*** (13.6477487)
Capital ratio	0.0548218 . (0.0324520)	0.0543655 . 0.0320092	0.0057873 (0.0194150)	0.0102334 (0.0161754)
log(Total assets)	-0.0629105 (0.1929237)	0.6440938 (0.5204476)	-0.0396012 (0.3295187)	0.8872919 * (0.3610488)
GDP growth	-0.0507726 (0.0630481)	0.1164299 . (0.0702579)	0.0132364 (0.0261372)	-0.0020621 (0.0521556)
Inflation	0.2195527 (0.1663500)	0.3330682 (0.2082113)	0.0060803 (0.0409543)	-0.1496762 (0.0877890) .
Real interest rate	0.0533322 . (0.0290378)	-0.0076444 (0.0350066)	-0.0751660 (0.0878119)	-0.1949584 * (0.0898240)
Unemployment	-0.2347580*** (0.0428068)	-0.1616237*** (0.0244670)	-0.1285562* (0.0618075)	0.0691990 (0.0782369)
Exchange rate	-0.0122533 (0.0194823)	0.0306890 (0.0397683)	-0.0113752 (0.0084925)	0.0178772 (0.0153900)
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Variables and their coefficients on bank's credit rating

Model (1) = "Individual
Model (2) = "Twoways"
Estimate
(Std. error)

Countries	**Eurozone**		**Non-Eurozone**	
Model	**(1)**	**(2)**	**(1)**	**(2)**
EPU	**-0.0056145**** (0.0017053)	**-0.0056145**** (0.0017053)	**-0.00062143** (0.00177565)	**0.0056820** (0.0049922)
Net loan ratio	0.0076411 (0.0074298)	0.0076411 (0.0074298)	-0.03935578** (0.01441011)	-0.0451017** (0.0139334)
Loan loss provisions ratio	-0.4229282 (0.3494169)	-0.4229282 (0.3494169)	1.37287723* (0.65748320)	1.2436799 (0.8343139)
Income ratio	0.7221699** (0.2358782)	0.7221699** (0.2358782)	0.11632615 (0.20851678)	-0.1294760 (0.3251626)
Leverage	9.3403060* (4.0296809)	9.3403060* (4.0296809)	27.72383417*** (7.45889343)	25.4631812** (9.3865700)
Capital ratio	0.0213254 (0.0147599)	0.0213254 (0.0147599)	0.04433060 (0.03200491)	0.0473566 (0.0305573)
log(Total assets)	-0.1314855 (0.2561613)	-0.1314855 (0.2561613)	-0.15435467 (0.31419490)	0.3032209 (0.4685070)
GDP growth	-0.0588524 (0.0448495)	-0.0588524 (0.0448495)	0.05539838* (0.02407830)	-0.0083119 (0.0363154)
Inflation	0.2020686 (0.1374244)	0.2020686 (0.1374244)	0.03538516 (0.06257985)	0.1058470 (0.1257070)
Real interest rate	0.0568341 (0.0720540)	0.0568341 (0.0720540)	0.00983548 (0.02273205)	-0.0050035 (0.0241345)
Unemployment	-0.2428052*** (0.0362051)	-0.2428052*** (0.0362051)	-0.32126715** (0.11116876)	-0.2450485 . (0.0362051)
Exchange rate	0.0544704 ** (0.0208936)	0.1203223 . (0.0641785)	-0.01714577. (0.01032128)	0.0017619 (0.0153575)
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

*NOTE: If Ireland is excluded from the Eurozone, then the impact of EPU would be -0.0099357 *** (0.0023967) in the Model (2).

Here is provided the time-fixed effects for every group:

Time-fixed effects for every sub-group

Model (2) "Twoways"

Bank-based time-fixed effects							
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
-3.1329	-2.8423	-3.2085	-3.5762	-3.9318	-4.2184	-4.6179	-3.6660
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
-3.7373	-2.1099	-3.0995	-3.3656	-3.4692	-3.5172	-3.6906	-3.8409

Market-based time-fixed effects							
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
-54.968	-54.846	-54.909	-55.416	-56.026	-56.147	-56.165	-56.158
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
-55.661	-56.565	-56.438	-56.551	-56.862	-57.207	-56.844	-57.115

Eurozone time-fixed effects							
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
-21.975	-21.663	-22.172	-22.814	-23.503	-23.733	-24.113	-23.664
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
-23.266	23.414	-23.187	-23.284	-23.944	-24.430	-24.678	-24.801

Non-Eurozone time-fixed effects							
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
-11.783	-12.315	-12.578	-12.610	-12.586	-12.602	-12.574	-13.051
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
-13.720	-13.252	-13.198	-13.822	-13.047	-13.157	-13.055	-12.863