Erasmus University Rotterdam
Erasmus School of Economics
MSc Strategy Economics

The Interplay of Economic Policy Uncertainty, Globalization, and Innovation: The Moderating Effect of the Multi-Dimensional view of Globalization.

Dominique van Slooten
Student Number, 472866

Supervisor: Jolanda Hessels
Second Assessor: Marius Hees

Date final version: 09/01/2023

Abstract

The main aim of this study is to investigate how the innovative performance of a country is affected by economic policy uncertainty and globalization. Economic policy uncertainty refers to a risk that originates from unpredictable regulatory changes that create market volatility, affect the economic ecosystem, and have an influence on a company's decision-making (Baker et al., 2016; Goodell, 2020; Al-Thaqeb & Algharabali, 2019). More specifically, this study identifies whether living in a more socially-, politically- or economically globalized environment can moderate the effect of economic policy uncertainty on innovation. An answer to this research question will be found through an extensive cross-country fixed effects analysis on 25 countries, over a sample period ranging from 1997 to 2015. The main dependent variable in this study is innovation, which is measured at country level. This study has identified five innovation variables to be investigated: Research and development (R&D) expenditure, national patent applications, national trademark applications, patents granted at the European Patent Office (EPO) and patents granted at the United States Patent and Trademark Office (USPTO). The present study's results are relevant in the context of national economic growth and sustainable development, as innovation capacity plays a crucial role in both (Tajaddini and Gholipour, 2021). A key finding of this study is that an increase in the economic policy uncertainty within a country is negatively related to the innovative performance of that country, when defined by the number of national patent- and trademark applications. Moreover, this paper concludes that there is little moderating effect of globalization on the relationship between economic policy uncertainty and innovation apparent. The only conclusive result was a negatively moderating effect of social globalization on the positive relationship between economic policy uncertainty and patent grants, when regressed against the patents granted at the United States Patent and Trademark Office (USPTO).

Table of Content

1. Introduction

Economic policy uncertainty refers to a risk that is associated with the unpredictability in the development of regulatory-, monetary-, and fiscal regulations (Al-Thaqeb & Algharabali, 2019). Economic policy uncertainty is a subset of economic uncertainty, which has the potential to create market volatility and can affect the economic ecosystem. Economic policy uncertainty emanates from a wide range of events that challenge the status quo (Al-Thaqeb & Algharabali, 2019). Several major events, such as the global financial crisis, the Russian annexation of Crimea, the election of Donald trump, the refugee crisis, and the Brexit have heightened the intensity of these economic policy uncertainties the past decade (Al-Thaqeb & Algharabali, 2019). The Brexit, for instance, caused uncertainty on how the relation between Europe and the UK would develop, on how economic policies would change and on how the future of the Euro would evolve (Al-Thaqeb & Algharabali, 2019). The spike in economic policy uncertainty the past decade has led to an increased interested in research on the impact of economic policy uncertainty (Julio and Yook 2012; Gulen and Ion 2016; Tajaddini & Gholipour, 2021; William & Fengrong, 2022). Uncertainty in the timing or the content of a regulatory-, monetary-, or fiscal policy poses a significant amount of uncertainty on a firm and has the potential to create market volatility and has far-reaching economic consequences. (Gulen & Ion, 2016).

The first studies that investigated the impact of economic policy uncertainty appeared in the end of the 20th century and were primarily focused on macroeconomic factors (Bernanke, 1983). A shift to analyzing the effect of economic policy uncertainty on variables related to firm performance was visible in the beginning of the 21st century ((Bloom, 2014). This movement was initiated by the recession in 2008, an increase in the amount of uncertainty measures and the emergence of more complex computer powered economic models that can incorporate uncertainty shocks (Bloom, 2014). It was found that economic policy uncertainty has a far-ranging effect on firm-related decisions such as investments, cash-holdings, mergers and acquisitions or innovation (e.g. Gulen & Ion, 2016; Phan et al., 2019; Bonaime et al., 2018).

Economic policy uncertainty could theoretically be both positively and negatively related to economic policy uncertainty (Tajaddini & Gholipour, 2021). As stated by real option theory, it is beneficial for a firm to delay a costly decision, to wait for additional information to become available (Bernanke, 1983; Greenland et al., 2019; Bloom et al., 2007). Innovation is an inherently risky- and uncertain process that requires an irreversible upfront investment, causing the returns to be riskier than most other investments (Gentry & Hubbard, 2000; Hall, 2002). Simultaneously, however, not all firms have the ability to postpone an investment, as this might be a costly decision when firms are competing for a patent (Bloom, 2014). According to strategic growth theory, early investments are commonly associated with greater returns in the future (van Vo and Le, 2017). Therefore, a firm can seize growth opportunities by investing early and acquiring an early mover advantage (van Vo and Le, 2017).

To our knowledge, there are only two papers assessing the impact of the overall economic policy uncertainty on innovation (Tajaddini & Gholipour, 2021; William & Fengrong, 2022). Tajaddini and Gholipour (2021) examined the cross-country impact of economic policy uncertainty on innovation, using the economic policy uncertainty index (BBD) as constructed by Baker, Bloom and Davis (2016). They used a sample of 19 countries spread around the world, selected based on the data availability on economic policy uncertainty. In line with real option theory, Tajaddini and Gholipour (2021) expected that a higher degree of economic policy uncertainty could decrease research and development (R&D) expenditures and inhibit innovation. Simultaneously, however, Tajaddini and Gholipour (2021) acknowledge that postponing an investment might be a costly decision in case firms are competing for a patent (Bloom, 2014). Therefore, they hypothesized that economic policy uncertainty could both increase as well as decrease research and development (R&D) expenditures and innovation output. Using data ranging from 1996 up to 2015, they found that economic policy uncertainty has a positive effect on innovation. William and Fengrong (2022) examined the same relationship but extended their research by differentiating between several industry- and country characteristics. Their research is based on a cross-country sample of 17 countries, with a similar sample ranging from 1997 up to 2015. Following the sole arguments made by real option theory, they hypothesize that economic policy uncertainty decreases innovative activities. In line with their expectation, they find a negative and significant effect of economic policy uncertainty on innovation (William & Fengrong, 2022).

This thesis will build forth on the knowledge previously established by Tajaddini and Gholipour (2021) and William and Fengrong (2022). This study will investigate the interplay of globalization, economic policy uncertainty and innovation. Since the 1980s and 1990s, we have witnessed a shift in the international marketplace, creating a global market for goods, labor, services, and financial capital (Deardorff & Stern, 2002). In recent years, however, several deglobalizing tendencies started to disrupt these globalizing patterns. Attitudes have changed after the dotcom bust in 2000 and the financial crisis in 2009, causing FDI to decrease (Garg & Sushil, 2021). These changing attitudes have been strengthened by rising economic inequality, concerns about the environmental impact of global trade, and a perception that globalization has led the erosion of cultural identities. Some deglobalizing trends include the decrease in free trade agreements, controversial actions against immigrants, heightened trade tariffs and trade protectionism (Garg & Sushil, 2021).

Theoretically, globalization patterns can impact innovation through a wide range of channels. To differentiate between these different channels, this thesis will distinguish between the social, political, and economic dimensions of globalization. By examining the individual effects of these three types of globalization, researchers can better understand the nuanced relationships between economic policy uncertainty, globalization, and innovation. Economic globalization refers to the economic channels of globalization, which is associated with the ease with which international trade

takes place (Dreher, 2006; Gygli et al., 2019). Economic globalization facilitates the diffusion of technologies, allowing for easier access to foreign technological knowledge (Blind & Jungmittag, 2004; Cheung & Lin 2004). It also promotes competition, which forces companies to innovate in order to keep up with their rivals (Lin, H-lin & Lin, S, 2010). Political globalization refers to the interconnectedness between nations through political channels (Dreher, 2006; Gygli et al., 2019). International collaborative efforts, such as the World Trade Organization (WTO), may increase competition within a country by reducing the fixed cost of market entry, which in turn can lead to increased pressure on companies to innovate. Social globalization drives a knowledge-enhancing mechanism that enables a firm to generate ideas and potential research paths (Murray et al., 2016; Gygli et al., 2019).

Several studies have highlighted how certain aspects of globalization can serve to mitigate uncertainty, through both a reduction in a country's exposure to the risks of other countries and an increase in the flow of information available to a country (Bernanke, 1983; Kim et al., 1993; Chalupnik et al., 2009). Economically globalized countries may be able to diversify their activities across multiple countries, while companies operating in more globally integrated markets may have a more diverse and broad customer base, making them less vulnerable to economic policy uncertainty in a single country (Rugman, 1976; Hitt et al., 2006). Similarly, the acquisition of information through political- and social globalization may reduce the ambiguity present in a given situation (Murray et al., 2016; Simmons & Elkins, 2004). According to real option theory, in times of uncertainty, firms are likely to delay their investments until more information becomes available (Bernanke, 1983; Greenland et al., 2019). Therefore, information obtained through social or political globalization may moderate the impact of uncertainty on innovation.

The aim of this study is to investigate how economic policy uncertainty and globalization relate to innovation. More specifically, this study identifies whether living in a more socially-, politically- and economically globalized environment can moderate the effect of economic policy uncertainty on innovation. A cross-country fixed effect analysis on 25 countries, selected based on data availability of the economic policy uncertainty index (BBD), is employed to find an answer to this research question. The following five measures are used to proxy the dependent variable innovation: Research and development (R&D) expenditure, national patent applications, national trademark applications, patents granted at the European Patent Office (EPO) and patents granted at the United States Patent and Trademark Office (USPTO) (Tajaddini & Gholipour, 2021). Research and development (R&D) expenditure is employed as an innovation input measure. Four innovation output measures are consulted, to give a more encompassing view on how economic policy uncertainty and globalization relate to different aspects of innovation. The multi-dimensional KOF globalization indices and the BBD political uncertainty index are employed as the main independent variables (Dreher, 2008; Baker et al., 2016). Even though data on the economic policy uncertainty index (BDD) is now available for a wide range of countries, the period covered for each country

deviates based on newspaper availability. Therefore, this study is limited to a common period starting in 1997, which alleviates any bias caused by country data discrepancies (William & Fengrong, 2022). Moreover, this study will be restricted to data recorded in the years up to 2015 to deal with truncation bias. Truncation bias is caused by a possible time lag between the patent application date and the grant date, causing the final years of a patent data set to be biased (Hall et al., 2001; William & Fengrong, 2022). A patent applied for is commonly assessed (and granted) within 2 years. This study follows a common procedure to account for truncation bias, deleting the final 2 years of a dataset to ensure that all patents applied for could have been granted (Hall et al., 2001; William & Fengrong, 2022). As this study works with a patent database version dating from 2017, this study will remain restricted to data recorded in the years up to 2015. Therefore, the final sample ranges from 1997 up to 2015.

This study contributes to the existing literature in several ways. First, the findings contribute to the literature on innovation and economic policy uncertainty. While several studies have examined this relationship, results have remained ambiguous (Tajaddini and Gholipour, 2021; William & Fengrong, 2022). Moreover, these previous studies have been restrained to fewer countries. Second, this study contributes to the literature on innovation and globalization. Feng et al. (2019) already investigated the direct relationship between the multi-dimensional view of globalization and innovation, using the KOF globalization index (Dreher, 2008). Their study, however, was constrained to a single country analysis of Chinese manufacturing firms. This study adds to the external validity of the results through incorporating a cross-country analysis on 25 countries. Lastly, this study adds to the current literature by examining the moderating effect of globalization on the relationship between innovation and economic policy uncertainty. As previously stated, the uncertainty mitigating and knowledge enhancing mechanism of globalization might significantly impact our findings. Therefore, neglecting the effect of globalization might generate biased results (William & Fengrong, 2022).

The remainder of this paper is organized in the following way. Chapter 2 will further elaborate on what economic policy uncertainty and globalization entail. Moreover, it will discuss the importance of defining globalization from a multifaceted perspective. In chapter 3, relevant existing literature will be reviewed to develop hypotheses. Chapter 4 presents a description of the data used and elaborates on the research methodology. Additionally, it will discuss potential quality checks to assess the robustness and potential internal- and external threats to validity. In chapter 5, results are presented, and counter arguments are given for findings that diverge from the hypothesized relationship. Chapter 6 will draw final conclusions and pose a definite answer to the research question. Lastly, research limitations will shortly be touched upon in chapter 7.

2. Literature review

This chapter accommodates the reader with the necessary background knowledge. In section 2.1, economic policy uncertainty is defined. Section 2.2 elaborates on the multi-dimensional view of globalization.

2.1 Economic policy uncertainty

A firm is greatly affected by the economic eco-system in which it operates. This ecosystem is subject to policy alterations by regulatory institutions. Economic policy uncertainty refers to a risk that originates from unpredictable regulatory changes initiated by regulatory institutions (Al-Thaqeb & Algharabali, 2019). Therefore, economic policy uncertainty is a subset of economic uncertainty. Economic policy uncertainty emanates from a wide range of events that challenge the status quo such as the global financial crisis, the Russian annexation of Crimea, the election of Donald trump, the refugee crisis, or the Brexit (Al-Thaqeb & Algharabali, 2019; William & Fengrong, 2022). During the financial crisis in 2008, for instance, there was political uncertainty on what resolving measurements the government would implement with regards to their spending behavior, their monetary policies, and their taxing regulations (Al-Thaqeb & Algharabali, 2019). Uncertainty in the timing or the content of a regulatory-, monetary-, or fiscal policy poses a significant amount of uncertainty on a firm and has the potential to create market volatility (Gulen & Ion, 2016). This specific source of uncertainty induced by political institutions might have far-reaching economic consequences.

Research on the impact of economic policy uncertainty has remained limited for a long period of time (Gulen & Ion, 2016). Gulen and Ion (2016) argue that this might result from the difficult task of finding an appropriate proxy for economic policy uncertainty. While the concept of economic policy uncertainty covers many types of policies, including fiscal-, monetary- and social policies, it is limited by factors that are linked to the regulatory system. Therefore, it cannot be proxied through standard measures of uncertainty as covered by volatility of returns or total factor productivity (Gulen & Ion, 2016). Some studies have used the election timing as a proxy for economic policy uncertainty (Jens, 2017; Julio & Yook, 2012; Bhattacharya et al., 2017; Atanassov et al.,2016). A study by Bhattacharya et al. (2017), for instance, investigated the relationship between uncertainty and innovation output in a cross-country study using data on 43 countries. They concluded that innovation output decreased significantly in the year after elections took place, a period in which political uncertainty is heightened. Moreover, they found that this effect is more pronounced in innovation intensive industries (Bhattacharya et al., 2017). Similarly, both Jens (2017) and Julio and Yook (2012) exploited the heightened political uncertainty in times of elections. Both studies found empirical evidence supporting a negative relation between policy uncertainty and investments. This measure, however, is limited to the coverage of the economic policy uncertainty associated with a period of elections (Gulen & Ion, 2016). As previously explained, economic policy uncertainty can emanate

from a wide range of events (e.g. Brexit, the financial crisis, the Covid-19 crisis). Therefore, using the elections as a measurement, neglects the fact that there are more events causing economic policy uncertainty (Gulen & Ion, 2016; William & Fengrong, 2022).

Recently, Baker, Bloom, and Davis (2016) managed to construct an index of economic policy uncertainty (BBD). This index (BBD) is calculated using a machine learning algorithm and is constructed as a weighted average of three components. This all-encompassing monthly measurement reflects the frequency by which newspapers within a specific country cover economic policy uncertainty (Baker et al., 2016). It measures economic policy uncertainty within the whole economy, at the country-level. For an article to count towards this economic policy uncertainty index (BBD), it must contain a trio of terms related to the economy, the policies and to uncertainty (Baker et al., 2016). The United States was one of the first countries for which Baker, Bloom and Davis (2016) developed the economic policy uncertainty index (BBD). This US index is based on the top 10 leading US newspapers and reflects the frequency with which an article contains "the following triple: "economic" or "economy"; "uncertain" or "uncertainty"; and one or more of "congress", "deficit", "Federal Reserve", "legislation", "regulation" or "White House"" (Bloom et al., 2016, p1).

The economic policy uncertainty index (BBD) has been widely employed by researchers and, therefore, can be assumed to be a reliable measure (Gulen & Ion, 2016; Tajaddini & Gholipour, 2021; William & Fengrong, 2022). Chapter 3.2.2 will further elaborate on the use of the economic policy uncertainty index (BBD) as a proxy for economic policy uncertainty, its advantages, and its disadvantages.

2.2 Globalization

Since the 1980s the world has changed drastically and we have witnessed a shift in the international marketplace, creating a global market for goods, labor, services and financial capital (Deardorff & Stern, 2002). This process that increases the interconnectedness, interdependence, and integrations among regions, nations, and societies is defined as globalization (Eden et al., 2001). Lately, however, several deglobalizing tendencies have started to disrupt these globalizing patterns. Attitudes have changed after the dotcom bust in 2000 and the financial crisis in 2009, causing FDI to decrease (Garg & Sushil, 2021). It created a more nationalistic stance, in which the importance of the national culture is emphasized (Garg & Sushil, 2021). Current literature elaborates on visible trends, including the decrease in free trade agreements, controversial actions against immigrants, heightened trade tariffs and trade protectionism (Garg & Sushil, 2021).

Clark (2000) defined globalization as "creating networks of connections among actors at multi continental distances, mediated through a variety of flows including people, information and ideas, capital, and goods" (Clark, 2000, p 86). Accordingly, there are various channels from which the interconnectedness among nations originates (Clark, 2000). The multi-dimensional perspective of

Clark (2000) recognizes the importance of distinguishing between these various channels of globalization, including a social-, political- and economic channel. Based on the multifaceted definition of globalization as defined by Clark (2000), Dreher (2006) developed as an all-encompassing globalization index (KOF) that examines social-, political- and economic globalization at the country-level. Dreher (2006) defined social globalization as the cross-border exchange of ideas, information and citizens. Social globalization enables the diffusion of information across states through communication networks and cultural reference groups (Hovhannisyan & Keller, 2014). Having access to the internet and television stimulates knowledge transfers electronically, while freedom to visit and having international airports may enhance the transfer of knowledge physically (Hovhannisyan & Keller, 2014). The political dimension refers to the interconnectedness among nations through political channels (Dreher, 2006; Gygli et al., 2019). Interconnectedness may be generated through both international organizations, such as the United Nations or the World Trade Organization, and individual relationships between countries, such as the exchange of political values and ideas. Additionally, Feng et al., (2019) relates political globalization with policy diffusion. Policy diffusion refers to the spread of policies across the world (Simmons & Elkins, 2004). This may lead to policy learning which refers to the influence of information accessible through policies in one country, to the benefit of policies in another country (Simmons & Elkins, 2004). Economic globalization refers to the interconnectedness among nations through economic channels. Dreher (2006) defined globalization from the economic perspective, as the ease with which international trade takes place. This construct of globalization solely encompasses the cross-border transfers of goods, capital, and services, and the information that comes available from these transfers (Dreher, 2006). Each of the three globalizations dimensions are subdivided into a de jure and de facto definition (Feld & Voigt, 2003). De facto, each of the globalization dimensions measure the actual flow of international activities and transactions (Gygli et al., 2019). De jure, these dimensions measure factors, such as certain conditions, events or theories, that in theory would accommodate and advance the flows of international activities and transactions (Gygli et al., 2019). Despite the development of several other multifaceted constructs of globalization (Harvey & Novicevic, 2002; Thoumrungroje & Tansuhaj; 2007), Dreher's definition of globalization is now widely recognized. It has become the most widely used construct of globalization in academic literature (Potrafke, 2015).

The use of a multi-dimensional construct that differentiates between the several channels of globalization, allows researchers to generate a more complete analysis on the driving factors behind globalization (Feng et al., 2019). Different channels of globalization might impact our economic- and social lives in differing ways. Political globalization might, for instance, generate additional uncertainty. It might be unclear how different policy changes interact with each other in a politically globalized environment, effecting companies in a multitude of countries. Economic globalization, on the other hand, might generate a more diversified market, allowing business to easily access new markets and resources, generating a path to circumvent uncertainty. This thesis will separately

consider the impact of each of the social-, political- and economic dimension of globalization on innovation. By considering the individual effects of these three channels of globalizations, researchers can better understand the nuanced relationships that exist between economic policy uncertainty, globalization and innovation. Chapter 3.2.3 will further elaborate on how the KOF globalization index is constructed and why the KOF globalization index is preferred as an independent variable in this study.

3. Hypothesis Development

The aim of this study is to investigate the relationship between economic policy uncertainty, globalization and innovation. More specifically, this study identifies whether living in a more socially-, politically and economically globalized environment can moderate the effect of economic policy uncertainty on innovation. In this section, existing literature is reviewed to develop relevant hypotheses.

3.1. Economic Policy Uncertainty

Economic policy uncertainty refers to the risk associated with the unpredictability of future regulatory-, monetary- and fiscal policies (Al-Thaqeb & Algharabali, 2019). Since a firm is greatly affected by the environment in which it operates, economic policy uncertainty influences a company's decision-making (Gulen & Ion, 2016; Al-Thaqeb & Algharabali, 2019). A general theory used to justify the relationship between uncertainty and firm performance is real option theory. This theory suggests that firms might decide to postpone their commitments to a more certain period, to prevent irreversible sunk cost (Bernanke, 1983; Greenland et al., 2019). In line with real option theory, one might expect that a higher degree of economic policy uncertainty will inhibit innovation, as it is an inherently risky- and uncertain process that requires an irreversible upfront investment (Gentry & Hubbard, 2000; Hall, 2002). Several studies found supporting evidence for this theory (Bhattacharya et al.,2017; Jens, 2017; Julio & Yook, 2012). A study by Bhattacharya et al. (2017), for instance, investigated the relationship between uncertainty and innovation output over 43 countries. They concluded that innovation output decreased significantly in the year after elections took place, a period in which political uncertainty is heightened. Moreover, they found that this effect is more pronounced in innovation intensive industries. Similarly, both Jens (2017) and Julio and Yook (2012) exploited the heightened political uncertainty in times of elections. Both studies found supporting empirical evidence, suggesting a negative relation between policy uncertainty and investments.

Strategic growth theory, however, questions the validity of real option theory as applied to innovation (van Vo & Le, 2017). Real option theory assumes that firms have monopolistic powers, neglecting possible costs that might be associated with delaying the investment. Innovation, however, is a rapid and constantly evolving process in which several companies might be competing for the

same patent (van Vo & Le, 2017). Delaying a research and development (R&D) investment might be detrimental, as this might lead to losing one's early mover advantage (Bloom, 2014). The strategic growth option theory states that, under imperfect competition, uncertainty might generate a significant growth option as early investments are commonly associated with greater returns in the future (van Vo and Le, 2017). Therefore, a firm can seize growth opportunities by investing early and acquiring an early mover advantage. In line with strategic growth theory, one might expect that a higher degree of economic policy uncertainty will enhance innovation (van Vo & Le, 2017).

Tajaddini and Gholipour (2021) were one of the first to specifically study the relationship between news-based economic policy uncertainty and innovation. Their study was of an exploratory nature, stating two opposing hypotheses. Based on real option theory, they hypothesized that economic policy uncertainty would increase innovation. It might be beneficial for a firm to delay a costly decision, to wait for additional information to become available (Hall, 2002; Greenland et al., 2019). Based on strategic growth theory, on the other hand, they hypothesized that economic policy uncertainty would decrease innovation. Not all firms have the ability to postpone an investment, as this might be a costly decision in case firms are competing for a patent (Bloom, 2014; van Vo & Le, 2017). To proxy economic policy uncertainty, Tajaddini and Gholipour (2021) employ the news-based economic policy uncertainty index (BBD) as constructed by Baker, Bloom, and Davis (2016). To proxy innovation, they employed both per capita research and development (R&D) expenditure and actual innovation output, which included patent applications, patent grants, and trademark applications. Research and development (R&D) was chosen to reflect the impact on critical innovation inputs, while the innovation output variables were chosen based on their importance for a country's long-term competitive advantage and economic growth (Tajaddini & Gholipour, 2021). Exploiting data across 19 countries using country- and year fixed-effects models, they found consistent results of a positive impact of economic policy uncertainty on research and development (R&D) expenditure as well as innovation on all output measures. These findings align with strategic growth option theory and seem to indicate that delaying a research and development investment would indeed be detrimental (Bloom, 2014; Van Vo & Le, 2017).

A recent study, *Economic Policy Uncertainty and Industry Innovation: Cross Country Evidence*, further investigates the relationship between economic policy uncertainty and technological innovation by examining industry-level innovation (William & Fengrong, 2022). The study estimates innovation using total patent counts, the number of patenting firms, and patent citations. It employs a news-based economic policy uncertainty index (BBD) as a proxy for economic policy uncertainty and examines the effect of economic policy uncertainty on innovation in a sample of 17 countries using the country-industry-year fixed effects approach. Based on the arguments of real option theory, the study hypothesizes that economic policy uncertainty is negatively related to innovation (Hall, 2002; Greenland et al., 2019). In line with their hypothesis, they find a significantly negative effect of economic policy uncertainty on innovation (William & Fengrong, 2022). This effect is found to be

consistent across five measures of innovation, including patent count, patenting entities, patent citations, patent originality and patent generality (William & Fengrong, 2022).

The contradicting findings of William and Fengrong (2022) and Tajaddini and Gholipout (2021) might be attributed to the use of differing model estimations. Tajaddini and Gholipour (2021) used country-year fixed-effects model estimations, while William and Fengrong (2022) used country-industry-year fixed-effects model estimations. There are two main reasons why this might lead to diverging results. First, industries might respond differently to economic policy uncertainty across countries. How an industry responds to economic policy uncertainty might, for instance, be determined by the innovation incentives provided by the government (William & Fengrong, 2022). Second, it could be suggested that the decision to delay an investment and accept the risk of losing an early mover advantage may be county-industry specific (William & Fengrong, 2022). Some countries have a natural competitive advantage in certain industries, leading to more developed and competitive industries in those countries (William & Fengrong, 2022). According to the theory of strategic growth options, companies operating in a more competitive environment feel pressured to secure their market share in order to survive (Bloom, 2014; van Vo and Le, 2017). Therefore, firms operating in highly competitive industries are more reliant on their innovative capabilities in order to succeed (Patnaik, 2016; Czarnitzki & Toole, 2013). As a result, it can be argued that companies that operate in a more competitive environment with a smaller market share may be more inclined to seize potential future growth opportunities in times of uncertainty (Tajaddini & Gholipour, 2021; Van Vo & Le, 2017).

This study remains of exploratory nature. Based on real option theory, one might expect a positive relationship between economic policy uncertainty and innovation (Bernanke, 1983; Greenland et al., 2019). Based on strategic growth option theory, however, one might expect a negative relationship between economic policy uncertainty and innovation (Bloom, 2014; van Vo & Le, 2017). This thesis tests for the following two opposing relationships:

Hypothesis 1a: An increase in the degree of economic policy uncertainty in a country is negatively related to a change of innovative activities in that country.

Hypothesis 1b: An increase in the degree of economic policy uncertainty in a country is positively related to a change of innovative activities in that country.

3.2 Direct Effect of Globalization on Innovation

Economic globalization refers to the cross-border transfers of goods, capital, and services, and the information that comes available from these transfers (Dreher, 2006). Theoretically, economic globalization can stimulate innovation through two mechanisms.

First, economic globalization might enhance innovation through a market enhancing mechanism. According to industrial economics, inward foreign direct investment (FDI) can increase competition in the local market, motivating firms to innovate in order to maintain their market share (Lin, H-lin & Lin, S, 2010). The introduction of foreign products to a domestic market can lead to reduced profit margins, prompting local firms to improve their efficiency through innovative activities in order to secure their market share (Lin, H-lin & Lin, S, 2010). This is known as the disciplining effect. Similarly, outward FDI may pose challenges for a domestic firm due to the competitiveness of the foreign market, leading the firm to continue innovating in order to remain successful (Kumar & Suddharthan, 1994). In the global market, domestic firms may face intense international competition, requiring them to continuously engage in innovative activities in order to achieve greater profit margins and survive (Kumar & Suddharthan, 1994).

Second, economic globalization might enhance innovation through a spillover mechanism. Blind and Jungmittag (2004) argue that firms must have certain competitive advantages in order to internationalize. These advantages can benefit local firms through spillover effects of both products and technological know-how (Cheung & Lin, 2004). These spillover effects enable a firm to internalizing foreign information, leading to enhanced innovative activities within a domestic firm (Cheung & Lin, 2004). Cheung and Lin (2004) identify four channels through which these spillover effects can occur: Reverse engineering, labor market mobility, demonstration effects, and employee training. Reverse engineering allows domestic firms to acquire foreign knowledge. Local firms can learn about foreign products and gain technical insights, which will enable them to produce technologies similar to those of foreign firms. Labor market mobility might enhance the flow of technical knowledge. For such, foreign know-how might be internalized by domestic firms, through turnovers of technical workers in the labor market (Cheung & Lin, 2004). Demonstration effects might lead to a fastened trial-and-error process by observing the behavior of foreign players (Cheung and Lin, 2004). Lastly, at the supply side, technological spillovers might result from employee training (Cheung & Lin, 2004). Domestic workers might be able to internalize foreign technological knowledge when firms start to produce abroad.

Theoretically, however, both inward and outward foreign direct investment (FDI) may also hinder innovation. Outward FDI, for example, may encourage firms to simply establish production sites abroad in order bring in a convenient supply of high-quality inputs that are produced using foreign technologies (Seker, 2012). This allows firms to take use of foreign knowledge without internalizing it and without investing in innovative activities (Lin, H-lin & Lin, S, 2010). Similarly, inward FDI may tempt domestic firms to acquire foreign technologies rather than investing in internalizing information and innovating (Kumar, 1987; Clark, 2000; Brambilla et al., 2009). According to Brambilla et al. (2009), FDI is more likely to lead to imitation rather than innovation.

Many studies have examined the relationship between economic globalization and innovation. While it is possible for both inward and outward foreign direct investment (FDI) to either promote or

hinder innovation, most research suggests that economic globalization has positive externalities on innovation (Kim et al., 1993; Pottelsberghe & Lichtenberg, 2001; Yeh, 2005; Branstetter, 2006; Salomon & Shaver, 2005). Pottelsberghe and Lichtenberg (2001) investigated whether importing goods from countries characterized by high research and development (R&D) expenditures, can enhance the innovative performance of a home country. Through an analysis of the United States, Japan and eleven European countries, Pottelsberghe and Lichtenberg (2001) found that inward foreign direct investment (FDI) tends to benefit from the technological advances of the host country, transferring this knowledge back to the domestic country. They also found that outward FDI serves as a channel for technology spillovers, improving the domestic productivity and innovative performance of the firm (Pottelsberghe & Lichtenberg, 2001). Salomon and Shaver (2005) studied the relationship between exporting and innovation in a sample of Spanish manufacturing firms. They measured innovation in terms of the number of innovative products in the home country and the number of patent applications. They found a significant positive relationship between a firm's exporting capacity and its innovative performance in the home country, one or two periods later (Salomon and Shaver, 2005). This finding was attributed to "learning by exporting", which refers to a process of knowledge acquisition enabled by exports. Firms tends to benefit from the technological advances of the host country, transferring this knowledge back to the home country (Salomon & Shaver, 2005). Feng et al. (2019) connect economic globalization to imports, exports and FDI. Through a firm-level analysis on a Chinese sample ranging from 1998 to 2009, Feng et al. (2019) investigate the relation between innovation and globalization. They find that economic globalization has a positive impact on innovation proxied by the ratio of new products over the total output. Their study, however, is restrained to a sample using Chinese firms, which reduces the external validity of the results.

In line with the discussion above, this study proposes that economic globalization enhances the innovative performance of firms.

Hypothesis 2: *An increase in the degree of economic globalization of a country is positively related to a change of innovative activities in that country.*

Political globalization refers to the interconnectedness among nations through political channels (Dreher, 2006). Interconnectedness may be generated through both international organizations, such as the United Nations or the World Trade Organization, and individual relationships between countries, resulting in the exchange of political values and ideas. Theoretically, political globalization can stimulate innovation through two mechanisms.

First, political globalization and cross-border governmental connections can generate a flow of political knowledge (Simmons & Elkins, 2004; Feng et al., 2019). Feng et al., (2019) relate political globalization to the diffusion of efficient government policies. Policy diffusion refers to the spread of policies across the world (Simmons & Elkins, 2004). Simmons and Elkins (2004)

investigated the driving mechanisms behind policy diffusion. According to Simmons and Elkins (2004), policy diffusion is partially driven by a knowledge enhancing mechanism that leads to political learning. Policy learning is the process by which countries use the knowledge and experiences of other countries to inform their own policy decisions (Simmons & Elkins, 2004). The political knowledge that becomes available in one country could enable another country to easily assess the consequences of a policy, such as the probability that a policy will become a success. Simmons and Elkins (2004) found that the political knowledge available might consequently lead to policy adaptation and diffusion, leading to the clustering of efficient government policies around the world (Simmons & Elkins, 2004). When policies are related to the innovation systems prevalent in a country, fewer policy failures through policy learning are expected to strengthen a country's political environment, which in turn might enhance innovation.

Second, political globalization can stimulate collaborative efforts between governments. These collaborative efforts may, consequently, lead to intensified competition. International collaborative efforts, such as the World Trade Organization (WTO) or embassies, may increase competition within a country by reducing the fixed cost of market entry, which in turn can lead to the attraction of multi-national firms and investments (Furguson & Forslid, 2014). An empirical paper by Ferguson and Forslid (2014) investigated whether having more embassies abroad, and therefore being more politically globalized, is related to the exporting performance of a firm. They hypothesize that embassies reduce the fixed cost of market entry through trade promotion (Furguson & Forslid, 2014). Consequently, they hypothesize that a reduction in market entry costs will lead to an increase in exports. In line with their hypothesis, they found that both medium and large-sized firms react positively to a country opening more embassies, by increasing their exports (Ferguson and Forslid, 2014). As previously elaborated on, international trade activities are positively related to innovation (Kim et al., 1993; Pottelsberghe & Lichtenberg, 2001; Yeh, 2005; Branstetter, 2006; Salomon & Shaver, 2005). Additionally, the collaborative efforts between governments might enhance collaboration. International intellectual property treaties (IP) between countries might, for instance, optimize the innovation environment in which collaboration may take place (Xiang & Wang, 2021). Pottelsberghe and Lichtenberg (2001) found that collaborative efforts among countries have enabled knowledge spillovers and enhanced the transfer of technologies.

In line with the discussion above, this study proposes that political globalization enhances the innovative performance of firms.

Hypothesis 3**:** *An increase in the degree of political globalization of a country is positively related to a change of innovative activities in that country.*

Social globalization refers to the interconnectedness among nations through social channels. Existent literature has widely elaborated on the importance of human communications and the flow of

information, to foster innovation (e.g., Hovhannisyan & Keller, 2014; Murray et al., 2016; Feng et al., 2019). While the international flow of skills had greatly influenced innovation in the past, the international flow of information has now become of greater importance. Two underlying mechanisms explain the relationship between social globalization, the flow of information and innovation: A knowledge enhancing mechanism and a mechanism driven by intensified market competition.

First, and most straightforward, the knowledge enhancing mechanism, driven by social globalization and the flow of information, enables a firm to generate ideas and possible paths of research (Murray et al., 2016). According to Dixit et al. (2005), the internet is a great enabler for this cross-border flow of information. Nevertheless, despite these communication networks and ease with which information is transferred electronically, Hovhannisyan and Keller (2014) found that foreign business travel is still positively related to innovation. They argue that some of the technology may be tacit and can more easily be transferred face-to-face (Hovhannisyan & Keller, 2014)

Second, social globalization has generated a flow of information, leading to lower market barriers and intensified market competition (Feng et al., 2019; Dixit et al., 2005). Several studies have elaborated on the relationship between social globalization and intensified competition. Dixit et al. (2005) examined that, with the internet as an enabler, the cross-border flow of information creates more transparency and might induce a price competition. Additionally, improved communications through the internet have increased a country's market reach and reduced the transaction costs involved in cross-border transactions, leading to intensified competition (Dixit et al., 2005). As previously elaborated, intensified competition might naturally lead to an increase in innovative activities (Lin, H-lin & Lin, S, 2010).

In line with the discussion above, this study proposes that social globalization enhances the innovative performance of firms.

Hypothesis 4: *An increase in the degree of social globalization of a country is positively related to a change of innovative activities in that country.*

3.3 Moderating Effect of Globalization on Innovation

Real option theory suggests that in periods of economic uncertainty, businesses may be reluctant to engage in innovative endeavors due to the perceived increase in risk and the uncertainty of potential returns (Bernanke, 1983; Greenland et al., 2019). This paper hypothesizes that globalization may mitigate some of the negative impacts of economic policy uncertainty on innovation.

Economic globalization allows firms to easily shift to different markets in times of unfavorable conditions (Kogut, 1983). By operating in multiple countries, a firm can reduce its

exposure to uncertainty in any one specific country (Kim et al., 1993). Rugman (1976) compares the diversification of a business internationally to the diversification of an asset holder's portfolio. Similar to an asset holder mitigating risks by holding a diverse portfolio, a business can mitigate profit risks by diversifying internationally and engaging in foreign operations (Rugman, 1976). Diversifying internationally can reduce dependence on the local market, being less susceptible to the economic policy uncertainty related to one country (Hitt et al., 2006; Kim et al., 1993). Economic policy uncertainty that is related to uncertain implementation of anti-trust laws, for instance, will generate uncertainty in the domestic country, but is likely to leave international operations unaffected.

Political globalization may offset some of the negative effects of economic policy uncertainty on innovation by increasing the flow of information through governmental networks and connections (Simmons & Elkins, 2004; Feng et al., 2019). Therefore, the acquisition of information through political globalization may reduce ambiguity in a given situation. According to real option theory, firms tend to delay investments and wait for more information to become available in times of uncertainty (Bernanke, 1983; Greenland et al., 2019). An empirical study by Chalupnik et al. (2009) found that knowledge and information systems can facilitate investment projects by mitigating the negative impact of uncertainty inherent in such activities. Having additional knowledge accessible may allow one to better asses the possible risks associated with certain innovative endeavors. Therefore, it could be argued that the information made available through political globalization can mitigate uncertainty. For example, information on the impact of similar policies in other countries may mitigate economic policy uncertainty within uncertain policies.

Social globalization may offset some of the negative effects of economic policy uncertainty on innovation by increasing the flow of information through communication networks and cultural reference groups (Hovhannisyan & Keller, 2014; Feng et al., 2019). According to real option theory, information accessible (through social globalization) might reduce the ambiguity that is prevalent in a situation (Bernanke, 1983; Greenland et al., 2019). Access to the internet and television stimulate electronic knowledge transfers, while the freedom to visit and having international airports may enhance the physical knowledge transfer. Social globalization may, for example, generate a flow of information on how other countries coped with periods of higher economic policy uncertainty. This information may provide insights on how to navigate economic policy uncertainty and may mitigate the economic policy uncertainty present within uncertain policies.

In line with the arguments above, this study hypothesizes that economic-, political- and social globalization are expected to positively moderate a negative relationship between economic policy uncertainty and innovation, by providing easy access to foreign markets.

Hypothesis 5a: *A negative relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of economic globalization.*

Hypothesis 6a: *A negative relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of political globalization.*

Hypothesis 7a: *A negative relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of social globalization.*

The theory of strategic growth option suggests that uncertainty can actually encourage innovative activity within a country, as delaying a research and development (R&D) investment may be detrimental (Bloom, 2014, Van Vo and Le, 2017). According to this theory, the strategic growth option is even more pronounced in a competitive environment. Under the pressure of high competition, firms may be inclined to increase their competitive advantages through innovation in order to maintain their market share (van Vo and Le, 2017).

Economic globalization is characterized by the ease of international trade, which is directly related to an increase in competition. According to industrial economics, inward foreign direct investment (FDI) is directly related to an increase of competition in the local market (Lin, H-lin & Lin, S, 2010). Political globalization can stimulate collaborative efforts between governments, creating clusters of monetary- and fiscal policy liberalization (Simmons & Elkins, 2004). Becoming a member of international organizations, such as the World Trade Organization (WTO), may increase competition within a country by reducing the fixed cost of market entry, which in turn can lead to increased pressure on companies to innovate. Similarly, social globalization is likely to increase market competition. The internet, as an enabling technology, can reduce the transaction costs involved in cross-border transactions, thereby improving communications, and increasing a country's market access (Dixit et al., 2005). This expansion of opportunities will directly enhance the competitive environment.

According to strategic growth option theory, the strategic growth option becomes even more pronounced in a competitive environment (van Vo and Le, 2017). Since an increase in each of the social-, political- and economic dimension of globalization are expected to increase competition, this study hypothesizes that the positive effect of economic policy uncertainty on innovation is more pronounced in social-, political and economically globalized countries.

Hypothesis 5b: *A positive relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of economic globalization.*

Hypothesis 6b: *A positive relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of political globalization.*

Hypothesis 7b: *A positive relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of social globalization.*

4. Data and Methodology

This chapter first presents a description of the data used (section 4.1), followed by an extensive description of the chosen variables (section 4.2). Section 4.3 elaborates on the econometric approach used in this study. Section 4.4 and 4.5 will assess the robustness and the validity of our results.

4.1 Sample Description

The aim of this study is to investigate how economic policy uncertainty and the multi-dimensional view of globalization impact innovation. Moreover, this study aims to identify whether living in a more socially-, politically- and economically globalized environment can moderate the effect of economic policy uncertainty on innovation.

Several dependent variables have been chosen to measure innovation in this study. Gross domestic expenditure on research and development (R&D) per capita in current purchasing power parity (PPP) dollars will be used as a proxy for innovation input (Tajaddini & Gholipour, 2021). Data on research and development (R&D) expenditure has been obtained from UNESCO. In addition, this study will analyze four different proxies for innovation output: patents applied for at the national office, trademarks applied for at the national office, patents granted at the European Patent Office (EPO), and patents granted at the United States Patent and Trademark Office (USPTO). This approach, based on previous research by Tajaddini and Gholipour (2021), aims to provide a more comprehensive view of the relationship between economic policy uncertainty and various aspects of innovation. Data on patents and trademarks applied for at the national level has been sourced from the World Intellectual Property Organization (WIPO). Information on patents granted at the European Patent office (EPO) and United States Patent and Trademark Office (USPTO) has been obtained from the the Organisation for Economic Co-operation and Development (OECD) database.

This study employs the news-based economic policy uncertainty index developed by Baker, Bloom, and Davis (2016) as a measure of economic policy uncertainty. Monthly data on the economic policy uncertainty index (BBD) is available for 28 countries, chosen based on the availability of newspaper data for those countries. The following countries are included in the study: Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Croatia, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, South Korea, Mexico, the Netherlands, Russia, Singapore, Spain, Sweden, the United Kingdom, and the United States (Baker et al., 2016). Not all countries have been included in the dataset from the same time period. Data for Pakistan was only available starting in 2010 and is

therefore excluded from the sample. Denmark and New Zealand were dropped from our sample, as the data could not be retrieved at the time of the study.

To measure the moderating impact of globalization, data on the KOF globalization measure is derived from the public KOF globalization website (KOF Swiss Economic Institute, 2021). This 2021 KOF Globalization database contains information on the political-, economic-, and social dimension of globalization. By considering the individual effects of these three types of globalizations, researchers can better understand the nuanced relationships that exist between economic policy uncertainty, globalization, and innovation.

Based on data availability, our final sample consists of the following 25 countries: Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Croatia, Denmark, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, South Korea, Mexico, Netherlands, Russian Federation, Singapore, Spain, Sweden, UK and the USA. Even though data on the economic policy uncertainty (EPU) is now available for a wide range of countries, the period covered for each country deviates. Therefore, this study is limited to a common period starting in 1997, which alleviates some of the bias caused by country data discrepancies (William & Fengrong, 2022). Moreover, this study follows a common procedure as described by Hall, Jaffe and Trajtenberg (2001) to account for truncation bias. Truncation bias is caused by a possible time lag between the patent application date and the grant date. Once a patent is applied for, it takes two to three years on average for the patent to be granted (Hall et al., 2001; William & Fengrong., 2022). Since this study works with a database version dating from 2017, the final years might be biased by incomplete information resulting from this lag period. Therefore, this study will be restricted to data recorded in the years up to 2015. This method allows us to assume that all applied innovations could have been granted in case it was a successful application (Hall et al., 2001; William & Fengrong., 2022). Based on the restrictions outlined above, the final coverage period ranges from 1997 up to 2015.

Control variables were obtained from the UNESCO Institute for Statistics, the International Monetary Fund, the World Bank, and the Organisation for Economic Co-operation and Development (OECD). Detailed definitions of the variables and their specific sources can be found in Table 1 in the appendix.

4.2 Variable Description

4.2.1 Innovative Measures

The focus of this study is on innovation as the main dependent variable. Data on innovation is collected at the country level on an annual basis. Previous literature has discussed the various measures that may be used to proxy innovation, with debate still ongoing as to which is the most effective (William & Fengrong, 2022). Some studies have utilized research and development (R&D) expenditure as a measure of innovation (Tajaddini & Gholipour, 2021; William & Fengrong, 2022),

however, this study recognizes the limitations of this approach. Research and development (R&D) expenditure serves as a proxy for innovation through input rather than actual success (William & Fengrong, 2022). In addition, there are issues with inconsistent accounting measures across different firms and varying accounting regulations across countries (William & Fengrong, 2022). As an alternative, this study employs several patent measures to proxy innovation. Following the methodology of Tajaddini and Gholipour (2021), four measures of innovation are used in this study: patents and trademarks applied for at the national patent office, patents granted at the European Patent Office (EPO), and patents granted at the United States Patent and Trademark Office (USPTO). Each of these proxies are expected to capture a different type of innovation. Patents applied for at the national office mostly capture domestic product- and technology related innovation, while trademarks applied for at the national office are likely to capture innovations related to branding. Patents granted at the EPO and USPTO are likely to capture international innovation, rather than domestic innovation. The use of these four differing innovation measures allows to give an al encompassing view on how economic policy uncertainty and globalization are related to different aspects of innovation. Both patents applied for and granted are analyzed in this study in order to consider any possible differences. It should be noted that the use of patents as a proxy for innovation may be inadequate due to the possibility of companies choosing not to apply for patents, potentially keeping their inventions as company secrets (Kleinknecht et al., 2002). Additionally, the use of patents as a proxy for innovation does not account for potential differences in innovation quality (William & Fengrong, 2022). Analyzing patents granted in comparison to those applied for has the advantage of only capturing successful innovations (William & Fengrong, 2022).

In order to eliminate any bias due to the potential double counting of patents and trademarks across various national offices, our sample filters on patents and trademarks applied for by residents. This implies that the patent must be filed and owned by an individual or entity residing in the country represented by the intellectual property (IP) office (Henry, 2020). The majority of patents are typically applied for and owned by a company, whose employees serve as the initial inventors and contributed to the development of the invention (Henry, 2020). By restricting our analysis to resident applications, we can minimize the likelihood that the innovative activity occurred in a different country represented by a different IP office. For patents granted at the European Patent Office (EPO) and United States Patent and Trademark Office (USPTO), the inventor's country of residence is used to identify where the innovative activity occurred. This study examines patents granted based on application year rather than the grant year, to stay closest to the moment of invention and to capture the time lag that is often apparent between application date and grant date (Acharya & Subramanian, 2009).

To prevent any bias caused by skewness, all proxies for innovation productivity have been normalized using a natural logarithm. Table 2 provides all the summary statistics of the independent variables.

4.2.2 Economic policy uncertainty index

This study utilizes a country-level news-based measure of economic policy uncertainty (EPU) known as the BBD index, constructed by Baker, Bloom, and Davis (2016). Driven by machine learning, the index (BBD) reflects the frequency with which newspapers within a particular country cover economic policy uncertainty in a given month (Baker et al., 2016). The economic policy uncertainty index is a normalized measure based on the volume of economic policy uncertainty discussed in the selected newspapers (Baker at al., 2016). The BBD index is intended to capture economic policy uncertainty at the country level and is currently available for 28 countries. The countries for which the index (BBD) is available are selected based on newspaper data accessibility. To accurately estimate the economic policy uncertainty within a given country, a sufficient volume of newspaper articles must be available. For an article within a newspaper to count towards this economic policy uncertainty index (BBD), it must contain a trio of terms related to the economy, the policies and to uncertainty (Baker et al., 2016). The United States was one of the first countries for which Baker, Bloom and Davis (2016) developed the economic policy uncertainty index (BBD). This US index is based on the top 10 leading US newspapers and reflects the frequency with which an article contains "the following triple: "economic" or "economy"; "uncertain" or "uncertainty"; and one or more of "congress", "deficit", "Federal Reserve", "legislation", "regulation" or "White House"" (Baker et al., 2016, p1).

The BBD index developed by Baker, Bloom and Davis (2016) has several advantages over alternative proxies (William & Fengrong, 2022). The main advantage is that it can capture economic policy uncertainty within the whole economy. As opposed to using election timing as a proxy, the BBD index is a dynamic measure that does not isolate certain events (Gulen and Ion, 2016). The BBD index captures many sources of uncertainty including, trade wars, pandemics, terrorism, or climate change (William & Fengrong, 2022). Economic policy uncertainty caused by these events disturb the economy and require governments to take action to absorb these shocks, using policy measures that directly affect business and financial markets (William & Fengrong, 2022, p.4). One disadvantage of the BBD index is that it captures various types of uncertainty, making it challenging to determine the specific source of a particular effect. Economic policy uncertainty related to regulatory business policies, for instance, may have a different impact on the economy than economic policy uncertainty related to tax or monetary policies. Additionally, this measure is dependent on media coverage in a given country, which could potentially be biased due to propaganda or fake news. Ghirelli et al. (2019) demonstrated that the construction of an index using news data is sensitive to the choice of news provider and the selection of newspapers. Despite these limitations, the news-based policy uncertainty index (BBD) is considered the most appropriate proxy for addressing the research question of the overall impact of economic policy uncertainty in this study.

This study has taken the average of the monthly BBD values in a given year and country, to convert the monthly economic policy uncertainty index (BBD) into an annual index (Greenland et al., 2019; Tajaddini & Gholipour, 2021; William & Fengrong, 2022).

4.2.3 Globalization

Globalization is a broad concept that extends beyond sole interest in increased trade flows and decreased barriers to capital (Potrafke, 2015). In recent years, several indices have been developed to measure the multifaceted nature of globalization, including the Kearney/Foreign Policy Magazine Globalization index, the Maastricht Globalization Index (Figge & Martens, 2014), the CSGR Globalization Index (Lockwood & Redoano, 2005), and the KOF Globalization Index (Dreher, 2006). The KOF Globalization Index is the most widely used measure of globalization at the country level, which suggests its validity and reliability (Potrafke, 2015).

The KOF globalization index is developed as an all-encompassing globalization index based on the multifaceted definition of globalization defined by Clark (2000). The index is composed of economic-, social-, and political dimensions of globalization, each of which carries equal weight. Beginning in 1970, the KOF Globalization Index has been calculated annually based on available data, at the country level (Dreher, 2006; Gygli et al., 2019). The original KOF Globalization Index (Dreher, 2006) is based on 23 underlying variables (Gygli et al., 2019). Dreher (2008) revised this index to take into account the importance of dividing each of the three dimensions of globalization into de jure and de facto categories (Feld & Voigt, 2003; Gygli et al., 2019). De facto, each of the globalization dimensions measure the actual flow of international activities and transactions (Gygli et al., 2019). De jure, these dimensions measure factors, such as certain conditions, events, or theories, that in theory would accommodate and advance the flows of international activities and transactions (Gygli et al., 2019). Dreher's revision (2008) expanded the index to include 21 additional underlying variables, with a small portion introduced to improve outdated proxies and the majority introduced to measure the de jure dimension of globalization (Gygli et al., 2019). The economic dimension was also split into trade and financial sub-indices, and the social dimension was divided into interpersonal, informational, and cultural sub-indices (Gygli et al., 2019). The weights of these higher-ranked sub-indices are determined using equal weights set over the time horizon, with trade and financial globalization each receiving a weight of 50 and the interpersonal, informational, and cultural sub-indices each receiving a weight of one third (Gygli et al., 2019). Lastly, this revised version allowed the weights of the underlying variables to vary over time (Gygli et al., 2019). Further details on all aspects covered within the KOF globalization index (and their weights) are provided in the appendix (Appendix, Table 2).

The KOF globalization index is a normalized data index that ranges between 0 and 100 (Gygli et al., 2019). Panel normalization implies that a country with the maximum value of this specific variable over the whole sample period observed, will automatically be assigned a value of 100 at that

time (KOF Swiss Economic Institute, 2021). This procedure perfectly deals with problems of outliers. A downside of this index is that consecutively adding data, will affect the ranking in the preceding years (Gygli et al., 2019). Linear interpolation is used to impute missing values when data is missing for a given year or country (Gygli et al., 2019). In cases where values are missing at the beginning or end of a series, they are replaced with the nearest available value (Gygli et al., 2019). The index is calculated using principal component analysis to determine the weights for each of the individual variables. The weights at time *t* are calculated using observations from the year *t-10* up to *t-1*. The full sample of countries is used for calculating the weights for each of the individual variables (Gygli et al., 2019).

One of the benefits of using the comprehensive KOF Index is that it can help to avoid potential problems related to the estimation of globalization. This is because the KOF Index is a more comprehensive measure that takes into account a variety of different factors (Chang et al., 2015; Gygli et al., 2019). A one-dimensional construct of globalization, such as trade as a percentage of the national GDP, often solely encompasses information on the flows of goods, capital, and (Gygli et al., 2019). Therefore, this construct of globalization does not account for the manifold of channels through which globalization evolves (Gygli et al., 2019). Different channels of globalization might impact our lives in differing ways. Political globalization might, for instance, generate additional uncertainty. It might be unclear how different policy changes interact with each other in a politically globalized environment, effecting companies in a multitude of countries. Economic globalization, on the other hand, might generate a more diversified market, allowing business to easily access new markets and resources, generating a path to waive uncertainty. While the use of the KOF Index as a composite measure of globalization offers numerous advantages, it also has some limitations. One of the main drawbacks of this index is that it is a composite measure that combines several different factors into a single score, which means that it can be difficult to disentangle the specific sources of any observed effects within each of the social, political, and economic dimensions (Gygli et al., 2019). Despite this limitation, the KOF globalization index is considered the most appropriate proxy available to study globalization due to its comprehensive nature (Chang et al., 2015; Potrafke, 2015).

KOF Economic Globalization

Dreher (2006) defined globalization from the economic perspective, as the ease with which international trade takes place. The index is composed from economic- and financial globalization. De facto, trade globalization is concerned with the trade in goods, services, and partner diversity. De jure, trade globalization is concerned with trade regulations, taxes, tariffs, and agreements (Gygli et al., 2019). De facto, financial globalization is concerned with foreign direct investment, portfolio investment, international debt, international reserves, and international income payments. De jure, financial globalization is concerned with investment restrictions, capital account openness and international investment agreements (Gygli et al., 2019).

KOF Political Globalization

According to Dreher (2006), political globalization is characterized by governmental connections and the spread of policies. De facto, political globalization concerns the number of embassies within a country, the number of UN peacekeeping missions a country is involved in and the number of international NGOs a country has (Gygli et al., 2019). De jure, political globalization includes the number of international organizations a country is involved in, the number of international treaties a country complies to and treaty partner diversity (Gygli et al., 2019).

KOF Social Globalization

Dreher (2006) defined social globalization as the exchange of ideas, information and citizens. The social index is composed of several subdivisions, including interpersonal-, informational- and cultural globalization. De facto, interpersonal globalization is concerned with voice traffic, transfers, international tourism, international students, and migration. De jure, interpersonal globalization is concerned with telephone subscriptions, freedom to visit the country and the number of international airports (Gygli et al., 2019). Informational globalization, de facto, is concerned with the used internet bandwidth, international patents, and the proportion of high technology exports. De jure, informational globalization is concerned with television access, internet access and press freedom (Gygli et al., 2019). Cultural globalization, de facto, is concerned with trade in cultural goods, trade in personal services, international trademarks, the number of McDonald's restaurants and the number of IKEA stores. De jure, cultural globalization is concerned with gender parity, human capital, and civil liberties (Gygly et al., 2019).

4.2.4 Control Variables

In our estimation, we have included a set of additional control variables as drivers of innovation. These variables were identified based on the previous studies of Tajaddini and Gholipour (2021) and William and Fengrong (2022) and include economic growth, financial development, tertiary education, and high-tech exports. In order to avoid multicollinearity issues, variables that may affect innovation productivity but are already captured within the globalization index, such as the trade to GDP ratio and FDI intensity (Tajaddini & Gholipour, 2021), are not controlled for separately. The summary statistics of the independent variables can be found in Table 3.

Previous research has investigated the relationship between economic growth and innovation, and has found that countries with higher levels of economic growth tend to have higher levels of innovative output and higher innovation productivity (Clarke, 2001; Acharya, Baghai, & Subramanian, 2013). Similar to William and Fengrong (2022), this study controls for gross domestic product (GDP) in millions of US dollars (PPP $) as a potential factor influencing a country's national industries' innovation productivity. While the study by William and Fengrong (2022) included both GDP and GDP per capita, this study choose to include only GDP. This decision is based on the

occurrence of multicollinearity issues when regressing against GDP per capita, caused by a significant correlation between the social globalization index and GDP per capita.

Several studies have found a positive correlation between financial development and innovation. This may be due to the reduced cost of financing investments and improved risk management that well-functioning financial systems provide (Hsu et al., 2014). In order to control for this, this study includes variables measuring credit market development and stock market development. To proxy credit market performance in a country, this study uses a variable measuring domestic private sector claims by banks as a percentage ratio of GDP (Hsu et al., 2014). Additionally, this study uses stock market capitalization as a percentage ratio of GDP as a proxy for stock market development (Hsu et al., 2014).

This study employs the gross enrolment ratio of tertiary education as a measure of the accessibility of human capital within a country. It is believed that this accessibility can enhance innovation by increasing a country's ability to absorb external knowledge (Wang et al., 2016).

Lastly, existing literature has found that having medium to high-tech industries within a country is positively related to the innovative performance of a country (Tajaddini & Gholipour, 2021). Therefore, this study controls for the number of high-technology exports, measures by the percentage of the total number manufacturing exports.

In selecting the control variables for this study, we have deliberately chosen the variables that are most relevant based on previous studies (Tajaddini & Gholipour, 2021; William & Fengrong, 2022). While it would have been possible to include a larger number of variables, we have limited ourselves to the most relevant controls in order to reduce the risk of diluting more important relationships (Kajerdt & Rydberg, 2021). Adding too many variables can lead to overfitting, resulting in poor estimations, as well as the risk of generating spurious regressions and multicollinearity problems (Kajerdt & Rydberg, 2021).

4.3 Methodology

Like prior studies examining the relationship between economic policy uncertainty and innovation, this study is conducted at the country level (Tajaddini & Gholipour, 2021; William & Fengrong, 2022). The data set for this study is an unbalanced panel data set consisting of 25 countries, covering the period from 1997 to 2015. The Hausman test indicated that a fixed-effects model is preferred over a random-effects model for each of the dependent variables. This study employs year-fixed-effects to control for any factors that vary over years, that are not accounted for by the control variables. Country-fixed-effects control for any factors that vary over countries, and remain stable over time, that are not accounted for by the control variables (Tajaddini & Gholipour, 2021). Incorporating a country-time fixed-effects model has the benefit to alleviate problems deriving from omitted variable bias. This identification strategy has been employed widely in cross-country studies,

to reduce endogeneity concerns, allowing one to draw more reliable statistical inferences (Hsu et al, 2014; Tajaddini & Gholipour, 2021, William & Fengrong, 2022).

The following equation (1) describes the empirical model estimated to investigate the relationship between economic policy uncertainty (EPU), globalization and innovation. Each of the variables are measured at time t, in country i.

$$Y_{it} = \beta_1 \cdot EPU_{it} + \beta_2 \cdot KOFS_{it} + \beta_3 \cdot KOFP_{it} + \beta_4 \cdot KOFE_{it} + \beta_5 \cdot KOFS_{it} \cdot EPU_{it} + \beta_6 \cdot KOFP_{it} \cdot EPU_{it} + \beta_7 \cdot KOFE_{it} \cdot EPU_{it} + X_{it} + \nu_i + \Omega_t + \mu_{it}$$

Y denotes the various innovation proxies employed in this study. The news-based economic policy uncertainty index (BBD) is denoted as EPU. KOF denotes the KOF Globalization Index, separated by the social- (KOFS), political- (KOFP) and economic (KOFE) dimensions. A vector of control variables is indicated as X. Country-fixed-effects are denoted by ν_i and time fixed effects are denoted by Ω_t. The symbol μ_{it} encompasses the error term. Table 1 in the appendix provides a detailed description of the variables used in this study.

Four different model specifications have been estimated. Specification (1) includes the control variables only. Specification (2) includes our first variable of interest, namely Economic Policy Uncertainty. In specification (3) the direct effect of three different globalization measurements have been analysed. Specification (4) combined the second and third model. In our final model, presented in specification (5), the moderating effect of globalization on economic policy uncertainty is examined. Each of the model estimations employed a natural logarithm of national patent applications, national trademark applications, patents granted at the European Patent Office (EPO) and patents granted at the United States Patent and Trademark Office (USPTO). Statistical significance at the 10%, 5% and 1% levels, is indicated by *, **, and *** respectively.

4.4 Robustness Check

First, this study conducts a subsample analysis on 11 European countries, to investigate whether results are robust to an analysis that is limited to one institutional environment. Attributes that do not vary across countries are not captured by country-specific fixed effects. Because European countries share a relatively comparable legal system, we will analyze possible differentiating effects using a subsample of 11 European countries: Belgium, Croatia, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Sweden, and the UK. The data set used in this study covers the period from 1997 to 2015, which means that the UK is still considered part of the European Union at this time.

Second, this study has re-examined the impact of globalization on innovation by introducing lagged variables for each of the independent- and control variables, to account for the possibility that

the effects on innovation may take some time to materialize. This robustness check also addresses the potential for bias due to reverse causality. As Potrafke (2015) notes, a common issue with quantitative studies that use the KOF globalization index as the independent variable is the potential for reverse causality. While this study aims to measure the effect of globalization on innovation, it is possible that our findings could instead reflect the reverse effect of innovation on globalization. For example, some studies have argued that innovating countries may gain a comparative advantage in manufacturing and experience an increase in exports (McAleer, 2010). To address this possibility, we conduct a robustness check using lagged variables.

5. Results

Section 5.1 elaborates on the descriptive statistics of the sample and provide an examination of the regression assumptions. In section 5.2, findings on the relationship between economic policy uncertainty, globalization and innovation are examined. Lastly, several robustness checks are performed in section 5.3.

5.1 Descriptive Statistics

This analysis uses a fixed-effects approach to examine an unbalanced data set from 25 countries between 1997 and 2015. Table 1 displays how the sample is constructed. The sample size (N) for each country varies, as some countries have missing data for certain years or no data at all (Table 1). In the absence of missing data, there would be a total of 19 observations (N) for each country. Two notable findings are discussed below. Belgium and the Netherlands are not included in the sample for national trademark applications due to the lack of available data for these countries. This is due to the Benelux Convention on Intellectual Property, which allows for the protection of trademarks in the Benelux region by registering with the BOIP, and the decision of Luxembourg, the Netherlands, and Belgium to no longer utilize their national trademark offices (Benelux Office for Intellectual Property, z.d.). Additionally, data on national patent applications is not available for Ireland. It is likely that this is due to the low level of innovation among Irish residents. When examining the total number of patent applications filed with the national office, some applications from Ireland are included. However, when the data is narrowed to only include applications filed by residents of Ireland, no applications are recorded. The decision to focus on patent applications filed by residents is further discussed in Section 4.2.1.

Table 1
Summary statistics on the composition of the sample.

Country	Descriptive Statistic	R&D Expenditure	National Trademark Applications	National Patent Applications	EPO Patent Grants	USPTO Patent Grants
Australia	N	10	19	19	19	19
	mean	727.48	34179.32	2374.74	387.56	1387.42
Belgium	N	19	0	19	19	19
	mean	708.5	.	638.11	767.28	881.07.
Brazil	N	16	18	19	19	19
	mean	139.9	95985.67	3937.21	95.56	204.47
Canada	N	19	19	19	19	19
	mean	665.3	19837.16	4493.11	1000.79	4808.46
Chile	N	9	19	19	19	19
	mean	71.06	23445.05	333.05	12.51	32.48
China	N	19	18	19	19	19
	mean	105.08	707485.78	251098.05	1394.89	4142.43
Colombia	N	17	19	19	19	19
	mean	19.86	11988.58	139.21	4.9	15.97
Croatia	N	17	19	19	19	19
	mean	143.92	1187	287.47	13.45	15.44
France	N	19	19	19	19	19
	mean	711.06	72699.79	14131.53	5054.59	4976.54
Germany	N	19	19	19	19	19
	mean	915.56	64185.63	47971.26	14143.78	13122.38
Greece	N	16	11	19	19	19
	mean	165.9	5400.18	503.63	36.86	51
Hong Kong	N	18	19	19	19	19
	mean	289.29	8833.16	137.84	73.14	276.02
India	N	19	17	19	19	19
	mean	25.43	125117.35	6001.11	272.19	1531.79
Ireland	N	19	19	0	19	19
	mean	536.44	1468.11	.	138.81	317.11
Italy	N	19	6	10	19	19
	mean	362.62	35642	8383.3	2580.39	2084.21
Japan	N	19	19	19	19	19
	mean	1009.42	103967.95	330300.16	11726.67	41993.35
Korea (S)	N	19	19	19	19	19
	mean	801.22	101980.05	112247.32	2003.58	10293.5
Mexico	N	19	19	19	19	19
	mean	55.07	51885.74	751.37	26.4	132.71
Netherlands	N	19	0	19	19	19
	mean	713.78	.	2332.74	1717.06	1862.32
Russia	N	19	19	19	19	19
	mean	163.75	28501.16	24718.26	123.54	328.23
Singapore	N	19	18	19	19	19
	mean	1257.51	4404.33	751.84	100.29	606.62
Spain	N	19	19	19	19	19
	mean	318.84	55389.32	2964.11	586.37	533.87
Sweden	N	16	19	19	19	19
	mean	1284.58	8425.05	2874.58	1593.23	1958.66
UK	N	19	19	19	19	19
	mean	527.59	28340.79	17838.95	2951.02	4856.18
US	N	19	19	19	19	19
	mean	1171.68	234421.05	213447.21	15745.19	107181.83

This table presents a detailed overview of the sample used in this study, which includes data from 25 countries between 1997 and 2015. Section 4.1 elaborates on the composition of our sample.

Table 2 presents the summary statistics for all of the dependent variables in this study. Again, the number of observations on each dependent variable (N) varies due to the unbalanced nature of the data set. In the absence of missing data, there would be a total of 475 observations (N) for each innovation proxy. R&D expenditure per capita has an average value of 525.52 (PPP$) across all countries, based on 442 observations. On average, countries in the sample apply for 44404.96 patents and register 80549.82 trademarks at their national office each year. In comparison, the number of patents granted by the EPO and USPTO is significantly lower, with an average of 2502 and 8143.76 grants, respectively, per country per year. The difference found in the number of patents and trademarks applied for at the national office and the number of patents granted at the international offices can be attributed to two factors. First, the difference can be attributed to the higher cost of applying for an European patent (international), which may range from 25,000 to 50,000 euros, as compared to the cost of 80 euros to file in the Netherlands. The higher cost is due to the additional requirements that must be met when applying for an European patent (Nederlands Enterprise Agency, 2021). Secondly, not all patents applied for will eventually succeed and be granted.

According to Hair et al. (2010), a variable is approximately normally distributed if the kurtosis remains below |7| and the skewness below |2|. The distribution of research and development (R&D) expenditure is approximately normal, as indicated by the low skewness (0.76) and kurtosis (2.74) values. All of the innovation output proxies have a positively skewed distribution, meaning that the right tail of the distribution is longer. This is evident in the positively skewed values for national patent applications (4.02), national trademark applications (6.74), USPTO patent grants (3.93), and EPO patent grants (6.34), with values more concentrated on the left side of the mean. Additionally, these four innovation proxies exhibit extremely fat tails, indicating that the probability of observing an "extreme" value is greater compared to a normal distribution. The kurtosis values for these proxies are 24.38 for national patent applications, 57.14 for national trademark applications, 18.39 for USPTO patent grants, and 6.34 for EPO patent grants. To assure normality of our independent variables, logarithmic transformations have been performed on national patent and trademark applications, EPO patent grants and USPTO patent grants.

As shown in Table 2, applying logarithmic transformations has resulted in approximately normally distributed variables.

Table 2
Summary statistics of all dependent variables used in this study

	N	Mean	Std. Dev.	Min	Max	Skewness	kurtosis
Original Variables							
R&D Expenditure	442	525.52	434.02	8.70	1878.38	.76	2.74
EPO Patent Grants	475	2502	4446.98	1.00	19240.44	2.15	6.34
USPTO Patent Grants	475	8143.76	22145.13	4.17	134781.73	3.93	18.39
National Patent Applications	447	44404.96	108406.60	26.00	968252.00	4.02	24.38
National Trademark Applications	411	80549.82	186555.08	547.00	1997058.00	6.74	57.14
Transformed Variables							
(Ln) USPTO Patents Grants	475	6.77	2.31	1.43	11.81	-.05	2.57
(Ln) EPO Patent Grants	475	5.95	2.30	.69	9.86	-.16	2.09
(Ln) National Patent Applications	447	8.35	2.33	3.26	13.78	.30	2.25
(ln) National Trademark Applications	411	10.25	1.54	6.3	14.51	-.34	2.96

This table displays summary statistics for the dependent variables used in this study, which includes data from 25 countries between 1997 and 2015. The definitions of the variables can be found in the appendix, Table 1.

Table 3 presents the summary statistics for the independent variables in this study. Table 3 shows that there are 459 observations (N) recorded for economic policy uncertainty (EPU). There are instances of missing data for the economic policy uncertainty index (BBD) for certain countries and years, with the result that certain years and countries are disproportionally represented. The availability of economic policy uncertainty (EPU) data for certain countries, such as Hong Kong and Belgium, is limited and begins at different points in time. For example, economic policy uncertainty data for Hong Kong is only available starting in 1998, while data for Belgium is only available starting in 2000. Economic policy uncertainty data for Croatia and Singapore is available starting in 2003. Over all countries, there is a total of 16 missing values generated, providing us with 459 remaining observations. The economic policy uncertainty index (BBD) is calculated by measuring the frequency with which newspapers in a particular country report on economic policy uncertainty in a given month, using the terms "economy," "policy," and "uncertainty." The average economic policy uncertainty (BBD) index within our sample is 107.89.

This study retrieved 475 observations (N) on the KOF globalization index, which indicates that there were no omitted variables. The KOF globalization index is a normalized data index that ranges from 0 to 100 and is panel-normalized, meaning that a country with the maximum value of the index for the entire sample period will be assigned a value of 100 at that time (Gygli et al., 2019). This normalization method helps to address the issue of outliers (Gygli et al., 2019). The descriptive statistics show that, on average, political globalization is the highest among the different dimensions of globalization in the sample, with an average index value of 85.03. Social globalization has a

slightly lower average index value of 72.24, while economic globalization has the lowest average index value of 66.68.

Table 3 also displays the summary statistics for the control variables in this study. This study controls for the financial development of a country by using measures of credit market development and stock market development (Hsu et al., 2014). Credit market development is represented by the domestic private sector claims of banks as a percentage of GDP, which is 86.91% on average in our sample. Stock market development is represented by stock market capitalization as a percentage of GDP, which is 106.76% on average in our sample. Additionally, the average enrollment ratio in our sample is 53.95%, and the average share of exports from medium to high-technology industries is 52.47% of total manufacturing exports. The average GDP in our sample is 2110354.1 million.

It is noteworthy that most independent- and control variables named above are approximately normally distributed with a kurtosis below |7| and a skewness below |2| (Hair et al., 2010). Exceptions in the data are the political globalization index, which has a negatively skewed distribution of -2.52 with a kurtosis of 10.06, and the GDP variable, which has a positively skewed distribution of 3.08 with a kurtosis of 12.9. The distribution of stock market capitalization as a percentage of GDP is also non-normally distributed, with a skewness of 5.17 and a kurtosis of 31.99, indicating that values have extremely fat tails and are more concentrated on the left side of the mean. Despite this, there is no need to transform the non-normal independent variables, as normality in panel-data sets are no hard requirement. The error terms in the model are normally distributed (Appendix, Table 6). No additional transformations are necessary.

Table 3
Summary statistics of all independent variables used in this study.

	N	Mean	Std. Dev.	Min	Max	Skewness	kurtosis
Independent Variables							
EPU (BBD)	459	107.89	43.16	27	305.43	1.12	4.89
KOF PO GI	475	85.03	14.57	26.75	98.06	-2.52	10.06
KOF EC GI	475	66.68	16.60	22.19	94.96	-.31	2.14
KOF SO GI	475	72.24	14.51	23.17	90.36	-1.18	3.87
Control Variables							
Domestic Credit (%GDP)	432	86.91	43.09	11.61	214.13	.33	2.58
Medium/High Tech Export	459	52.47	18.53	0	85.39	-.49	2.38
Tertiary Education	355	53.95	23.54	5.35	122.4	-.07	2.81
Market Capitalization (%GDP)	424	106.76	159.02	.02	1254.47	5.17	31.99
GDP (x Million)	475	2110354.1	3209344.40	43347.27	18206023	3.08	12.9

This table displays summary statistics for the dependent variables used in this study, which includes data from 25 countries between 1997 and 2015. Definitions of variables can be found in appendix, table 1.

The unbalanced and incomplete nature of the dataset must be taken into account when designing an appropriate regression model. In longitudinal panel data, it is common to predict missing variables in a presumably unbiased manner. This study, however, did not apply this method because the dataset included many missing values that were surrounded by even more missing values, making the procedure ineffective. Alternatively, to allow for reliable comparison, it is important to maintain the same number of observations in each regression model specification, regardless of the inclusion of additional variables.

5.2 Results on the cross country fixed-effects regression model

A cross-country fixed-effects regression on five innovation measures is performed, to investigate the relationship between economic policy uncertainty, globalization, and innovation. Moreover, this study examines the moderating effect of social-, political- and economic globalization on the relationship between economic policy uncertainty and innovation measures.

5.2.1 Assumptions of the cross country fixed-effects regression model

There are a few assumptions that must be satisfied in order to perform an accurate panel-data fixed effects regression analysis.

First, a linear relationship between the independent and dependent variables must be present. Second, there must not be perfect multicollinearity, as this can cause unstable estimations and inflated standard errors (Stock & Watson, 2003). While the study by William and Fengrong (2022) included both GDP and GDP per capita, this study choose to include GDP only. This decision is based on the occurrence of multicollinearity issues when including GDP per capita, caused by a significant correlation of 0.85 between the social globalization index and GDP per capita. Table 4 shows the correlation matrix for the remaining and transformed regression variables. Some variables display relatively high correlations, with the highest correlation of 0.82 observed between the social and economic globalization indices, which is significant at the 1% level. The Variance Inflation Factor (VIF) is employed to test whether this correlation causes any issues related to multicollinearity. As measured by the VIF index (Appendix, Table 3), no VIF value exceeds 10. This indicates that there are no severe concerns for multicollinearity within this analysis.

Non-normality is generally not a concern for large sample sizes, but this study has sample sizes ranging from 236 to 279 observations. Therefore, highly skewed variables could potentially be problematic (Hair et al., 2010). Any dependent variable that has a skewness higher than |2| or a kurtosis higher than |7| has been transformed to (natural) logarithmic scales. In line with the normality assumption, residuals from the regression are normally distributed (Appendix, Table 6).

Lastly, the model assumes that variances of the error term is homoscedastic and uncorrelated. According to the Modified Wald Test for groupwise heteroskedasticity in fixed effect regression model, the assumption of homoskedasticity is violated (Appendix, Table 5). The Wooldridge test for

autocorrelation in panel data confirms that there is enough evidence to reject the null hypothesis, concluding autocorrelation in the variance of the error term (Appendix, table 4). To solve for autocorrelation and heteroskedasticity, clustered standard errors are employed.

Table 4

Pairwise Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) R&D Expenditure	1.00													
(2) (Ln) National Patent Applications	0.37***	1.00												
(3) (Ln) USPTO Patents Grants	0.65***	0.84***	1.00											
(4) (Ln) EPO Patent Grants	0.63***	0.80***	0.95***	1.00										
(5) (ln) National Trademark Applications	0.03	0.75***	0.59***	0.54***	1.00									
(6) EPU	0.18***	0.09*	0.15***	0.15***	0.09*	1.00								
(7) KOF PO GI	0.20***	0.48***	0.39***	0.52***	0.39***	0.03	1.00							
(8) KOF EC GI	0.53***	-0.20***	0.16***	0.27***	-0.48***	0.03	-0.01	1.00						
(9) KOF SO GI	0.65***	0.00	0.35***	0.41***	-0.33***	0.20***	0.05	0.82***	1.00					
(10) Domestic Credit (%GDP)	0.33***	0.18***	0.35***	0.37***	-0.02	0.17***	-0.14***	0.51***	0.53***	1.00				
(11) Market Capitalization (%GDP)	0.06	-0.26***	-0.02	-0.09*	-0.15***	0.06	-0.69***	0.30***	0.30***	0.42***	1.00			
(12)GDP (x Million)	0.19***	0.67***	0.57***	0.48***	0.67***	0.08*	0.21***	-0.28***	-0.13***	-0.06	-0.08*	1.00		
(13) Tertiary Education	0.57***	0.22***	0.37***	0.41***	-0.08	0.13**	0.26***	0.47***	0.66***	0.38***	0.04	-0.12**	1.00	
(14) Medium/High Tech Exports	0.51***	0.53***	0.63***	0.64***	0.24***	0.03	0.19***	0.22***	0.32***	0.18***	-0.12**	0.24***	0.13**	1.00

This table presents the correlation coefficients between all explanatory and control variables based on a sample of 25 country-level variables from 1997 to 2015. The definitions of all initial variables can be found in Table 1 in the appendix. Logarithmic transformation are performed on the National Patent Applications, National Trademark Applications, the USPTO patent grants and the EPO Patent Grants. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively. **** p<0.01, ** p<0.05, * p<0.1*

5.2.2 Economic Policy Uncertainty: Direct effect

Table 5 presents the regression results on the first two hypotheses. The hypothesized relationship between economic policy uncertainty and innovative performance was of exploratory nature. Findings indicate a negative relationship between economic policy uncertainty and innovation, when regressed against national patent applications (-0.00131***) and national trademark applications (-0.000936*). This finding is significant at the 1% level. A one unit increase in economic policy uncertainty in one country is related to a 0.09% and 0.13% decrease in national patent applications and national trademark applications of that country, respectively. For national patent applications and national trademark applications, hypothesis 1a is confirmed. According to real option theory, a firm is likely to postpone investments to a later period to prevent sunk costs (Bernanke, 1983; Greenland et al., 2019). For the other three innovation measures, however, findings are contradicting. Results indicate that an increase in the degree of economic policy uncertainty (BBD) in a country is associated with a change positive change in R&D expenditure (0.406), patent grants at the EPO (0.00105) and patent grants at the USPTO (0.000349). These findings are in line with strategic growth option theory (van Vo and Le, 2017). Under imperfect competition, uncertainty might generate a significant growth option as early investments are commonly associated with greater returns in the future (van Vo and Le, 2017). These findings are, however, insignificant and, therefore, no conclusions can be reached.

The effect of economic policy uncertainty on innovation may vary depending on the specific nature of the uncertainty, as well as the specific measure of innovation. There are potential sources of economic policy uncertainty that are expected to affect the the number of patents applied for at the national office, but not necessarily the the number of patents granted at the EPO or USPTO. Economic policy uncertainty related to laws that only apply within a specific jurisdiction are likely to impact patent applications within that jurisdiction only. Uncertainty around possible antitrust laws, for instance, could affect a firm's ability to compete in the domestic market and its willingness to invest in new products or technologies within the domestic market. This source of economic policy uncertainty is likely to have less impact on global operations, moving patenting activities to the USPTO and EPO, while keeping up with their research and development (R&D) activities.

5.2.3 KOF Globalization: Direct Effect

Table 5 presents the regression results on the relationship between innovation and globalization (KOF). The second hypothesis states that an increase in the degree of economic globalization within a country is positively related to a change of innovative activities within that country. Results indicate a positive relationship between innovation and economic globalization, when regressed against patent applications at the national office (0.0216***), patent grants at the EPO (0.0295***) and patent grants at the USPTO (0.0222***). These results are significant at the 1% level. A one unit increase in the KOF economic globalization index of a country is related to a 2.16%,

2.95%, and 2.22% increase in that country's national patent applications, EPO patent grants, and USPTO patent grants, respectively. These results support our second hypothesis. When economic globalization is regressed against R&D expenditure, we find a similar positive but insignificant coefficient of 12.29. While this result is consistent with the second hypothesis, they are inconclusive. According to Branstetter (2006) and Salomon and Shaver (2005), a more economically globalized country is likely to benefit from greater knowledge spillovers and higher innovation performance. Contradicting, however, when regressed against national trademark applications, we find a negative but insignificant coefficient of -0.00298. An alternative explanation for this finding might be the negative spillover effect of economic globalization, creating an excessive flow of foreign capital that causes the host country to become dependent on imported technologies (Kumar, 1987; Clark, 2000; Brambilla et al., 2009) According to Brambilla et al. (2009), FDI is more likely to lead to imitation rather than innovation. This finding is, however, insignificant and no conclusions can be drawn.

Results indicate that an increase in the degree of political globalization within a country is positively related to a change of innovative activities in that country. A coefficient of 0.0343*** is found when regressed on national patent applications, a coefficient of 0.0173* when regressed on national trademark applications, a coefficient of 0.0572** when regressed on EPO patent grants and, lastly, a coefficient of 0.0672*** when regressed on USPTO patent grants. Each of the above results are significant and support the third hypothesis. A one unit increase in the KOF political globalization index of a country is related to a 3.43%, 1.73%, 5.72% and 6.72% increase in a country's national patent applications, national trademark applications, EPO grants and USPTO grants, respectively. A positive and insignificant coefficient of 7.856 is found when regressed on research and development (R&D) expenditures. This finding is insignificant, indicating that no conclusions can be drawn on the relationship between political globalization and R&D expenditures. These positive findings might be the result of cross-border governmental connections that generate a flow of political knowledge (Simmons & Elkins; Feng et al., 2019). The political knowledge available in one country could lead to policy learning and policy diffusion, resulting in fewer policy failures (Simmons & Elkins, 2004). When policies are related to innovation systems prevalent in a country, this might result in the enhanced innovative performance of a country.

A positive relationship between the social globalization index and innovation is found when regressed on national trademark applications (0.0186**) and USPTO patent grants (0.0239*). A one unit increase in the KOF social globalization index in a country is related to a 1.86% and 2.39% increase in that country's national trademark applications and USPTO grants, respectively. These finding are significant at the 5% and 10% level, respectively, and confirm the fourth hypothesis. Human communications have become an important asset to enhance the flow of information, leading to the generation of ideas and increasing innovative performance (Murray et al., 2016; Feng et al., 2019). Moreover, improved communications through the internet have increased a country's market reach and reduced the transaction costs involved in cross-border transactions (Dixit et al., 2005).

Table 5

Result from a cross-country fixed effects analysis of five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	0.406	-0.00131***	-0.000936*	0.00105	0.000349
	(0.504)	(0.000404)	(0.000490)	(0.000821)	(0.000574)
KOF EC GI	12.29	0.0216***	-0.00298	0.0295***	0.0222***
	(9.597)	(0.00594)	(0.00452)	(0.00722)	(0.00695)
KOF SO GI	-28.46***	-0.000458	0.0186**	-0.00448	0.0239*
	(9.162)	(0.00971)	(0.00868)	(0.0193)	(0.0133)
KOF PO GI	7.856	0.0343***	0.0173*	0.0572**	0.0672***
	(14.03)	(0.0108)	(0.00915)	(0.0268)	(0.0198)
GDP (X Million)	1.66e-05***	1.76e-07***	6.40e-08***	1.33e-07***	1.07e-07***
	(5.26e-06)	(2.33e-08)	(2.19e-08)	(4.63e-08)	(2.72e-08)
Domestic Credit (% GDP)	0.181	0.00184	0.00155	0.000460	0.000630
	(0.667)	(0.00141)	(0.00134)	(0.00120)	(0.000996)
Medium / High Tech Exports	-3.289	0.0183**	0.0172***	0.0105	0.00417
	(1.939)	(0.00841)	(0.00584)	(0.0103)	(0.00945)
Tertiary Education	-0.357	0.00565*	-0.00920***	0.0118***	0.0126***
	(2.731)	(0.00291)	(0.00305)	(0.00382)	(0.00306)
Market Capitalization (% GDP)	0.0597	-0.000288	0.000208	0.000209	-0.000241
	(0.0954)	(0.000274)	(0.000186)	(0.000220)	(0.000258)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	632.8	2.562**	6.992***	-2.281	-2.968*
	(1,075)	(1.137)	(0.987)	(2.093)	(1.509)
Observations	265	258	236	279	279
R-squared	0.670	0.842	0.729	0.742	0.843
Number of CatCountry	24	23	22	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

The resulting increase in market competition might lead to an increase in innovative activities (Lin, H-lin & Lin, S, 2010). Contradicting results are found, however, when regressed against research and development (R&D) expenditure, national patent applications and EPO patent grants. A negative coefficient of -28.46*** is found when regressed on R&D expenditure. This finding is significant at the 1% significance level. A one unit increase in the social globalization index (KOF) of a country is related to to a -28.46 million decrease in that country's R&D expenditures. The third

hypothesis is rejected for R&D expenditures. There are several explanations to how social globalization could decrease R&D expenditures, while increasing national patent applications and USPTO patent grants. For example, social globalization may increase access to foreign knowledge and technology, which could reduce the need for domestic R&D but still allows for innovative efforts and patenting activities (Lin, H-lin & Lin, S, 2010). Alternatively, a social globalization may optimize the innovation environment in which collaboration with other firms or institutions take place (Xiang and Wang, 2021), which may result in shared costs and risks on research and development (R&D). A negative and insignificant coefficient is found when regressed on national patent applications (-0.00448) and EPO patent grants (-0.000458). These results insignificant and no conclusions can be drawn.

5.2.4 KOF Globalization: Moderating Effect on a Negative Relationship

Results in table 5 and 6 indicate that an increase in the degree of economic policy uncertainty (EPU) in a country is negatively related to a change of national patent and trademark applications in that country. It is hypothesized that a negative relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of globalization (hypothesis 5a, 6a, 7a). Table 6 presents the regression results of the moderating effect of globalization on the relationship between economic policy uncertainty and innovation.

In line with hypothesis 5a, a positively moderating economic globalization coefficient is found when regressed against national patent applications (7.77e-05) and national trademark applications (8.23e-06). Diversifying internationally can mitigate some of the existing local risks, being less susceptible to the economic policy uncertainty related to one country (Hitt et al., 2006; Kim et al., 1993). Findings are insignificant and, therefore, inconclusive.

In line with hypothesis 6a, results indicate a positively moderating effect of political globalization when regressed on national patent applications (5.57e-06). Political globalization enables the spread of information through, for instance, governmental connections and networks (Simmons & Elkins, 2004; Feng et al., 2019). In line with real option theory, information will reduce the amount of uncertainty prevalent in economic policy uncertainty, thereby reducing the decline in investments (Chalupnik et al., 2009; Bernanke, 1983). An opposing moderating effect of political globalization is found when regressed on national trademark applications (-1.52e-05). The following argument could possibly explain this result. Countries that are more politically connected have agreed upon certain international rules, causing it to become more difficult for them to use political instruments to implement sudden or unexpected changes in economic policies. The loss in flexibility in times of economic policy uncertainty could lead to a more pronounced negative impact of political globalization on the relationship between economic policy uncertainty and innovation. Due to insignificance, however, all findings remain inconclusive.

In line with hypothesis 7a, a positively moderating social globalization coefficient is found (6.10e-06) when regressed against national trademark applications. Social globalization may offset some of the negative effects by increasing the flow of information through communication networks and cultural reference groups (Simmons & Elkins, 2004; Hovhannisyan & Keller, 2014). The information may, for instance, provide insights on how to best navigate through economic policy uncertainty. Additional knowledge will reduce uncertainty, which in turn reduces the value to postpone an investment (Chalupnik et al., 2009; Bernanke, 1983). As opposed to the hypothesized relationship, however, social globalization is found to have a negatively moderating coefficient when regressed against national patent applications (-9.13e-05). The following alternative explanation supports this result. It could be argued that, in times of greater economic policy uncertainty, firms are inclined to shift their focus to incremental innovations, as these are presumed to be less risky. If individuals and firms are exposed to a wider range of cultural influences, firms can easily shift their focus to incremental innovations, by adopting established practices and technologies to new references groups. Consequently, a shift away from disruptive technologies will cause a decrease in patenting activities. All findings are insignificant and, therefore, findings remain inconclusive.

5.2.5 KOF Globalization: Moderating Effect on a Positive Relationship

Results in table 5 and 6 indicate that an increase in the degree of economic policy uncertainty (EPU) in a country is positively related to a change in research and development (R&D) expenditure, patent grants at the EPO and patent grants at the USPTO. It is hypothesized that a positive relation between economic policy uncertainty and innovation is positively moderated in countries with a greater degree of globalization (Hypothesis 5b, 6b and 7b). Table 6 presents the regression results of the moderating effect of globalization on the relationship between economic policy uncertainty and innovation.

In line with our hypothesis 5b, a positively moderating economic globalization coefficient is found when regressed against EPO patent grants (2.37e-05) and USPTO patent grants (8.46e-05). According to strategic growth theory, the value of the strategic growth option will be enhanced in a competitive environment (van Vo and Le, 2017). Economic globalization is defined by the ease of international trade, which directly enhances competition. Therefore, the value of the strategic growth option is expected to grow under a greater degree of economic globalization. The findings are, however, insignificant and, therefore, inconclusive. An opposing negatively moderating coefficient of economic globalization is found (-0.0208) when regressed on research and development (R&D) expenditures. This result can be theoretically supported by the following argument. Firms that operate in an economically globalized environment are more likely to be involved in international operations. Consequently, these firms are likely to have a more established reputation and enhanced brand recognition, which can provide a competitive advantage and make them less reliant on innovation to drive growth and remain competitive. Consequently, delaying an investment is less detrimental,

making the strategic growth option become less valuable. This findings is also insignificant, and therefore, inconclusive.

In line with hypothesis 6b, a positively moderating political globalization coefficient is found when regressed against USPTO patent grants (2.69e-05). According to strategic growth theory, the value of the strategic growth option will be enhanced in a competitive environment. Political globalization can stimulate collaborative efforts between governments, leading to intensified competition. The following example will elaborate on this. Being a member of certain international organizations, such as the World Trade Organization (WTO), is expected to stimulate international trade through a reduction in the cost of market entry. Therefore, political globalization will increase market competition, which will lead to an increase in the value of the strategic growth option. Opposing insignificant results are found when regressed on R&D expenditures (-0.00576) and EPO patent grants (-1.37e-05). The following argument could be used to explain this diverging result. As previously elaborated, firms that operate in a politically globalized environment may be more involved in international operations, due to several collaborative efforts between governments that create clusters of monetary- and fiscal policy liberalization (Furguson & Forslid, 2014; Simmons & Elkins, 2004). Firms that operate internationally are likely to have a more established reputation and enhanced brand recognition, which can provide a competitive advantage and make them less reliant on innovation to drive growth and remain competitive. Consequently, delaying an investment is less detrimental, reducing the value of the strategic growth option. All results are insignificant and, therefore, inconclusive.

Social globalization is found to have a negatively moderating effect on the relationship between economic policy uncertainty and innovation, when regressed against USPTO patent grants. Table 6 displays a coefficient of -0.000159**, which is significant at the 5% level. For this innovation measure, hypothesis 7b needs to be rejected. A negative and insignificant coefficient is found when regressed against R&D expenditures (-0.00745) and EPO patent grants (-8.93e-05). For these innovation measures, results remain inconclusive. The following alternative explanation supports this result. As previously elaborated, firms that operate in a socially globalized environment may be more involved in international operations (Feng et al., 2019; Dixit et al., 2005). Internet access, for instance, can reduce the transaction costs involved in cross-border transactions, thereby improving communications, and increasing a country's market access (Dixit et al., 2005). Firms that operate internationally are likely to have a more established reputation and enhanced brand recognition, which can provide a competitive advantage and make them less reliant on innovation to drive growth and remain competitive. Consequently, delaying an investment is less detrimental, making the strategic growth option become less valuable

5.2.6 Control variables

As displayed in table 6, a country's GDP is positively related to the innovative performance of a country. A positive and significant coefficient is found for each of the five innovation measures

Domestic private sector claims by banks as a percentage ratio of GDP is positively related to the innovative performance of a country. For each of the five innovation measures, a positive coefficient is found. Results are insignificant.

Medium- and high-tech exports as a percentage of total number of manufacturing exports are positively related to innovation when proxied by the number of national patent applications, the number of national trademark applications, USPTO patent grants and EPO patent grants. Results are significant when regressed against national patent and trademark applications. Opposing negative results are found when regressed on R&D expenditures. This result is, however, insignificant.

The gross enrollment ratio in tertiary education is negatively related to R&D expenditures and national trademark applications. This result is significant for national trademark applications. A positive relation is found when regressed on national patent applications, EPO patent grants and USPTO patent grants. This result is significant when regressed against EPO- and USPTO patent grants.

Lastly, a country's stock market capitalization as a percentage ratio of GDP is negatively related to the innovative performance of that country when regressed on USPTO patent grants and national patent applications. A negative and insignificant coefficient is found. A positive and insignificant relation is found when regressed on R&D expenditures, trademark applications and EPO patent grants.

5.2.7 The Model

The R-squares of each of the final models displayed in table 6 are relatively high, indicating that the explanatory variables succeed to explain a significant part of the variation occurring in cross-country innovation performance. The lowest R-square is found when regressing the variables of interest on research and development (R&D) expenditure (0.681). This is supposedly explained by ambiguous beliefs on the reliability of R&D expenditures as an innovation measure. First, this measure might generate possible accounting problems. Accounting regulations for R&D expenses might differ across countries and firms might account for R&D costs differently (William & Fengong, 2022). Firms could, for example, either capitalize the expense as a future investment or treat it as an actual expense.

Table 6

Result from a cross-country fixed effects analysis five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	2.773	-5.70e-05	-0.000567	0.00724**	0.00420
	(2.096)	(0.00200)	(0.00276)	(0.00343)	(0.00338)
KOF EC GI	14.86	0.0138*	-0.00383	0.0279**	0.0140
	(10.69)	(0.00694)	(0.00740)	(0.0104)	(0.0109)
KOF SO GI	-28.98***	0.00970	0.0197*	0.00342	0.0374***
	(9.983)	(0.0110)	(0.00996)	(0.0230)	(0.0117)
KOF PO GI	5.375	0.0365**	0.0204*	0.0552*	0.0638***
	(12.96)	(0.0130)	(0.0108)	(0.0277)	(0.0197)
EPU # KOF EC GI	-0.0208	7.77e-05	8.23e-06	2.37e-05	8.46e-05
	(0.0208)	(5.24e-05)	(4.49e-05)	(6.27e-05)	(5.62e-05)
EPU # KOF SO GI	-0.00745	-9.13e-05	6.10e-06	-8.93e-05	-0.000159**
	(0.0242)	(5.83e-05)	(6.48e-05)	(8.06e-05)	(6.73e-05)
EPU # KOF PO GI	-0.00576	5.57e-06	-1.52e-05	-1.37e-05	2.69e-05
	(0.0128)	(1.95e-05)	(2.36e-05)	(2.42e-05)	(3.12e-05)
GDP (X Million)	1.20e-05**	1.70e-07***	6.64e-08**	1.19e-07**	9.00e-08***
	(4.99e-06)	(2.36e-08)	(2.51e-08)	(4.84e-08)	(2.66e-08)
Domestic Credit (% GDP)	0.0838	0.00200	0.00150	0.000375	0.000866
	(0.628)	(0.00139)	(0.00131)	(0.00132)	(0.00102)
Medium / High Tech Exports	-3.427	0.0171*	0.0166**	0.00945	0.00364
	(2.188)	(0.00852)	(0.00621)	(0.00990)	(0.00741)
Tertiary Education	-1.169	0.00542	-0.00930***	0.00982**	0.0115***
	(2.606)	(0.00320)	(0.00321)	(0.00366)	(0.00261)
Market Capitalization (% GDP)	0.0614	-0.000222	0.000178	0.000243	-9.46e-05
	(0.0855)	(0.000224)	(0.000162)	(0.000191)	(0.000217)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	734.9	2.218*	6.758***	-2.465	-3.113**
	(975.1)	(1.204)	(1.085)	(2.208)	(1.447)
Observations	265	258	236	279	279
R-squared	0.681	0.846	0.730	0.749	0.855
Number of CatCountry	24	23	22	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

5.3 Robustness

5.3.1 Subsample analysis: European Countries

The study is conducted using country fixed-effects model estimations, to account for country specific attributes that vary across countries. These fixed effects, however, do not capture attributes that are constant across a multitude of countries. European countries, for instance, have similar jurisdictions that are not accounted for by the country fixed effects of our initial analysis. Therefore, our results might be impacted by a specific jurisdiction to which a multitude of countries adhere. This section examines the impact of economic policy uncertainty and globalization on the innovative performance of a country, using the sole sub-sample of 11 European countries. This study will first consider the direct effect of economic policy uncertainty and globalization on innovation using a subsample of 11 European countries (Appendix, Table 12). Consequently, the moderating effect of social-, political- and economic globalization on innovation will be discussed (Appendix, Table 13).

First, the robustness of the relationship between economic policy uncertainty and innovation will be discussed. The initial regression found a significant effect of economic policy uncertainty on innovation when regressed against national patent and trademark applications. Both these relationships lose significance in a regression on a sub-sample of 11 European countries. The initially negative and significant relationship between economic policy uncertainty and national trademark applications (Main Text, Table 5), turned positive and insignificant (Appendix, Table 12). The impact of economic policy uncertainty on national patents, remained negative and turned insignificant. There are no significant and conclusive relationships between economic policy uncertainty and innovation left when considering a sub-sample of European countries (Appendix, Table 12).

Second, the relationship between economic globalization and innovation is analyzed. The positive and significant relationship between economic globalization and patents granted at the European Patent Office (EPO) is robust, indicating that the positive and significant results remain. A striking finding is that the initially positive and insignificant relationship between economic globalization and research and development (R&D) expenditures (Main Text, Table 5), has now turned negative and significant in the sub-sample analysis (Appendix, Table 12). The effect of economic globalization on both national patent applications and patents granted at the United States Patent and Trademark Office (USPTO) had turned insignificant in the sub-sample analysis (Appendix, Table 12).

The relationship between political globalization and innovation is robust when regressed against EPO patent grants. Results remain positive and significant. The impact of political globalization on research and development (R&D) expenditures was positive and insignificant in our initial analysis (Main Text, Table 5), and turned negative and significant in our subsample analysis (Appendix, Table 12). The impact of political globalization on national trademark applications

remains significant, but becomes negative (Appendix, Table 12). The impact of political globalization on national patent application and USPTO patent grants turned insignificant in the subsample analysis (Appendix, Table 12).

Fourth, the robustness of the relationship between social globalization and innovation will be examined. The effect of social globalization on national trademark applications remained significant, while turning negative (Appendix, Table 12). The relationship between social globalization and USPTO patent grants lost significance. Similarly, the relationship between social globalization and research and development (R&D) expenditure lost significance (Appendix, Table 12).

Table 13 in the appendix displays whether living in a more globalized environment can moderate the effect of economic policy uncertainty on innovation, using a subsample of 11 European countries. The only significant, and therefore conclusive, finding in the initial regression was the moderating effect of social globalization on the relationship between economic policy uncertainty and USPTO patent grants. The moderating effects was found to be positive and significant in our initial analysis (Main Text, Table 6), and has now turned negative and insignificant (Appendix, Table 13). While this effect turned insignificant, other moderating effects turned significant. First, the negatively moderating impact of social globalization on the relationship between economic policy uncertainty and national patent applications gained significance (Appendix, Table 13). Second, the positively moderating impact of social globalization on the relationship between economic policy uncertainty and national trademark applications gained significance (Appendix, Table 13). Third, the moderating effect of economic globalization on the relationship between economic policy uncertainty and research and development (R&D) expenditures turned significant (Appendix, Table 13). This effect used to be negative and has now turned positive. Lastly, the moderating effect of political globalization on the relationship between economic policy uncertainty and national patent grants gained significance, while remaining positive (Appendix, Table 13).

5.3.2 Lagged Globalization Variables

This robustness check introduces lags for each of the independent- and control variables, to account for the possibility that the effects on innovation may take some time to materialize. Moreover, the introduction of lagged variables addresses possible problems related to reverse causality. This study will first consider the direct effect of economic policy uncertainty and globalization on innovation using lagged variables (Appendix, Table 19). Consequently, the moderating effect of social-, political- and economic globalization on innovation will be discussed (Appendix, Table 20). The section below will elaborate on the most noteworthy findings.

The direct effect of economic policy uncertainty (EPU) on innovation was robust for three out of the five innovation specifications. When regressed against national patent applications, the relation between economic policy uncertainty (EPU) and innovation becomes negative. This relationship was insignificant in the initial analysis (Main Text, Table 5) and has now turned significant (Appendix,

Table 19). Moreover, it is apparent that the direct effect of economic policy uncertainty lost significance when regressed on national trademark applications. The direction of the effect remains the same (Appendix, Table 19).

The direct relationship between economic globalization and innovation is robust to the introduction of lagged variables (Appendix, Table 19). Besides some changes in significance, the direct relationship between social- and political globalization and innovation is also robust. The relationship between social globalization and research and development (R&D) expenditures remains negative and significant. The effect of social globalization on national trademark applications and USPTO patent grants was significant in our original analysis (Main Text, Table 5) and has now turned insignificant (Appendix, Table 19). Similarly, the effect of political globalization on national patent applications, EPO patent grants and USPTO patent grants have remained positive and significant (Appendix, Table 19). The relationship between political globalization and national trademark applications was significant in our initial analysis (Main Text, Table 5) and has now turned insignificant (Appendix, Table 19).

All moderating effects lost significance in a regression using lagged variables (Appendix, Table 20). The only significant, and therefore conclusive, finding in the initial regression (Main Text, Table 6) was the moderating effect of social globalization on USPTO patent grants.

While our analysis cannot completely rule out some reverse causality bias and materialization time, findings remain relatively robust to the introduction of lagged variables.

6. Discussion and Conclusion

The main aim of this study is to investigate how the innovative performance of a country is affected by economic policy uncertainty and globalization. Economic policy uncertainty refers to the risk associated with the unpredictability of future regulatory-, monetary- and fiscal policies (Al-Thaqeb & Algharabali, 2019). Since a firm is greatly affected by the environment in which it operates, economic policy uncertainty influences a company's decision-making (Gulen & Ion, 2016; Al-Thaqeb & Algharabali, 2019). More specifically, this study identifies whether living in a more social-, political- and economical globalized environment can moderate the effect of economic policy uncertainty on innovation. An answer to this research question will be found through an extensive cross-country fixed effects regression analysis on 25 countries over a period ranging from 1997 up to 2015. The main dependent variable in this study is innovation, which is measured at the country level. Similar to the study conducted by Tajaddini and Gholipour (2021), this study has identified five innovation variables to be investigated: Research and development (R&D) expenditure, national patent applications, national trademark applications, patents granted at the European Patent Office (EPO) and patents granted at the United States Patent and Trademark Office (USPTO). The present

study's results are relevant in the context of national economic growth and sustainable development, as innovation capacity plays a crucial role in both (Tajaddini and Gholipour, 2021).

A key finding is that an increase in the economic policy uncertainty within a country is negatively related to the innovative performance of that country, when defined by the number of national patent- and trademark applications. Real option theory states that innovation is an inherently risky- and uncertain process that requires an irreversible upfront investment (Gentry and Hubbard, 2000; Hall, 2002). This theory suggests that firms might decide to postpone their commitments to a more certain period, to prevent irreversible sunk cost (Bernanke, 1983; Greenland et al., 2019). In line with real option theory, findings indicate that a country's innovative performance in terms of national patent- and trademark applications decreases in times of greater economic policy uncertainty. Striking is that economic policy uncertainty has no significant effect on the remaining three innovation proxies, namely research and development (R&D) expenditure, patents granted at the European Patent Office (EPO), patents granted at the United States Patent and Trademark Office (USPTO). This difference might result from the underlying source that caused the economic policy uncertainty. Economic policy uncertainty related to laws that only apply within a specific jurisdiction are likely to impact patent applications within that specific jurisdiction only. Therefore, some sources of economic policy uncertainty are expected to affect the the number of patents and trademarks applied for at the national office, but not necessarily the the number of patents granted at the European Patent Office (EPO) or United States Patent and Trademark Office (USPTO). Uncertainty around possible antitrust laws, for instance, could affect a firm's ability to compete in the domestic market and its willingness to invest in new products or technologies in the domestic market. This source of economic policy uncertainty is likely to have less impact on global operations.

Moreover, this study concludes that social-, political- and economic globalization tend to have a positive effect on innovation. A positive and significant effect of economic globalization is found when regressed against national patent application, patents granted at the European Patent Office (EPO) and patents granted at the United States Patent and Trademark Office (USPTO). These findings align with the common belief that FDI enhances innovation through possible spillover-effects (Cheung and Lin, 2004), or the disciplining effect (Lin, H-lin & Lin, S, 2010). A positive and significant effect of social globalization is found when regressed against national trademark applications and patents granted at the United States Patent and Trademark Office (USPTO). Existent literature has widely elaborated on the importance of human communications and the flow of information, to foster innovation (e.g. Hovhannisyan & Keller, 2014; Murray et al., 2016; Feng et al., 2019). A knowledge enhancing mechanism, driven by social globalization and the flow of information, enables a firm to generate ideas and possible paths of research (Murray et al., 2016). A positive and significant effect of political globalization is found when regressed against national patent applications, national trademark applications, patents granted at the United States Patent and Trademark Office (USPTO) and patents granted at the European Patent Office (EPO). Political

globalization and cross-border governmental connections can stimulate the political flow of information to create a path of policy learning (Simmons & Elkins, 2004; Feng et al, 2019). Consequently, strengthening a country's policy instruments may prevent any policy failures related to innovation system. One exception that makes us question the positive relation between globalization and innovation is the relationship between social globalization and research and development (R&D) expenditures, for which a significantly negative coefficient is found. The following alternative explanation supports this result. Social globalization may increase access to foreign knowledge and technology, which could reduce the need for domestic R&D (Kumar, 1987; Clark, 2000). This could result in a decrease R&D expenditure, while remaining able to increase national patent applications and patents granted at the United States Patent and Trademark Office (USPTO). Moreover, a company may be able to reduce its R&D expenditure by collaborating with other firms or institutions (Xiang & Wang, 2021), to share the costs and risks. This could possibly explain how research and development (R&D) expenditures could decrease, while innovative performance increases.

This paper concludes that there is little moderating effect of globalization on the relationship between economic policy uncertainty and innovation. The only conclusive result was the negatively moderating effect of social globalization on the positive relationship between economic policy uncertainty and patents granted at the United States Patent and Trademark Office (USPTO). The following alternative explanation supports this result. As previously elaborated, firms that operate in a socially globalized environment may be more involved in international operations (Feng et al., 2019; Dixit et al., 2005). Internet access, for instance, can reduce the transaction costs involved in cross-border transactions, thereby improving communications, and increasing a country's market access (Dixit et al., 2005). Firms that operate internationally are likely to have a more established reputation and enhanced brand recognition, which can provide a competitive advantage and make them less reliant on innovation to drive growth and remain competitive. Consequently, delaying an investment is less detrimental, making the strategic growth option become less valuable

For further research it will be interesting to investigate how the de jure and de facto dimension of globalization impact the innovative performance of a country in different manners. Previous studies have elaborated on the importance of making a distinction between these two (e.g. Quinn et al., 2011; Dreher, 2006; Gygli et al., 2019). Dreher (2006) concluded, for instance, that the two dimensions impact economic growth differently. By subdividing the analysis in a de jure and de facto dimension, researchers can better understand the nuanced relationships between economic policy uncertainty and innovation.

7. Limitations of the data

First, this study is based on a sample of 25 countries spread around the globe. The sample is restricted to data availability of the BBD economic policy uncertainty index (Dreher, 2008). While this was inevitable, it might raise validity concerns. According to criticus, the economic policy

uncertainty (BBD) index is predominantly represented by developed economies (Ogbonna et al. 2022). Consequently, there might be some bias caused by the extent to which certain country characteristics are unevenly represented in our sample. This study acknowledges that overrepresentation of developed countries might limit the external validity of our results. These countries might respond differently to globalization and economic policy uncertainty, as compared to lesser developed countries.

Second, due to data availability limitations, this study is conducted using an unbalanced sample between 1997 and 2015. While this period is carefully selected, there might be some statistical bias apparent from countries that joined the sample at a later time. Additionally, some countries might be unevenly represented in our sample.

Moreover, due to data availability, this study is to some extend restricted in its adaptability of control variables. Controlling for governance index (Tajaddini & Gholipour, 2021) and value-added in each industry (William & Fengrong, 2022) is considered out-of-scope for this research, as the datasets available were very limited in the number of countries and years available.

In contrast to the study conducted by William and Fengrong (2022), this study has been limited to the sole inclusion of country-level variables. There is no readily accessible database for firm-level patenting data. PATSTAT is a commonly used database, but unfortunate this study did not have access to this licensed data base. Therefore, this study has not been able to differentiate between different industries. As stated by William and Fengrong (2022), however, high tech industries or industries dependent on external finance are differently affected by economic policy uncertainty. The decision to delay, and to take up the risk of losing an early mover advantage, depends on the industry status within a specific country. It can be argued that firms in countries with highly competitive industries respond differently to economic policy uncertainty, as they are more incentivized to innovate to secure their market share (Patnaik, 2016; Tajaddini and Gholipour, 2021; Van Vo and Le, 2017). Similarly, the effect of globalization might be more pronounced for industries within countries that are already highly competitive. Each dimension of globalization will cause the industry to become even more competitive, decreasing the chance of survival when you lag behind. The importance of one’s innovative capabilities will be more pronounced in case competition is further enhanced by political-, social- or economic globalization.

References

Acharya, V. V., Baghai, P. R., & Subramanian, K. (2013). Labor laws and innovation. *Journal of Law and Economics, 56(4), 997–1037.*

Al-Thaqeb, S. A., & Algharabali, B. G. (2019). Economic policy uncertainty: a literature review. *The Journal of Economic Asymmetries, 20*. https://doi.org/10.1016/j.jeca.2019.e00133

Atanassov, J., Julio, B., & Leng, T. (2016). The bright side of political uncertainty: the case of r&d. *Ssrn Electronic Journal*. https://doi.org/10.2139/ssrn.2648252

Baker, S.R., Bloom, N., and Davis, J.S. (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics 131(4), 1593-1636.*

Bernanke, B.S. (1983). Irreversibility, uncertainty and cyclical investment. *Quarterly Journal of Economics, Vol. 97, pp. 85-106.*

Bhattacharya, U., Hsu, P.H., Tian, X. and Xu, Y. (2017). What affects innovation more: policy or policy uncertainty?. *Journal of Financial and Quantitative Analysis, Vol. 52, pp. 1869-1901.*

Blind, K., & Jungmittag, A. (2004). Foreign direct investment, imports and innovations in the service industry. *Review of Industrial Organization : An International Journal Published for the Industrial Organization Society*, *25*(2), 205–227. https://doi.org/10.1007/s11151-004-3537-x

Bloom, N. (2014). Fluctuations in uncertainty. *The Journal of Economic Perspectives, Vol.28, pp. 153-176.*

Bloom, N., Bond, S. and Reenen, J.V. (2007). Uncertainty and investment dynamics. *The Review of Economic Studies, Vol. 74, pp. 391-415.*

Bonaime, A. A., Gulen, H., & Ion, M. (2018). Does policy uncertainty affect mergers and acquisitions?. *Journal of Financial Economics, 129(3), 531–558.*

Brambilla I, Hale G, Long C. (2009). Foreign direct investment and the incentives to innovate and imitate. *Scand J Econ 111(4):835–861*

Branstetter, L. (2006). Is Foreign Direct Investment a Channel of Knowledge Spillovers? Evidence from Japan's FDI in the United States. *Journal of International Economics, 68, pp. 325-344.*

Chalupnik, M. & Wynn, D. & Clarkson, P. (2009). Approaches to mitigate the impact of uncertainty in development processes. *Proceedings of the 17th International Conference on Engineering Design. 1. 459-570.*

Chang, C.-L.., Chang, S. P., & McAleer, M. J. (2010). Globalization and knowledge spillover: international direct investment, exports and patents. *Report / Econometric Institute, Erasmus University Rotterdam, Pp. 1-39*. http://repub.eur.nl/pub/20785.

Chang, C.-P., Lee, C.-C., Hsieh, M.-C., (2015). Does globalization promote real output? Evidence from quantile cointegration regression. *Econ. Model. 44, 25–36.*

Cheung & Lin, P. (2004). Spillover effects of fdi on innovation in china: evidence from the provincial data. *China Economic Review*, *15*(1), 25–44. https://doi.org/10.1016/S1043-951X(03)00027-0

Clark, W. C. (2000). Environmental Globalization.*Governance in a Globalizing World (Washington, DC: Brookings Institution Press), 86–108.*

Clarke, G. (2001). How institutional quality and economic factors impact technological deepening in developing countries. *Journal of International Development, Vol. 13, pp. 1097-1118.*

Czarnitzki, D. and Toole, A.A. (2013). The R&D investment–uncertainty relationship: do strategic rivalry and firm size matter?. *Managerial and Decision Economics, Vol. 34, pp. 15-28.*

Deardorff, A. V., & Stern, R. M. (2002). What you should know about globalization and the world trade organization. *Review of International Economics*, *10*(3), 404–423. https://doi.org/10.1111/1467-9396.00340

Dixit, A., Braunsberger, K., Zinkhan, G. M., & Yue, P. (2005). Information technology-enhanced pricing strategies: managerial and public policy implications. *Journal of Business Research*, *58*(9), 1169.

Dreher, Axel. (2006). Does Globalization Affect Growth? Evidence from a new Index of Globalization. *Applied Economics 38,* 10: 1091-1110.

Eden, L., & Lenway, S. (2001). Introduction to the symposium multinationals: the janus face of globalization. *Journal of International Business Studies*, *32*(3), 383–400.

Feld, L.-P., & Voigt, S. (2003). Economic growth and judicial Independence: Cross-country evidence using a new set of indicators. *European Journal of Political Economy*, *19*(3), 497–527.

Feng, G.-F., Zheng, M., Wen, J., Chang, C.-P., & Chen, Y. E. (2019). The assessment of globalization on innovation in chinese manufacturing firms. *Structural Change and Economic Dynamics, 50, 190–202. https://doi.org/10.1016/j.strueco.2019.06.012*

Ferguson, S., & Forslid, R. (2019). Sizing up the impact of embassies on exports. *The Scandinavian Journal of Economics*, *121*(1), 278–297. https://doi.org/10.1111/sjoe.12260

Figge, L., & Martens, P. (2016). Globalisation continues: The Maastricht Globalisation Index. *Sustainable Development Research at ICIS: Taking stock and looking forward (pp. 381). Universiteit Maastricht, ICIS. https://www.maastrichtuniversity.nl/research/institutes/icis/sustainable-development-research-icis-%E2%80%93-taking-stock-and-looking-ahead*

Garg, S., & Sushil. (2021). Determinants of deglobalization: a hierarchical model to explore their interrelations as a conduit to policy. *Journal of Policy Modeling*, *43*(2), 433–447. https://doi.org/10.1016/j.jpolmod.2021.01.001

Gentry, W.M. and Hubbard, R.G. (2000). Tax policy and entrepreneurial entry. *American Economic Review, Vol. 90 No. 2, pp. 283-287.*

Ghirelli, C., P´erez, J., Urtasun, A. (2019). A new economic policy uncertainty index for Spain. *Economics Letters 182, 64–67. doi: 10.1016/j.econlet.2019.05.021.*

Goodell, John W. (2020). COVID-19 and finance: Agendas for future research. *Finance Res. Lett. 35 (C). Elsevier. Graham,*

Greenland, A., Ion, M. and Lopresti, J. (2019). Exports, investment and policy uncertainty. *Canadian Journal of Economics, Vol. 19, pp. 1248-1288*

Gulen, H., & Ion, M. (2016). Policy uncertainty and corporate investment. *Review of Financial Studies, 29(3), 523–564.*

Gygli, S., Haelg, F., Potrafke, N., & Sturm, J.-E. (2019). The kof globalisation index – revisited. *The Review of International Organizations*. *14*(3), 543–574. https://doi.org/10.1007/s11558-019-09344-2

Hair, J., Black, W. C., Babin, B. J. & Anderson, R. E. (2010). Multivariate data analysis (7thed.). *Upper Saddle River, New Jersey: Pearson Educational International.*

Hall, B. H., Jaffe, A., & Trajtenberg, M. (2001). The NBER patent citation data file: Lessons, insights, and methodological tools. *NBER Working Paper No. 8498.*

Hall, B.H. (2002). The financing of research and development. *Oxford Review of Economic Policy. Vol.18 No. 1, pp. 35-51.*

Harvey, M., & Novicevic, M. M. (2002). The hypercompetitive global marketplace: the importance of intuition and creativity in expatriate managers. *Journal of World Business*, *37*(2), 127–138. https://doi.org/10.1016/S1090-9516(02)00072-X

Henry, M. (2020). Patent ownership VS. inventorship: Who really controls the rights to a patent? *Henry Patent Law Firm. https://henry.law/blog/patent-ownership-vs-inventorship/*

Hitt, M.A., Tihanyi, L., Miller, T., Connelly, B. (2006). International diversification: antecedants, outcomes and moderators. *Journal of Management* 32(6): 831–867.

Hovhannisyan, N., & Keller, W. (2015). International business travel: an engine of innovation? *Journal of Economic Growth*, *20*(1), 75–104. https://doi.org/10.1007/s10887-014-9107-7

Hsu, P.H., Tian, X. and Xu, Y. (2014). Financial development and innovation: cross-country evidence. *Journal of Financial Economics, Vol. 112, pp. 116-135.*

Jens, C.E. (2017). Political uncertainty and investment: Causal evidence from us gubernatorial elections. *Journal of Financial Economics 124(3), 563-579.*

Julio, B, and Yook, Y. 2012. Political uncertainty and corporate investment cycles. *Journal of Finance 67(1), 45-83.*

Kim, W. C., Hwang, P., & Burgers, W. P. (1993). Multinationals' Diversification and the Risk-Return Trade-Off. *Strategic Management Journal, 14*(4), 275–286. http://www.jstor.org/stable/2486795

Kleinknecht, A., Montfort, V. K., & Brouwer, E. (2002). The non-trivial choicebetween innovation indicators. *Economics of Innovation and New Technology,11(2), 109–121.*

KOF Swiss Economic Institute. (2021). *2021 KOF Globalisation Index*. https://ethz.ch/content/dam/ethz/special-interest/dual/kofdam/documents/Globalization/2021/KOFGI_2021_method.pdf

Kogut, B. (1983). Foreign direct investment as a sequential process. *The multinational corporation in the 1980s*. https://www.econbiz.de/Record/foreign-direct-investment-as-a-sequential-process-kogut-bruce/10002214170

Kumar, N. (1987). Technology Imports and Local Research and Development in Indian Manufacturing. *The Developing Economies, 25, pp. 220-233.*

Kumar, N., & Siddharthan, N. S. (1994). Technology, firm size and export behavior in developing countries: the case of indian enterprises. *Journal of Development Studies, 31*(2), 289.

Lin, H.-lin, & Lin, E. S. (2010). Fdi, trade, and product innovation: theory and evidence. *Southern Economic Journal, 77*(2), 434–464.

Lockwood, B., & Redoano, M. (2005). The CSGR Globalisation Index: an Introductory Guide. *Centre for the Study of Globalisation and Regionalisation Working Paper 155/04.*

McAleer, M. J.. (2010). Globalization and knowledge spillover: international direct investment, exports and patents. *Report / Econometric Institute, Erasmus University Rotterdam, Pp. 1-39*. http://repub.eur.nl/pub/20785.

Murray, F., Aghion, P., Dewatripont, M., Kolev, J., & Stern, S. (2016). Of mice and academics: examining the effect of openness on innovation. *American Economic Journal: Economic Policy*, *8*(1), 212–252.

Ogbonna, O. E., Ogbuabor, J. E., Manasseh, C. O., & Ekeocha, D. O. (2022). Global uncertainty, economic governance institutions and foreign direct investment inflow in africa. *Economic Change and Restructuring, (20220129)*. https://doi.org/10.1007/s10644-021-09378-w

Nederlands Enterprise Agency. (2021). *Patent Application in Europe: Costs*. RVO. https://english.rvo.nl/information/patents-intellectual-property/how-to-apply-for-patent/europe/costs

Patnaik, R. (2016). Competition and the real effects of uncertainty. *Available at SSRN*

2797866.

Phan, V. H., Nam, H. N., Hien, T. N., & Shantaram, H. (2019). Policy uncertainty and firm cash holdings. *Journal of Business Research, 95, 71–82.*

Potrafke, N. (2015). The evidence on globalisation. *The World Economy*, *38*(3), 509–552. https://doi.org/10.1111/twec.12174

Pottelsberghe, B.P. and F. Lichtenberg. (2001). Does Foreign Direct Investment Transfer Technology across Borders? *Review of Economics and Statistics, 83, pp. 490-497.*

Quinn, D. P., Schindler, M., & Toyoda, M. A. (2011). Assessing measures of financial openness and integration. *IMF Economic Review*, *59*(3), 488–522.

Rugman, A. (1976). Risk Reduction by International Diversification. *J Int Bus Stud* 7, 75–80 (1976). https://doi.org/10.1057/palgrave.jibs.8490702

Salomon, R.M. and J.M. Shaver. (2005). Innovation, Learning by Exporting: New Insights from Examining Firms. *Journal of Economics & Management Strategy, 14, pp. 431-460.*

Simmons, B. A., & Elkins, Z. (2004). The globalization of liberalization: policy diffusion in the international political economy. *The American Political Science Review*, *98*(1), 171–189.

Stock, J., & Watson, M. (2003). An Introduction to Econometrics (4th ed.). *Pearson.*

Tajaddini, R., & Gholipour, H. F. (2021). Economic policy uncertainty, r&d expenditures and innovation outputs. *Journal of Economic Studies*, *48*(2).

Thoumrungroje, A., & Tansuhaj, P. (2007). Globalization effects and firm performance. *Journal of International Business Research, 6(2), 43.*

Benelux Office for Intellectual Property. (z.d.). *Trademark in the Benelux, EU or international?*. BOIP. https://www.boip.int/en/entrepreneurs/trademarks/trademark-in-benelux-eu-or-international

Van Vo, L. and Le, H.T.T. (2017). Strategic growth option, uncertainty, and R&D investment. *International Review of Financial Analysis, Vol. 51, pp. 16-24.*

Wang, Y., Ning, L., Li, J. and Prevezer, M. (2016). Foreign direct investment spillovers and the geography of innovation in Chinese regions: the role of regional industrial specialization and diversity. *Regional Studies, Vol. 50, pp. 805-822.*

William, M., & Fengrong, W. (2022). Economic policy uncertainty and industry innovation: cross country evidence. *Quarterly Review of Economics and Finance*, *84*, 208–228. https://doi.org/10.1016/j.qref.2022.01.012

Xiang, J., Ma, F., & Wang, H. (2021). The effect of intellectual property treaties on international innovation collaboration: a study based on uspto patents during 1976-2017. *Library Hi Tech, (2021)*. https://doi.org/10.1108/LHT-08-2020-0202

Appendix

Table 1

Description of variables.

Variable	Description
Panel variables	
Country	Country
Year	Year
Dependent Variables Innovation	
Research and development (R&D) expenditure	Total gross intramural research and development (R&D) expenditure per capita in current purchasing power parity dollars (PPP $).
Patent granted at the European Patent Office (EPO)	Patents granted at the European Patent Office (EPO)
Patent granted at the United States Patent and Trademark Office (USPTO)	Patents granted at the United States Patent and Trademark Office (USPTO)
National Patent Applications	Patent Applications at the National Patent Office, applied for by Residents (direct and PCT). Patents are counted by a country's filing office.
National Trademark Applications	Resident Trademark applications at the National Patent Office, applied for by Residents (direct and via the Madrid system). Patents are counted by a country's filing office.
Independent Variables	
Economic policy uncertainty (EPU)	Economic Policy Uncertainty Index
KOF Economic Globalization Index (KOF EC GI)	Economic Globalization Index (KOF)
KOF Social Globalization Index (KOF SO GI)	Social Globalization Index (KOF)
KOF Political Globalization Index (KOF PO GI)	Political Globalization Index (KOF)
Control Variables	
Gross Domestic Product (GDP) (x Million)	Gross Domestic Product (GDP) measured in US dollars (x Million)
Domestic Credit (% GDP)	domestic credit to the private sector by banks, measured as a % of total gross domestic product (GDP). Domestic credit by banks refers to any financial resource that generates a claim for repayment, provided by corporations that take depositories. The central bank is excluded from this definition.
Market Capitalization (%GDP)	market capitalization of listed domestic companies, measured as a % of gross domestic product (GDP). Market capitalization is defined as the market value of a company, which is measured through the multiplication of the number of shares that are currently outstanding and the share price.
Medium/ High Tech Exports	medium and high tech esports, as a % of total manufactured exports.
Tertiary Education	Gross enrollment ratio in Tertiary education. This proxy is measured as the enrollment in tertiary education, as a percentage of the total age group that officially belongs to the tertiary level of education.

Table 2

Globalization Index (KOF), Variables and Weights (Gygli et al., 2019).

Globalisation Index, de facto	Weights	Globalisation Index, de jure	weights
Economic Globalisation, de facto	**33.3**	**Economic Globalisation, de jure**	**33.3**
Trade Globalisation, de facto	*50.0*	*Trade Globalisation, de jure*	*50*
Trade in goods	38.1	Trade regulations	27.9
Trade in services	42.6	Trade taxes	28.1
Trade partner diversity	19.3	Tariffs	26.4
		Trade agreements	17.5
Financial Globalisation, de facto	*50.0*	*Financial Globalisation, de jure*	*50.0*
Foreign direct investment	26.3	Investment restrictions	30.6
Portfolio investment	16.5	Capital account openness	38.8
International debt	29	International Investment Agreements	30.6
International reserves	0.8		
International income payments	27.5		
Social Globalisation, de facto	**33.3**	**Social Globalisation, de jure**	**33.3**
Interpersonal Globalisation, de facto	*33.3*	*Interpersonal Globalisation, de jure*	*33.3*
International voice traffic	20.7	Telephone subscriptions	38.7
Transfers	22.2	Freedom to visit	32.7
International tourism	21.2	International airports	28.6
International students	18.7		
Migration	17.2		
Informational Globalisation, de facto	*33.3*	*Informational Globalisation, de jure*	*33.3*
Used internet bandwidth	40.8	Television access	38.1
International patents	30.1	Internet access	43.5
High technology exports	29.1	Press freedom	18.4
Cultural Globalisation, de facto	*33.3*	*Cultural Globalisation, de jure*	*33.3*
Trade in cultural goods	27.4	Gender parity	22.2
Trade in personal services	24.6	Human capital	41.7
International trademarks	3	Civil liberties	36.2
McDonald's restaurant	24.4		
IKEA stores	20.6		
Political Globalisation, de facto	**33.3**	**Political Globalisation, de jure**	**33.3**
Embassies	37.2	International organizations	36.5
UN Peace keeping missions	24.6	International treaties	32.6
International NGOs	38.2	Treaty partner diversity	30.9

The economic dimension is split up into a trade- and a financial sub-index. The social dimension got split up into an interpersonal-, informational- and cultural sub-index. The weights of these higher ranked sub-indices are determined using equal weights that are set over the time horizon. Principal component analysis to determine the weights for each of the individual variables. The weights at time *t* are calculated using observations from the year *t-10* up to *t-1*. The full sample of countries is used for calculating the weights for each of the individual variables.

Gygli, Savina, Florian Haelg, Niklas Potrafke and Jan-Egbert Sturm (2019): The KOF Globalisation Index – Revisited, *Review of International Organizations, 14(3), 543-57* https://doi.org/10.1007/s11558-019-09344-2

Table 3

Multicollinearity checked by its VIF index.

Variable	VIF	1/VIF
EPU	1.58	0.631160
KOF SO GI	9.96	0.100442
KOF EC GI	6.70	0.149257
KOF PO GI	4.06	0.246053
Domestic credit (% GDP)	1.95	0.513964
Medium/ High Tech Exports	1.73	0.578736
Tertiary Education	2.50	0.399939
Market Capitalization (%GDP)	4.57	0.219034
GDP (x Million)	1.64	0.610767
Mean VIF	4.35	

This table presents the VIF index of all raw variables. Results are based on an unbalanced sample of 25 countries' innovation performance between November 1997 and 2017. Table 1 in the appendix provides definitions of all initial variables. There is no multicollinearity problem (VIF<10).

Table 4

Wooldridge Test for autocorrelation in panel data.

Variable	F-value	Prob > F
R&D Expenditure	230.097	0.0000
(Ln) National Patent Applications	51.878	0.0000
(Ln) National Trademark Applications	25.640	0.0000
(Ln) EPO patent Grants	1.256	0.2751
(Ln) USPTO patent Grants	16.993	0.0005

This table presents the Wooldridge test statistic and p-value. Under the null-hypothesis, there is no first-order autocorrelation in the data.

Table 5

Modified Wald Test for groupwise heteroskedasticity in fixed effect regression model (xttest).

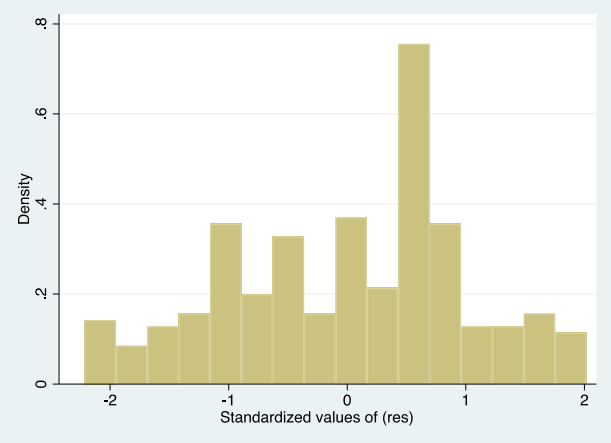
Variable	Chi2	Prob > Chi2
R&D Expenditure	2962.45	0.0000
(ln) National Patent Applications	2.2e+28	0.0000
(Ln) National Trademark Applications	8.9e+28	0.0001
(Ln) EPO Patent Grants	4.0e+29	0.0000
(Ln) USPTO Patent Grants	1200.95	0.0000

This table presents the Wald test statistic and p-value. All innovation measurement specifications generate significant heteroskedastic error terms.

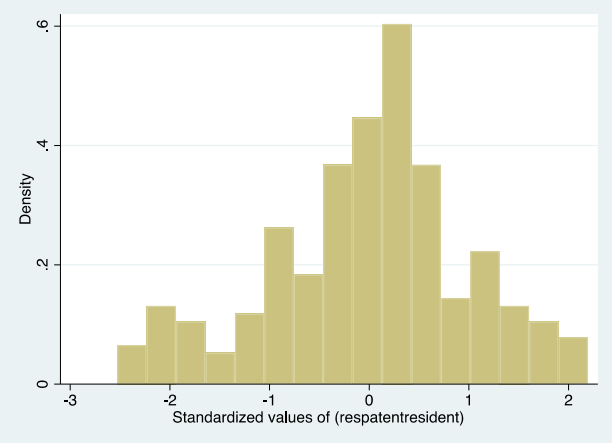
Table 6

Standardized residuals plot.

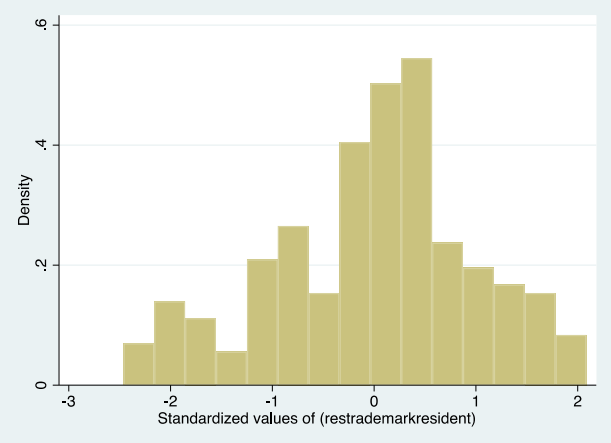
R&D Expenditure



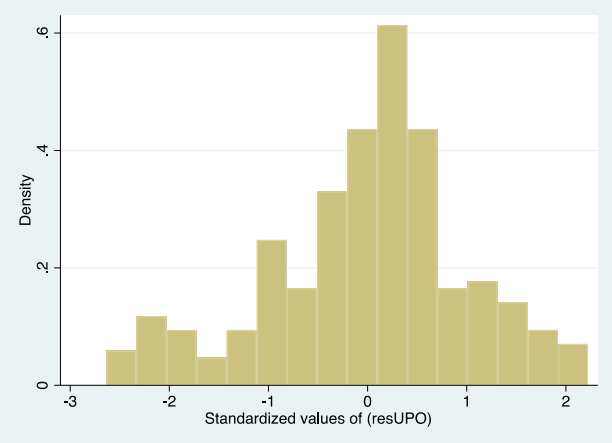
National Patent Applications



National Trademark Applications



EPO Grants



USPTO Grants

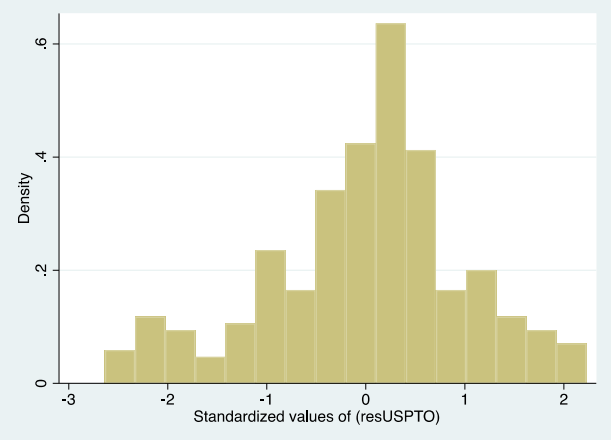


Table 7

Result from a cross-country fixed effects analysis on research and development (R&D) expenditure.

	(1)	(2)	(3)	(4)	(5)
EPU		0.196		0.406	2.773
		(0.522)		(0.504)	(2.096)
KOF EC GI			11.29	12.29	14.86
			(9.616)	(9.597)	(10.69)
KOF SO GI			-28.00***	-28.46***	-28.98***
			(9.569)	(9.162)	(9.983)
KOF PO GI			5.759	7.856	5.375
			(15.36)	(14.03)	(12.96)
EPU # KOF EC GI					-0.0208
					(0.0208)
EPU # KOF SO GI					-0.00745
					(0.0242)
EPU # .KOF PO GI					-0.00576
					(0.0128)
GDP (X Million)	-2.98e-06	-2.93e-06	1.58e-05***	1.66e-05***	1.20e-05**
	(1.23e-05)	(1.22e-05)	(5.21e-06)	(5.26e-06)	(4.99e-06)
Domestic Credit (% GDP)	0.326	0.222	0.383	0.181	0.0838
	(0.938)	(0.838)	(0.815)	(0.667)	(0.628)
Medium / High Tech Exports	-3.650	-3.499	-3.072	-3.289	-3.427
	(5.476)	(5.116)	(2.014)	(1.939)	(2.188)
Tertiary Education	-0.689	-0.485	-0.708	-0.357	-1.169
	(2.154)	(2.303)	(2.662)	(2.731)	(2.606)
Market Capitalization (% GDP)	0.145	0.143	0.0521	0.0597	0.0614
	(0.164)	(0.165)	(0.0898)	(0.0954)	(0.0855)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	318.3	290.4	861.7	632.8	734.9
	(320.0)	(274.6)	(1,219)	(1,075)	(975.1)
Observations	265	265	265	265	265
R-squared	0.574	0.575	0.663	0.670	0.681
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent
variable is R&D expenditure. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 8

Results from a cross-country fixed effects analysis on the natural logarithm of national patent applications.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.00203***		-0.00131***	-5.70e-05
		(0.000364)		(0.000404)	(0.00200)
KOF EC GI			0.0241***	0.0216***	0.0138*
			(0.00549)	(0.00594)	(0.00694)
KOF SO GI			-0.00186	-0.000458	0.00970
			(0.00947)	(0.00971)	(0.0110)
KOF PO GI			0.0415***	0.0343***	0.0365**
			(0.0106)	(0.0108)	(0.0130)
EPU # KOF EC GI					7.77e-05
					(5.24e-05)
EPU # KOF SO GI					-9.13e-05
					(5.83e-05)
EPU # .KOF PO GI					5.57e-06
					(1.95e-05)
GDP (X Million)	1.63e-07***	1.63e-07***	1.78e-07***	1.76e-07***	1.70e-07***
	(2.65e-08)	(2.47e-08)	(2.36e-08)	(2.33e-08)	(2.36e-08)
Domestic Credit (% GDP)	-0.000390	0.00120	0.000937	0.00184	0.00200
	(0.00158)	(0.00138)	(0.00161)	(0.00141)	(0.00139)
Medium / High Tech Exports	0.0290**	0.0285**	0.0170*	0.0183**	0.0171*
	(0.0116)	(0.0106)	(0.00831)	(0.00841)	(0.00852)
Tertiary Education	0.00984*	0.00696*	0.00714*	0.00565*	0.00542
	(0.00522)	(0.00353)	(0.00371)	(0.00291)	(0.00320)
Market Capitalization (% GDP)	-0.000536**	-0.000542**	-0.000244	-0.000288	-0.000222
	(0.000207)	(0.000210)	(0.000249)	(0.000274)	(0.000224)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	5.817***	6.063***	1.848	2.562**	2.218*
	(0.617)	(0.592)	(1.192)	(1.137)	(1.204)
Observations	258	258	258	258	258
R-squared	0.753	0.790	0.828	0.842	0.846
Number of CatCountry	23	23	23	23	23

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable is patent application at the national office. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 9

Result from a cross-country fixed effects analysis on the natural logarithm of national trademark applications.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.00114**		-0.000936*	-0.000567
		(0.000421)		(0.000490)	(0.00276)
KOF EC GI			-0.00140	-0.00298	-0.00383
			(0.00455)	(0.00452)	(0.00740)
KOF SO GI			0.0174**	0.0186**	0.0197*
			(0.00833)	(0.00868)	(0.00996)
KOF PO GI			0.0234***	0.0173*	0.0204*
			(0.00726)	(0.00915)	(0.0108)
EPU # KOF EC GI					8.23e-06
					(4.49e-05)
EPU # KOF SO GI					6.10e-06
					(6.48e-05)
EPU # .KOF PO GI					-1.52e-05
					(2.36e-05)
GDP (X Million)	7.02e-08***	7.07e-08***	6.55e-08***	6.40e-08***	6.64e-08**
	(2.48e-08)	(2.45e-08)	(2.13e-08)	(2.19e-08)	(2.51e-08)
Domestic Credit (% GDP)	0.000640	0.00136	0.00103	0.00155	0.00150
	(0.00146)	(0.00134)	(0.00140)	(0.00134)	(0.00131)
Medium / High Tech Exports	0.0228**	0.0220**	0.0167**	0.0172***	0.0166**
	(0.00920)	(0.00866)	(0.00633)	(0.00584)	(0.00621)
Tertiary Education	-0.00721**	-0.00832**	-0.00854***	-0.00920***	-0.00930***
	(0.00314)	(0.00308)	(0.00302)	(0.00305)	(0.00321)
Market Capitalization (% GDP)	-3.48e-05	-2.31e-05	0.000233	0.000208	0.000178
	(0.000242)	(0.000235)	(0.000194)	(0.000186)	(0.000162)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	8.930***	9.084***	6.428***	6.992***	6.758***
	(0.404)	(0.418)	(0.833)	(0.987)	(1.085)
Observations	236	236	236	236	236
R-squared	0.687	0.706	0.717	0.729	0.730
Number of CatCountry	22	22	22	22	22

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable is trademark applications at the national office. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 10

Result from a cross-country fixed effects analysis on the natural logarithm of patent granted at the European Patent Office (EPO).

	(1)	(2)	(3)	(4)	(5)
EPU		-1.56e-05		0.00105	0.00724**
		(0.000811)		(0.000821)	(0.00343)
KOF EC GI			0.0277***	0.0295***	0.0279**
			(0.00717)	(0.00722)	(0.0104)
KOF SO GI			-0.00329	-0.00448	0.00342
			(0.0199)	(0.0193)	(0.0230)
KOF PO GI			0.0515*	0.0572**	0.0552*
			(0.0283)	(0.0268)	(0.0277)
EPU # KOF EC GI					2.37e-05
					(6.27e-05)
EPU # KOF SO GI					-8.93e-05
					(8.06e-05)
EPU # .KOF PO GI					-1.37e-05
					(2.42e-05)
GDP (X Million)	1.16e-07**	1.16e-07**	1.32e-07***	1.33e-07***	1.19e-07**
	(4.60e-08)	(4.61e-08)	(4.66e-08)	(4.63e-08)	(4.84e-08)
Domestic Credit (% GDP)	-0.000113	-0.000104	0.000982	0.000460	0.000375
	(0.00211)	(0.00198)	(0.00138)	(0.00120)	(0.00132)
Medium / High Tech Exports	0.0256	0.0256	0.0112	0.0105	0.00945
	(0.0156)	(0.0157)	(0.0107)	(0.0103)	(0.00990)
Tertiary Education	0.0140***	0.0140***	0.0109**	0.0118***	0.00982**
	(0.00432)	(0.00432)	(0.00401)	(0.00382)	(0.00366)
Market Capitalization (% GDP)	-0.000147	-0.000147	0.000189	0.000209	0.000243
	(0.000344)	(0.000346)	(0.000230)	(0.000220)	(0.000191)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	3.054***	3.056***	-1.708	-2.281	-2.465
	(0.996)	(1.021)	(2.181)	(2.093)	(2.208)
Observations	279	279	279	279	279
R-squared	0.666	0.666	0.736	0.742	0.749
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable is patents grants at the EPO. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 11

Result from a cross-country fixed effects analysis on the natural logarithm of patent granted at the United States Patent and Trademark Office (USPTO).

	(1)	(2)	(3)	(4)	(5)
EPU		-0.000769		0.000349	0.00420
		(0.000579)		(0.000574)	(0.00338)
KOF EC GI			0.0215***	0.0222***	0.0140
			(0.00690)	(0.00695)	(0.0109)
KOF SO GI			0.0243*	0.0239*	0.0374***
			(0.0132)	(0.0133)	(0.0117)
KOF PO GI			0.0653***	0.0672***	0.0638***
			(0.0206)	(0.0198)	(0.0197)
EPU # KOF EC GI					8.46e-05
					(5.62e-05)
EPU # KOF SO GI					-0.000159**
					(6.73e-05)
EPU # .KOF PO GI					2.69e-05
					(3.12e-05)
GDP (X Million)	1.06e-07***	1.06e-07***	1.06e-07***	1.07e-07***	9.00e-08***
	(3.45e-08)	(3.46e-08)	(2.72e-08)	(2.72e-08)	(2.66e-08)
Domestic Credit (% GDP)	-0.000444	-1.38e-05	0.000804	0.000630	0.000866
	(0.00169)	(0.00162)	(0.00113)	(0.000996)	(0.00102)
Medium / High Tech Exports	0.0241	0.0236	0.00439	0.00417	0.00364
	(0.0151)	(0.0152)	(0.00954)	(0.00945)	(0.00741)
Tertiary Education	0.0164***	0.0155***	0.0123***	0.0126***	0.0115***
	(0.00356)	(0.00340)	(0.00299)	(0.00306)	(0.00261)
Market Capitalization (% GDP)	-0.000827***	-0.000820**	-0.000248	-0.000241	-9.46e-05
	(0.000292)	(0.000293)	(0.000261)	(0.000258)	(0.000217)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	4.139***	4.244***	-2.777*	-2.968*	-3.113**
	(0.861)	(0.894)	(1.576)	(1.509)	(1.447)
Observations	279	279	279	279	279
R-squared	0.743	0.747	0.843	0.843	0.855
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sample of 25 countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable is patents grants at the USPTO. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 12

The direct effect of economic policy uncertainty and globalization on innovation, using a subsample analysis on 11 European countries: Result from a cross-country fixed effects analysis on five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	-0.296	-0.000709	0.000182	0.000931	0.00108
	(0.302)	(0.000542)	(0.000923)	(0.000642)	(0.000686)
KOF EC GI	-12.47*	-0.0313	0.000893	0.0236***	-0.00557
	(5.829)	(0.0173)	(0.0146)	(0.00634)	(0.0273)
KOF SO GI	9.067	0.00951	-0.0449*	-0.0177	0.0215
	(6.880)	(0.0178)	(0.0212)	(0.0169)	(0.0237)
KOF PO GI	-20.74**	-0.0625	-0.120***	0.0795***	-0.0262
	(8.398)	(0.0386)	(0.0327)	(0.0192)	(0.0252)
GDP (X Million)	-0.000206**	-1.23e-07	-7.66e-09	1.31e-07***	-3.48e-07
	(9.13e-05)	(2.47e-07)	(1.87e-07)	(4.25e-08)	(2.72e-07)
Domestic Credit (% GDP)	0.139	-0.000214	-0.00359*	0.000110	0.000792
	(0.471)	(0.00186)	(0.00158)	(0.00103)	(0.00143)
Medium / High Tech Exports	4.715	0.0134	0.0203*	0.00826	0.00790
	(4.386)	(0.00929)	(0.00993)	(0.00868)	(0.0113)
Tertiary Education	-1.127	0.0150***	-0.00849*	0.0108***	0.0152***
	(2.261)	(0.00370)	(0.00451)	(0.00268)	(0.00437)
Market Capitalization (% GDP)	2.379***	0.00388*	-0.00137	0.000195	0.00223
	(0.551)	(0.00200)	(0.00237)	(0.000211)	(0.00193)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	2,127**	13.85***	22.95***	-2.663	6.611**
	(899.8)	(4.105)	(3.654)	(1.740)	(2.323)
Observations	131	114	93	273	135
R-squared	0.863	0.610	0.678	0.758	0.769
Number of CatCountry	11	10	9	24	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 13

The moderating effect of globalization on the relationship between economic policy uncertainty and innovation, using a subsample analysis on 11 European countries: Result from a cross-country fixed effects analysis on five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	-9.366*	-0.0155	-0.0438***	0.000440	0.0143
	(4.876)	(0.00974)	(0.0121)	(0.00693)	(0.00851)
KOF EC GI	-20.92**	-0.0357	-0.0283**	-0.0150	-0.00216
	(9.164)	(0.0253)	(0.00945)	(0.0103)	(0.0284)
KOF SO GI	15.50	0.0280	-0.0437**	0.0358**	0.0227
	(8.580)	(0.0208)	(0.0180)	(0.0121)	(0.0231)
KOF PO GI	-21.16*	-0.0912**	-0.0937***	0.0396**	-0.0232
	(9.865)	(0.0399)	(0.0232)	(0.0137)	(0.0313)
EPU # KOF EC GI	0.0700*	0.000133	0.000106	2.25e-05	4.34e-05
	(0.0373)	(8.51e-05)	(9.56e-05)	(3.99e-05)	(7.86e-05)
EPU # KOF SO GI	-0.0180	-0.000272**	0.000229**	2.79e-05	-8.25e-05
	(0.0460)	(0.000112)	(7.78e-05)	(5.76e-05)	(0.000143)
EPU # .KOF PO GI	0.0534	0.000290***	0.000172	-4.26e-05	-0.000102
	(0.0363)	(5.92e-05)	(9.37e-05)	(4.50e-05)	(0.000103)
GDP (X Million)	-0.000257**	-2.27e-07	-3.39e-07	-3.92e-07**	-1.56e-07
	(9.68e-05)	(1.97e-07)	(2.71e-07)	(1.66e-07)	(2.74e-07)
Domestic Credit (% GDP)	0.582	0.00150	-0.00270*	0.000599	0.000881
	(0.477)	(0.00230)	(0.00141)	(0.000445)	(0.00121)
Medium / High Tech Exports	4.869	0.0134	0.0144	-0.00255	0.0112
	(3.908)	(0.00798)	(0.00997)	(0.00688)	(0.0102)
Tertiary Education	-2.471	0.0113**	-0.0127*	0.00189	0.0168***
	(2.384)	(0.00362)	(0.00573)	(0.00224)	(0.00436)
Market Capitalization (% GDP)	1.892**	0.00247	-0.00314*	0.000575	0.00229
	(0.617)	(0.00196)	(0.00160)	(0.000434)	(0.00192)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	2,466**	15.59**	23.88***	1.551	5.510*
	(987.7)	(4.887)	(2.969)	(1.971)	(2.614)
Observations	131	114	93	135	135
R-squared	0.878	0.686	0.765	0.778	0.776
Number of CatCountry	11	10	9	11	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 14

Sub-sample analysis on 11 European countries: Result from a cross-country fixed effects analysis on Research and Development (R&D) Expenditure.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.375		-0.296	-9.366*
		(0.402)		(0.302)	(4.876)
KOF EC GI			-15.04*	-12.47*	-20.92**
			(7.809)	(5.829)	(9.164)
KOF SO GI			8.560	9.067	15.50
			(6.827)	(6.880)	(8.580)
KOF PO GI			-20.52*	-20.74**	-21.16*
			(9.605)	(8.398)	(9.865)
EPU # KOF EC GI					0.0700*
					(0.0373)
EPU # KOF SO GI					-0.0180
					(0.0460)
EPU # .KOF PO GI					0.0534
					(0.0363)
GDP (X Million)	-0.000209*	-0.000185	-0.000218**	-0.000206**	-0.000257**
	(0.000114)	(0.000109)	(9.67e-05)	(9.13e-05)	(9.68e-05)
Domestic Credit (% GDP)	0.183	0.201	0.113	0.139	0.582
	(0.471)	(0.462)	(0.469)	(0.471)	(0.477)
Medium / High Tech Exports	3.887	3.016	5.070	4.715	4.869
	(3.939)	(4.172)	(4.234)	(4.386)	(3.908)
Tertiary Education	-1.818	-2.585	-0.429	-1.127	-2.471
	(2.360)	(2.469)	(2.209)	(2.261)	(2.384)
Market Capitalization (% GDP)	2.395**	2.350***	2.415***	2.379***	1.892**
	(0.806)	(0.720)	(0.590)	(0.551)	(0.617)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	7.463	108.1	2,266*	2,127**	2,466**
	(319.3)	(328.8)	(1,074)	(899.8)	(987.7)
Observations	131	131	131	131	131
R-squared	0.843	0.848	0.861	0.863	0.878
Number of CatCountry	11	11	11	11	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.

Table 15

Sub-sample analysis on 11 European countries: Result from a cross-country fixed effects analysis on the natural logarithm of National Patent Applications

	(1)	(2)	(3)	(4)	(5)
EPU		-0.00111*		-0.000709	-0.0155
		(0.000493)		(0.000542)	(0.00974)
KOF EC GI			-0.0423**	-0.0313	-0.0357
			(0.0137)	(0.0173)	(0.0253)
KOF SO GI			0.00872	0.00951	0.0280
			(0.0182)	(0.0178)	(0.0208)
KOF PO GI			-0.0670	-0.0625	-0.0912**
			(0.0403)	(0.0386)	(0.0399)
EPU # KOF EC GI					0.000133
					(8.51e-05)
EPU # KOF SO GI					-0.000272**
					(0.000112)
EPU # .KOF PO GI					0.000290***
					(5.92e-05)
GDP (X Million)	-1.19e-07	-3.19e-08	-1.72e-07	-1.23e-07	-2.27e-07
	(2.46e-07)	(2.19e-07)	(2.35e-07)	(2.47e-07)	(1.97e-07)
Domestic Credit (% GDP)	-0.000136	-1.78e-06	-0.000389	-0.000214	0.00150
	(0.00171)	(0.00157)	(0.00191)	(0.00186)	(0.00230)
Medium / High Tech Exports	0.00986	0.0106	0.0122	0.0134	0.0134
	(0.00819)	(0.00759)	(0.0102)	(0.00929)	(0.00798)
Tertiary Education	0.0129**	0.0110**	0.0168***	0.0150***	0.0113**
	(0.00497)	(0.00434)	(0.00451)	(0.00370)	(0.00362)
Market Capitalization (% GDP)	0.00403	0.00356	0.00418*	0.00388*	0.00247
	(0.00306)	(0.00270)	(0.00207)	(0.00200)	(0.00196)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	6.668***	6.766***	15.07***	13.85***	15.59**
	(0.623)	(0.503)	(4.143)	(4.105)	(4.887)
Observations	114	114	114	114	114
R-squared	0.541	0.564	0.602	0.610	0.686
Number of CatCountry	10	10	10	10	10

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.

Table 16

Sub-sample analysis on 11 European countries: Result from a cross-country fixed effects analysis on the natural logarithm of National Trademark Applications.

	(1)	(2)	(3)	(4)	(5)
EPU		0.000826		0.000182	-0.0438***
		(0.00130)		(0.000923)	(0.0121)
KOF EC GI			0.00282	0.000893	-0.0283**
			(0.0162)	(0.0146)	(0.00945)
KOF SO GI			-0.0447*	-0.0449*	-0.0437**
			(0.0216)	(0.0212)	(0.0180)
KOF PO GI			-0.122***	-0.120***	-0.0937***
			(0.0356)	(0.0327)	(0.0232)
EPU # KOF EC GI					0.000106
					(9.56e-05)
EPU # KOF SO GI					0.000229**
					(7.78e-05)
EPU # .KOF PO GI					0.000172
					(9.37e-05)
GDP (X Million)	-1.81e-07	-2.10e-07	-4.73e-09	-7.66e-09	-3.39e-07
	(3.07e-07)	(3.32e-07)	(1.84e-07)	(1.87e-07)	(2.71e-07)
Domestic Credit (% GDP)	-0.00301	-0.00323	-0.00354*	-0.00359*	-0.00270*
	(0.00235)	(0.00247)	(0.00158)	(0.00158)	(0.00141)
Medium / High Tech Exports	0.0170	0.0168	0.0205*	0.0203*	0.0144
	(0.0110)	(0.0109)	(0.00955)	(0.00993)	(0.00997)
Tertiary Education	-0.0160**	-0.0141**	-0.00889*	-0.00849*	-0.0127*
	(0.00607)	(0.00452)	(0.00435)	(0.00451)	(0.00573)
Market Capitalization (% GDP)	-0.000538	-0.000495	-0.00140	-0.00137	-0.00314*
	(0.00295)	(0.00269)	(0.00242)	(0.00237)	(0.00160)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	9.440***	9.340***	22.95***	22.95***	23.88***
	(0.948)	(0.907)	(3.694)	(3.654)	(2.969)
Observations	93	93	93	93	93
R-squared	0.541	0.549	0.677	0.678	0.765
Number of CatCountry	9	9	9	9	9

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.

Table 17

Sub-sample analysis on 11 European countries: Result from a cross-country fixed effects analysis on the natural logarithm of USPTO patent grants.

	(1)	(2)	(3)	(4)	(5)
EPU		0.00113*		0.00108	0.0143
		(0.000559)		(0.000686)	(0.00851)
KOF EC GI			0.00423	-0.00557	-0.00216
			(0.0262)	(0.0273)	(0.0284)
KOF SO GI			0.0230	0.0215	0.0227
			(0.0236)	(0.0237)	(0.0231)
KOF PO GI			-0.0275	-0.0262	-0.0232
			(0.0269)	(0.0252)	(0.0313)
EPU # KOF EC GI					4.34e-05
					(7.86e-05)
EPU # KOF SO GI					-8.25e-05
					(0.000143)
EPU # .KOF PO GI					-0.000102
					(0.000103)
GDP (X Million)	-2.03e-07	-2.75e-07	-3.01e-07	-3.48e-07	-1.56e-07
	(2.68e-07)	(2.77e-07)	(2.77e-07)	(2.72e-07)	(2.74e-07)
Domestic Credit (% GDP)	0.000868	0.000802	0.000891	0.000792	0.000881
	(0.00127)	(0.00130)	(0.00144)	(0.00143)	(0.00121)
Medium / High Tech Exports	0.00223	0.00446	0.00682	0.00790	0.0112
	(0.0113)	(0.00955)	(0.0122)	(0.0113)	(0.0102)
Tertiary Education	0.0122**	0.0143**	0.0127**	0.0152***	0.0168***
	(0.00479)	(0.00451)	(0.00411)	(0.00437)	(0.00436)
Market Capitalization (% GDP)	0.00198	0.00214	0.00210	0.00223	0.00229
	(0.00221)	(0.00221)	(0.00193)	(0.00193)	(0.00192)
Fixed Effects	Yes	Yes	yes	Yes	Yes
Constant	5.808***	5.533***	6.137**	6.611**	5.510*
	(0.884)	(0.803)	(2.614)	(2.323)	(2.614)
Observations	135	135	135	135	135
R-squared	0.753	0.763	0.761	0.769	0.776
Number of CatCountry	11	11	11	11	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.

Table 18

Sub-sample analysis on 11 European countries: Result from a cross-country fixed effects analysis on the natural logarithm of EPO grants.

	(1)	(2)	(3)	(4)	(5)
EPU		0.000453		0.000603	0.000440
		(0.000301)		(0.000406)	(0.00693)
KOF EC GI			-0.00881	-0.0143	-0.0150
			(0.00907)	(0.0105)	(0.0103)
KOF SO GI			0.0396***	0.0388***	0.0358**
			(0.0110)	(0.0109)	(0.0121)
KOF PO GI			0.0327*	0.0334*	0.0396**
			(0.0151)	(0.0155)	(0.0137)
EPU # KOF EC GI					2.25e-05
					(3.99e-05)
EPU # KOF SO GI					2.79e-05
					(5.76e-05)
EPU # .KOF PO GI					-4.26e-05
					(4.50e-05)
GDP (X Million)	-2.66e-07	-2.95e-07	-4.15e-07**	-4.41e-07**	-3.92e-07**
	(1.84e-07)	(1.81e-07)	(1.78e-07)	(1.67e-07)	(1.66e-07)
Domestic Credit (% GDP)	0.000398	0.000371	0.000509	0.000454	0.000599
	(0.000570)	(0.000547)	(0.000432)	(0.000397)	(0.000445)
Medium / High Tech Exports	-0.00214	-0.00125	-0.00360	-0.00300	-0.00255
	(0.00634)	(0.00671)	(0.00684)	(0.00677)	(0.00688)
Tertiary Education	0.00229	0.00314	0.000378	0.00174	0.00189
	(0.00229)	(0.00209)	(0.00188)	(0.00198)	(0.00224)
Market Capitalization (% GDP)	0.000249	0.000310	0.000665	0.000739	0.000575
	(0.000642)	(0.000628)	(0.000623)	(0.000627)	(0.000434)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	6.554***	6.444***	1.604	1.868	1.551
	(0.373)	(0.401)	(2.121)	(2.129)	(1.971)
Observations	135	135	135	135	135
R-squared	0.730	0.733	0.768	0.774	0.778
Number of CatCountry	11	11	11	11	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.

Table 19

The direct effect of economic policy uncertainty and globalization on innovation, using lagged independent- and control variables: Result from a cross-country fixed effects analysis on five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	0.650	-0.00136***	-0.000560	0.00100	0.000179
	(0.488)	(0.000464)	(0.000574)	(0.000671)	(0.000352)
KOF EC GI lag1	12.58	0.0207***	0.00588	0.0216**	0.0320***
	(9.940)	(0.00653)	(0.00473)	(0.00807)	(0.00880)
KOF SO GI lag1	-32.47***	-0.00565	0.0147	-0.0132	0.0120
	(11.15)	(0.00980)	(0.00866)	(0.0168)	(0.0123)
KOF PO GI lag1	21.46	0.0423**	0.00535	0.0998***	0.0448***
	(18.04)	(0.0157)	(0.00851)	(0.0198)	(0.0122)
GDP (X Million) lag 1	1.73e-05***	1.77e-07***	6.99e-08***	1.20e-07**	1.03e-07***
	(5.77e-06)	(2.47e-08)	(1.90e-08)	(4.30e-08)	(3.02e-08)
Domestic Credit (% GDP) lag 1	-0.0577	0.000946	0.00149	0.000506	0.00120
	(0.564)	(0.00151)	(0.00149)	(0.00117)	(0.00113)
Medium / High Tech Exports lag 1	-2.938	0.0173*	0.0211***	0.00269	0.00753
	(2.544)	(0.00884)	(0.00532)	(0.00938)	(0.00807)
Tertiary Education lag 1	-0.270	0.00275	-0.00945**	0.00767***	0.0106***
	(2.444)	(0.00356)	(0.00340)	(0.00261)	(0.00219)
Market Capitalization (% GDP) lag 1	0.0164	-0.000201	5.89e-05	0.000494	-0.000351
	(0.105)	(0.000294)	(0.000148)	(0.000306)	(0.000224)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	-235.0	2.522*	7.464***	-4.075**	-1.080
	(1,226)	(1.317)	(0.802)	(1.635)	(1.254)
Observations	249	241	219	261	261
R-squared	0.697	0.811	0.750	0.735	0.833
Number of CatCountry	24	23	22	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 20

The moderating effect on the relationship between economic policy uncertainty an innovation, using lagged independent- and control variables: Result from a cross-country fixed effects analysis on five innovation specifications.

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	2.540	-0.000579	-0.00250	0.00603*	0.00603*
	(1.857)	(0.00195)	(0.00220)	(0.00312)	(0.00312)
KOF EC GI lag1	14.57	0.0138	0.000410	0.0222*	0.0222*
	(10.70)	(0.00858)	(0.00671)	(0.0118)	(0.0118)
KOF SO GI lag1	-32.43***	0.00239	0.0188*	-0.00821	-0.00821
	(11.53)	(0.0116)	(0.00991)	(0.0178)	(0.0178)
KOF PO GI lag1	18.57	0.0462**	0.0140	0.0920***	0.0920***
	(17.32)	(0.0193)	(0.00974)	(0.0197)	(0.0197)
EPU # KOF EC GI lag1	-0.0153	7.17e-05	5.55e-05	3.85e-06	3.85e-06
	(0.0251)	(6.26e-05)	(3.73e-05)	(6.87e-05)	(6.87e-05)
EPU # KOF SO GI lag1	-0.00854	-7.09e-05	-1.25e-05	-8.25e-05	-8.25e-05
	(0.0284)	(5.89e-05)	(4.96e-05)	(6.24e-05)	(6.24e-05)
EPU # KOF PO GI lag1	-0.00308	-2.33e-06	-7.67e-06	9.11e-06	9.11e-06
	(0.0127)	(2.09e-05)	(2.15e-05)	(2.67e-05)	(2.67e-05)
GDP (X Million)	1.20e-05**	1.74e-07***	8.06e-08***	1.01e-07**	1.01e-07**
	(5.50e-06)	(2.45e-08)	(1.91e-08)	(4.60e-08)	(4.60e-08)
Domestic Credit (% GDP)	-0.167	0.00109	0.00167	0.000382	0.000382
	(0.539)	(0.00144)	(0.00143)	(0.00135)	(0.00135)
Medium / High Tech Exports	-3.055	0.0161	0.0200***	0.00239	0.00239
	(2.766)	(0.00941)	(0.00536)	(0.00940)	(0.00940)
Tertiary Education	-0.844	0.00251	-0.00869***	0.00623**	0.00623**
	(2.429)	(0.00400)	(0.00292)	(0.00285)	(0.00285)
Market Capitalization (% GDP)	0.0192	-0.000162	6.28e-05	0.000565*	0.000565*
	(0.0980)	(0.000256)	(0.000133)	(0.000276)	(0.000276)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	-105.0	2.131	6.861***	-3.791**	-3.791**
	(1,177)	(1.519)	(0.918)	(1.678)	(1.678)
Observations	249	241	219	261	261
R-squared	0.704	0.814	0.757	0.744	0.744
Number of CatCountry	24	23	22	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors. Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 21

Result from a cross-country fixed effects analysis on R&D, using lagged independent- and control variables.

	(1)	(2)	(3)	(4)	(5)
EPU		0.412		0.650	2.540
		(0.472)		(0.488)	(1.857)
KOF EC GI lag1			11.02	12.58	14.57
			(10.08)	(9.940)	(10.70)
KOF SO GI lag1			-32.19**	-32.47***	-32.43***
			(11.72)	(11.15)	(11.53)
KOF PO GI lag1			18.81	21.46	18.57
			(18.93)	(18.04)	(17.32)
EPU # KOF EC GI lag1					-0.0153
					(0.0251)
EPU # KOF SO GI lag1					-0.00854
					(0.0284)
EPU # KOF PO GI lag1					-0.00308
					(0.0127)
GDP (X Million)	-3.27e-06	-3.69e-06	1.75e-05**	1.73e-05***	1.20e-05**
	(1.28e-05)	(1.23e-05)	(6.46e-06)	(5.77e-06)	(5.50e-06)
Domestic Credit (% GDP)	0.268	0.0262	0.283	-0.0577	-0.167
	(1.009)	(0.841)	(0.737)	(0.564)	(0.539)
Medium / High Tech Exports	-1.859	-1.672	-2.543	-2.938	-3.055
	(5.431)	(5.064)	(2.786)	(2.544)	(2.766)
Tertiary Education	0.241	0.750	-0.883	-0.270	-0.844
	(2.233)	(2.237)	(2.435)	(2.444)	(2.429)
Market Capitalization (% GDP)	0.0380	0.0293	0.0112	0.0164	0.0192
	(0.153)	(0.152)	(0.106)	(0.105)	(0.0980)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	226.7	176.7	90.60	-235.0	-105.0
	(379.6)	(339.5)	(1,322)	(1,226)	(1,177)
Observations	249	249	249	249	249
R-squared	0.555	0.563	0.679	0.697	0.704
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent
variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 22

Result from a cross-country fixed effects analysis on the natural logarithm of National Patent Applications, using lagged independent- and control variables.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.00203***		-0.00136***	-0.000579
		(0.000462)		(0.000464)	(0.00195)
KOF EC GI lag1			0.0234***	0.0207***	0.0138
			(0.00635)	(0.00653)	(0.00858)
KOF SO GI lag1			-0.00571	-0.00565	0.00239
			(0.00895)	(0.00980)	(0.0116)
KOF PO GI lag1			0.0478***	0.0423**	0.0462**
			(0.0159)	(0.0157)	(0.0193)
EPU # KOF EC GI lag1					7.17e-05
					(6.26e-05)
EPU # KOF SO GI lag1					-7.09e-05
					(5.89e-05)
EPU # KOF PO GI lag1					-2.33e-06
					(2.09e-05)
GDP (X Million)	1.63e-07***	1.65e-07***	1.76e-07***	1.77e-07***	1.74e-07***
	(2.82e-08)	(2.58e-08)	(2.55e-08)	(2.47e-08)	(2.45e-08)
Domestic Credit (% GDP)	-0.00138	0.000259	1.67e-05	0.000946	0.00109
	(0.00177)	(0.00156)	(0.00169)	(0.00151)	(0.00144)
Medium / High Tech Exports	0.0261**	0.0261**	0.0162*	0.0173*	0.0161
	(0.0125)	(0.0117)	(0.00872)	(0.00884)	(0.00941)
Tertiary Education	0.00841	0.00516	0.00446	0.00275	0.00251
	(0.00568)	(0.00411)	(0.00433)	(0.00356)	(0.00400)
Market Capitalization (% GDP)	-0.000433*	-0.000422*	-0.000176	-0.000201	-0.000162
	(0.000214)	(0.000216)	(0.000276)	(0.000294)	(0.000256)
Fixed Effects	yes	yes	yes	yes	yes
Constant	6.117***	6.333***	1.859	2.522*	2.131
	(0.655)	(0.664)	(1.390)	(1.317)	(1.519)
Observations	241	241	241	241	241
R-squared	0.711	0.750	0.794	0.811	0.814
Number of CatCountry	23	23	23	23	23

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 23

Result from a cross-country fixed effects analysis on the natural logarithm of National Trademark Applications, using lagged independent- and control variables.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.000764		-0.000560	-0.00250
		(0.000510)		(0.000574)	(0.00220)
KOF EC GI lag1			0.00694	0.00588	0.000410
			(0.00465)	(0.00473)	(0.00671)
KOF SO GI lag1			0.0145	0.0147	0.0188*
			(0.00861)	(0.00866)	(0.00991)
KOF PO GI lag1			0.00805	0.00535	0.0140
			(0.00850)	(0.00851)	(0.00974)
EPU # KOF EC GI lag1					5.55e-05
					(3.73e-05)
EPU # KOF SO GI lag1					-1.25e-05
					(4.96e-05)
EPU # KOF PO GI lag1					-7.67e-06
					(2.15e-05)
GDP (X Million)	7.21e-08***	7.34e-08***	6.97e-08***	6.99e-08***	8.06e-08***
	(2.11e-08)	(2.08e-08)	(1.89e-08)	(1.90e-08)	(1.91e-08)
Domestic Credit (% GDP)	0.000361	0.000909	0.00117	0.00149	0.00167
	(0.00145)	(0.00149)	(0.00145)	(0.00149)	(0.00143)
Medium / High Tech Exports	0.0250***	0.0247***	0.0208***	0.0211***	0.0200***
	(0.00779)	(0.00738)	(0.00567)	(0.00532)	(0.00536)
Tertiary Education	-0.00774**	-0.00868***	-0.00899**	-0.00945**	-0.00869***
	(0.00315)	(0.00299)	(0.00351)	(0.00340)	(0.00292)
Market Capitalization (% GDP)	-8.96e-05	-7.74e-05	6.69e-05	5.89e-05	6.28e-05
	(0.000191)	(0.000184)	(0.000153)	(0.000148)	(0.000133)
Fixed Effects	yes	yes	yes	yes	yes
Constant	8.830***	8.917***	7.169***	7.464***	6.861***
	(0.334)	(0.348)	(0.791)	(0.802)	(0.918)
Observations	219	219	219	219	219
R-squared	0.723	0.733	0.745	0.750	0.757
Number of CatCountry	22	22	22	22	22

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent
variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 24

Result from a cross-country fixed effects analysis on the natural logarithm of USPTO patent grants, using lagged independent- and control variables.

	(1)	(2)	(3)	(4)	(5)
EPU		-0.000742		0.000179	0.00453*
		(0.000452)		(0.000352)	(0.00231)
KOF EC GI lag1			0.0317***	0.0320***	0.0284**
			(0.00879)	(0.00880)	(0.0130)
KOF SO GI lag1			0.0120	0.0120	0.0206
			(0.0124)	(0.0123)	(0.0121)
KOF PO GI lag1			0.0441***	0.0448***	0.0400***
			(0.0119)	(0.0122)	(0.0127)
EPU # KOF EC GI lag1					4.49e-05
					(6.49e-05)
EPU # KOF SO GI lag1					-0.000113*
					(6.30e-05)
EPU # KOF PO GI lag1					1.18e-05
					(2.12e-05)
GDP (X Million)	9.84e-08***	9.93e-08***	1.03e-07***	1.03e-07***	8.58e-08**
	(3.41e-08)	(3.40e-08)	(3.02e-08)	(3.02e-08)	(3.10e-08)
Domestic Credit (% GDP)	-0.000561	-0.000111	0.00129	0.00120	0.00121
	(0.00207)	(0.00201)	(0.00122)	(0.00113)	(0.00121)
Medium / High Tech Exports	0.0210	0.0208	0.00762	0.00753	0.00692
	(0.0139)	(0.0139)	(0.00815)	(0.00807)	(0.00717)
Tertiary Education	0.0151***	0.0141***	0.0104***	0.0106***	0.00932***
	(0.00343)	(0.00300)	(0.00230)	(0.00219)	(0.00214)
Market Capitalization (% GDP)	-0.000687**	-0.000674*	-0.000351	-0.000351	-0.000262
	(0.000328)	(0.000327)	(0.000224)	(0.000224)	(0.000172)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	4.334***	4.426***	-0.992	-1.080	-1.031
	(0.745)	(0.768)	(1.228)	(1.254)	(1.255)
Observations	261	261	261	261	261
R-squared	0.745	0.749	0.833	0.833	0.842
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent
variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 25

Result from a cross-country fixed effects analysis on the natural logarithm of EPO grants, using lagged independent-and control variables.

	(1)	(2)	(3)	(4)	(5)
EPU		-7.61e-05		0.00100	0.00603*
		(0.000795)		(0.000671)	(0.00312)
KOF EC GI lag1			0.0198**	0.0216**	0.0222*
			(0.00867)	(0.00807)	(0.0118)
KOF SO GI lag1			-0.0130	-0.0132	-0.00821
			(0.0176)	(0.0168)	(0.0178)
KOF PO GI lag1			0.0958***	0.0998***	0.0920***
			(0.0210)	(0.0198)	(0.0197)
EPU # KOF EC GI lag1					3.85e-06
					(6.87e-05)
EPU # KOF SO GI lag1					-8.25e-05
					(6.24e-05)
EPU # KOF PO GI lag1					9.11e-06
					(2.67e-05)
GDP (X Million)	1.05e-07**	1.05e-07**	1.20e-07**	1.20e-07**	1.01e-07**
	(4.61e-08)	(4.61e-08)	(4.34e-08)	(4.30e-08)	(4.60e-08)
Domestic Credit (% GDP)	-0.000202	-0.000156	0.00101	0.000506	0.000382
	(0.00235)	(0.00209)	(0.00139)	(0.00117)	(0.00135)
Medium / High Tech Exports	0.0187	0.0186	0.00321	0.00269	0.00239
	(0.0141)	(0.0143)	(0.00990)	(0.00938)	(0.00940)
Tertiary Education	0.0127***	0.0126***	0.00666**	0.00767***	0.00623**
	(0.00418)	(0.00410)	(0.00277)	(0.00261)	(0.00285)
Market Capitalization (% GDP)	2.95e-05	3.09e-05	0.000490	0.000494	0.000565*
	(0.000427)	(0.000429)	(0.000308)	(0.000306)	(0.000276)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	3.600***	3.610***	-3.583**	-4.075**	-3.791**
	(0.885)	(0.914)	(1.693)	(1.635)	(1.678)
Observations	261	261	261	261	261
R-squared	0.614	0.614	0.729	0.735	0.744
Number of CatCountry	24	24	24	24	24

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are a sample of 25 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent
variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three lagged globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.

Table 26

Direct effect using a subsample Analysis on 11 European Countries: Result from a cross-country fixed effects analysis on five innovation specifications

	R&D Expenditure	(Ln) National Patent Applications	(Ln) National Trademark Applications	(Ln) EPO patent grants	(Ln) USPTO patent grants
EPU	-0.296	-0.000709	0.000182	0.000931	0.00108
	(0.302)	(0.000542)	(0.000923)	(0.000642)	(0.000686)
KOF EC GI	-12.47*	-0.0313	0.000893	0.0236***	-0.00557
	(5.829)	(0.0173)	(0.0146)	(0.00634)	(0.0273)
KOF SO GI	9.067	0.00951	-0.0449*	-0.0177	0.0215
	(6.880)	(0.0178)	(0.0212)	(0.0169)	(0.0237)
KOF PO GI	-20.74**	-0.0625	-0.120***	0.0795***	-0.0262
	(8.398)	(0.0386)	(0.0327)	(0.0192)	(0.0252)
GDP (X Million)	-0.000206**	-1.23e-07	-7.66e-09	1.31e-07***	-3.48e-07
	(9.13e-05)	(2.47e-07)	(1.87e-07)	(4.25e-08)	(2.72e-07)
Domestic Credit (% GDP)	0.139	-0.000214	-0.00359*	0.000110	0.000792
	(0.471)	(0.00186)	(0.00158)	(0.00103)	(0.00143)
Medium / High Tech Exports	4.715	0.0134	0.0203*	0.00826	0.00790
	(4.386)	(0.00929)	(0.00993)	(0.00868)	(0.0113)
Tertiary Education	-1.127	0.0150***	-0.00849*	0.0108***	0.0152***
	(2.261)	(0.00370)	(0.00451)	(0.00268)	(0.00437)
Market Capitalization (% GDP)	2.379***	0.00388*	-0.00137	0.000195	0.00223
	(0.551)	(0.00200)	(0.00237)	(0.000211)	(0.00193)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Constant	2,127**	13.85***	22.95***	-2.663	6.611**
	(899.8)	(4.105)	(3.654)	(1.740)	(2.323)
Observations	131	114	93	273	135
R-squared	0.863	0.610	0.678	0.758	0.769
Number of CatCountry	11	10	9	24	11

This table presents the cross-country fixed effects regression on 5 pre-determined innovation measures. Results are based on a sub-sample of 11 European countries which innovation performance was measured between 1997 and 2015. T-statistics are reported in parenthesis. The independent variable differs over each of the model specifications. The main variables of interest are the economic policy uncertainty (EPU), the three globalization specifications (KOFSOGI, KOFPOGI, KOFECGI) and the interaction between these two. Table 1 provides definitions of all variables. All models are estimated using country- and time- fixed effects and robust standard errors.
Statistical significance at the 10%, 5% and 1% levels, are indicated *, **, and *** respectively.