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THE EFFECT OF ECONOMIC POLICY UNCERTAINTY ON CORPORATE INVESTMENT DECISIONS: EVIDENCE FROM TURKEY

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Danışman: PROF. DR. JALE SÖZER ORAN

İstanbul, 2020

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ÖZET

EKONOMİ POLİTİKASI BELİRSİZLİĞİNİN KURUMSAL YATIRIM KARARLARINA ETKİSİ: TÜRKİYE ÖRNEĞİ

Bu tez çalışmasının amacı, belirsizliğin, Borsa İstanbul'a (BIST) kote olmuş imalat sanayi sektörü şirketlerinin kurumsal yatırım kararları üzerindeki etkisini araştırmaktır. Belirsizliğe ekonomi politikası belirsizliği endeksi temsili değişkeni ile yaklaşılmıştır. Çalışmanın amacı doğrultusunda, ilk aşamada, Baker vd.'nin (2015) metodu takip edilerek, Türkiye için haber bazlı aylık bir ekonomi politika belirsizlik endeksi oluşturulmuştur. Endeks verisi Şubat 2000'den Aralık 2018'e kadar olan zamanı kapsamaktadır. Veriyi elde etmek için beş adet Türkçe gazetenin dijital arşivleri taranmıştır. Çalışmanın sonuçlarına göre ekonomi politikası belirsizlik endeksi hem iç hem de dış olaylardan etkilenmektedir. Endeks başlıca, seçimler ve yurtiçi politik belirsizlikler ile yükselişe geçmiştir.

İkinci olarak, bu çalışmada, ekonomi politikası belirsizlik endeksinin BIST'e kote olan imalat sektörü şirketlerinin kurumsal yatırım kararları üzerindeki etkisi ölçülmüştür. Bu amaçla, örneklem olarak Türkiye'de imalat sektöründe faaliyet gösteren 107 adet şirketin 2005 birinci çeyrek ve 2018 dördüncü çeyrek arasındaki mali verileri seçilmiştir. Çalışmada, panel veri analizi yapılmış ve Sabit Etkiler Modeli kullanılmıştır. Sonuçlara göre ekonomi politikası belirsizliğinin imalat sektörü şirketlerinin kurumsal yatırım kararları üzerindeki etkisi zamanla değişmektedir. Kısa dönemde, bu etki istatistiksel olarak anlamsızken, orta vadede ekonomi politikası belirsizliğinin kurumsal yatırım kararları üzerindeki etkisi anlamlı ve negatiftir. Anlamlı ve negatif etki, Reel Opsiyon Teorisinin tahminlerini desteklemektedir. Ayrıca, sonuçlara göre ekonomi politikası belirsizliğinin yatırım kararlarına olan etkisi gecikmeli olarak ortaya çıkmıştır. Bu sonuç da Reel Opsiyonlar Teorisinin geri çevrilemezlik varsayımıyla ve yatırımların ileriye dönük olma özelliği ile aynı doğrultudadır. Yatırım kararlarını verenler, pozitif bir şokla karşılaştıklarında yatırım kararlarını askıya almaktadırlar ya da yatırımlardan vazgeçmektedirler. Bununla birlikte, ekonomi politika belirsizliğinin kurumsal yatırım kararları üzerindeki etkisi uzun vadede pozitife dönüşmüştür.

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ABSTRACT

THE EFFECT OF ECONOMIC POLICY UNCERTAINTY ON CORPORATE INVESTMENT DECISIONS: EVIDENCE FROM TURKEY

The aim of this Ph.D. thesis is to investigate the impact of uncertainty on the corporate investment decisions of the BIST (Borsa İstanbul) - listed manufacturing firms. We used the economic policy uncertainty (EPU) as a proxy for uncertainty. To examine the impact of EPU on investment decisions, first, following the method of Baker et al. (2015), we developed a monthly news-based EPU index for Turkey over the period from February, 2000 to December, 2018. We used the digital archives of five leading Turkish newspapers to obtain data. The results show that the Turkish EPU index is affected by both domestic and foreign events. It rises mainly with elections and national political uncertainties.

Second, we measured the impact of EPU on the corporate investment decisions of the publicly traded manufacturing firms. The sample consists of the quarterly financial statements of 107 BIST-listed manufacturing firms. The data period is from 2005 Q1 to 2018 Q4. We used balanced panel data analysis and estimated the regression equation parameters with fixed effects model. The results change with respect to time period. In the short-term, we observed that the impact of EPU on corporate investment decisions is insignificant. In the medium-term, as in line with the predictions of the real options theory, EPU has a negative and significant effect on the investment decisions of the BIST - listed manufacturing firms. The results also show that there is a time gap between decision to invest and realization of corporate investments. This finding is in line with the irreversibility assumption of real options theory and forward-looking feature of investments. When firms meet with a positive common shock in the investment environment, they tend to delay their investments or disinvest. Moreover, the results show that in the long-term, the effect of EPU on corporate investment decisions is positive.

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LIST OF ABBREVIATIONS

AKP	Adalet ve Kalkınma Partisi
BBD	Bloom, Baker and Davis
BIST	Borsa İstanbul
CAPEX	Capital Expenditure
CAPM	The Capital Asset Pricing Model
CBRT	Central Bank of Turkey
CCI	Consumer Confidence Index
CD	Cross-section Dependence
CDS	Credit Default Swap
CF	Cash Flow
CI	Corporate Investment
CORP	Corporate Investment
CPI	Consumer Price Index
DD	Distance to Default
EMBI	Emerging Market Bond Index
EPU	Economic Policy Uncertainty
EVDS	Elektronik Veri Dağıtım Sistemi
FED	Federal Reserve
GDP	Gross Domestic Product
GEG	Güçlü Ekonomiye Geçiş
GMM	Generalized Method of Moments
GST	Goods and Services Tax
IPS	Im, Pesaran and Shin
LEV	Leverage
LM	Lagrange Multiplier
LSDV	Least Squares Dummy Variable
M	Mean
MRPC	Marginal Revenue Product of Capital

NPV	Net Present Value
OECD	The Organization for Economic Cooperation and Development
OHAL	A State of Emergency
OLS	Ordinary Least Squares
QRT	Quarter Dummy
R&D	Research and Development
ROA	Return on Asset
SARS	Severe Acute Respiratory Syndrome
SIZE	Size
SMEs	Small and Medium-Sized Enterprises
S&P	Standard & Poor's
SPF	Survey of Professional Forecasters
TA	Total Assets
TBMM	Grand National Assembly of Turkey
TQ	Tobin's Q
U.K.	United Kingdom
U.S.	United States
VAR	Vector Autoregression
VIX	Volatility S&P 500
VW	Volkswagen

INTRODUCTION

> "*German car manufacturer Volkswagen has not stopped its investment in Turkey, Deputy Trade Minister Rıza Tuna Turagay said Thursday. Volkswagen on Tuesday announced it has postponed the final decision on whether to build a car plant in Turkey, amid international criticism of Ankara's military operation in northern Syria. On a question regarding a delay or even cancellation of a VW investment on the sidelines of an event in Istanbul, Turagay stressed it is not the case at the moment*" ("Volkswagen hasn't halted investment", 2019, paras. 1-2).

As stated in the news above, investment decisions are not independent of daily events, politics and recent developments in the economy. Economic or political uncertainties affect the cost of production, sales and therefore profits of the companies. Managers face with uncertainties that make them to consider all probabilities of future outcomes in the decision-making process. If they face with uncertainty shocks, they may postpone or even halt investments under the assumptions that investment is irreversible and that new information that resolves existing uncertainties arrive over time.

The impact of uncertainty on corporate investment decisions is not clear-cut from a theoretical point of view. Baddaley (2003) states that the debate on the investment-uncertainty relationship started with the assertion that they are positively related. This positive relationship between investment and uncertainty is known as the Oi-Hartman-Abel effect (after Oi, 1961; Hartman, 1972; Abel, 1983). According to this approach, increased price uncertainty leads competitive risk-neutral firms to increase their investment levels due to Jensen's inequality (Ferderer, 1993). On the other hand, according to real options theory, investment spending and uncertainty are negatively related. The existence of the choice between to invest now or to "wait and see" until the market conditions turn favourable in the future increases the critical investment threshold. The implication of this is that the higher uncertainty leads to lower investing or a delay in investment (Trigeorgis, 2002).

Based on the theoretical predictions, empirical studies investigating the impact of uncertainty on corporate investment decisions have also found supporting evidence on behalf of the negative relationship between the two variables. The first aim of this thesis is to investigate the impact of uncertainty on the investment decisions of the BIST-listed manufacturing firms that operate in Turkey. We investigated the short, medium and long-term impacts. The investigation of the effect of uncertainty on corporate investment plans for this research is motivated by the predictions of the real options theory, which is based on irreversibility assumption and forward-looking feature of investments.

To examine the impact of uncertainty on the corporate investment decisions of the BIST - listed manufacturing firms, first, following the method of Baker, Bloom and Davis (2016), we constructed a monthly economic policy uncertainty index for Turkey over the period from February, 2000 to December, 2018. This index is a news-based index that is prepared using the digital archives of five leading Turkish newspapers. The second aim of this thesis is to develop a well-prepared Turkish economic policy uncertainty index based on audited data. We used this EPU index as a proxy for uncertainty. We also used four firm-specific control variables, namely Tobin's Q, cash flow, firm size, and leverage ratio and one macroeconomic control variable, namely Gross Domestic Product (GDP) ratio to clearly identify the relationship between uncertainty and corporate investment decisions. Second, in order to measure the impact of uncertainty on the corporate investment decisions, we chose a sample that consists of the quarterly financial statements of the 107 BIST-listed manufacturing firms over the period from 2005 Q1 to 2018 Q4. Besides the fact that the academic literature on the subject from the Turkish market is rare, we chose Turkey because it is one of the developing countries, where companies may prefer to invest in due to its geographical location, qualified labor force and fast-growing young population. We also used the firms listed in Borsa İstanbul because the firms listed in BIST are among the largest firms operating in Turkey, which have a big potential to have irreversible investments. We used balanced panel data analysis and estimated the regression equation parameters with the fixed effects model. We expect to find a negative impact of uncertainty on investment in line with the predictions of the real options theory.

The motivations for this research are as follows. Developing an EPU index for Turkey is important in the sense that it is a complementary uncertainty measure to other risk measures, such as Turkey's credit default swaps, the emerging markets bond index and the BIST volatility index. Besides this index is prominent in providing guidance to investors, managers and analysts in uncertain times where it is difficult to make decisions. Although the impact of uncertainty on corporate investment decisions is a widely studied topic in the literature, examining this effect with a relatively new uncertainty proxy may yield more robust results. Moreover, the studies on this topic for Turkey are very rare. In particular, to the best of our knowledge, this is the first study that investigates the impact of economic policy uncertainty on corporate investments of Turkish publicly traded manufacturing firms on a firm level basis. This thesis therefore attempts to fill the gap in the literature, both by developing an accurate Turkish economic policy uncertainty index, where all the related news from the digital archives of the newspapers have been audited and by examining the investment behavior of publicly traded Turkish manufacturing firms under uncertainty.

This thesis is composed of three sections. Section 1 offers detailed information about the EPU index. In this section, we will first review the previous research on the EPU index and provide some country specific examples of the implementation of the EPU index following the Baker, Bloom and Davis (2013; 2016) methods. Second, we will construct a news-based EPU index for Turkey following the Baker, Bloom and Davis (2016) method. Section 2 provides the theoretical foundation for the impact of uncertainty on corporate investment plans, as well as previous research on this subject. Section 3 presents the hypotheses developed, the data and the methodology. Finally, Section 4 gives the empirical results and limitations of the study and ideas for further research.

1. THE ECONOMIC POLICY UNCERTAINTY INDEX FOR TURKEY

In this section, we developed an EPU index, covered previous research on this subject and discussed the empirical results of fluctuations in the EPU index.

1.1. ECONOMIC POLICY UNCERTAINTY

Economic policy is a branch that generally includes approaches to how and when macroeconomic balances should be changed by the public authorities (Eğilmez and Kumcu, 2017; p. 26). In the absence of governments, price mechanism and market forces would determine the consequences of economic activity. On the other hand, in the absence of markets, governments would allocate economic resources (Gilpin, 2015). Government intervention may be necessary to efficiently allocate resources, reduce market-created distributional inequalities and stabilize aggregate demand (Korkman, 2005). The rationale for economic policy is to create market preconditions, to provide public goods, to ensure competitive conditions, to manage externalities, to exploit scale effects, to take into account asymmetric information, to improve redistribution of income, and to reduce macroeconomic imbalances (Korkman, 2005; p. 7).

When policymakers attempt to influence the economy, they primarily use two tools: monetary policy and fiscal policy.

Fiscal policy is the use of tools such as taxation, government spending, borrowing, foreign trade policy, incentives, and subsidies by governments to maintain internal and external equilibrium in the economy (Eğilmez and Kumcu, 2017). There are two types of fiscal policy: expansionary and contractionary. Fiscal policies that increase aggregate demand by increasing government spending or lowering taxes are called expansionary, whereas fiscal policies that decrease aggregate demand by reducing government spending or raising taxes are called contractionary. Governments are expected to pursue expansionary fiscal policies during downturns and contractionary fiscal policies during booms.

Monetary policy is, in its broadest sense, the actions of central banks to influence the amount of money supply. The traditional function of monetary policy was limited to cash injection into the market or cash withdrawal from the market through monetary policy instruments (Orhan and Erdoğan, 2007). By contrast, with the modern banking activities and the introduction of new financial instruments, central banks have started to use not only direct but also indirect tools to manage market liquidity. Besides, unconventional monetary forms such as quantitative easing have emerged. As Orhan and Erdoğan (2007) have argued, economic conditions determine the nature of monetary policy.

Economic policy uncertainty is one form of uncertainty that investors should consider as part of the investment decision-making process. Economic policy uncertainties may arise as a result of uncertainty as to who makes policy decisions, policy inactions, the economic effects of fiscal and monetary policies, and uncertainty as a result of non-economic considerations in relation to policy changes (Baker, Bloom and Davis, 2014, p. 7).

1.2 UNCERTAINTY VERSUS RISK

Until the Knight's (1921) research on risk, uncertainty, and profit, the terms risk and uncertainty were used as one and the same. Knight (1921), however, classifies uncertainty as measurable and immeasurable and defines measurable uncertainty as "risk" and immeasurable uncertainty as "uncertainty". Gough (1988, p. 9) provides the difference between risk and uncertainty as follows:

> *"The distinction between risk and uncertainty hinges on the probabilities of occurrence. We say that a risky situation is one where the set of possible outcomes is well known and where a probability distribution for these outcomes can be agreed upon by a set of 'relevant experts' (this probability distribution may be objective or subjective). An uncertain situation occurs when either the set of outcomes is unknown (uncertainty with respect to the environment in which the*

decision is being made) or where agreement as to a probability distribution cannot be reached."

Fisher (1971, p. 202) as below provides another description, which shows the difference between risk and uncertainty:

> *"A risky situation is one in which the outcome is subject to an uncontrollable random event stemming from a known probability distribution. The toss of a true coin, for example, involves a risk, with the probability of a head turning up being 0.5. An uncertain situation, on the other hand, is characterized by the fact that the probability distribution of the uncontrollable random event is unknown".*

Examples of Knight's uncertainty are those related to exercising judgement and forming opinions that depend on future course of events (Knight, 1921, p. 233).

It is difficult to measure uncertainty in empirical studies. With respect to uncertainty measures, three methods are primarily used in the literature. These are newspaper-based measures of uncertainty, finance-based measures of uncertainty, and measures of disagreement among forecasters on key economic variables (Moore, 2017).

In this study, we used newspaper-based measure of uncertainty created by Baker, Bloom and Davis (2016) to measure economic policy uncertainty in Turkey. Following the steps proposed by Baker, Bloom and Davis (2016), we developed a monthly economic policy uncertainty index for the period from February, 2000 to December, 2018. Although this is not the first study in which an EPU index for Turkey is developed, it differs in certain ways from other studies: First, as Moore (2017) points out, one of the drawbacks of the method of Baker, Bloom and Davis is that it produces false positives, the news that are not related in fact with economic policy uncertainty but are brought by the computer search engine with the given keywords. Although the correlation between the machine-created and the hand-created series can be high, there may be deviations in some years. By machine-created series, we imply computer generated news and by hand-created series, we imply computer generated news, which are then audited by people. In order to eliminate false positives, which could lead to a fake rise in the index, we audited all news

generated by computer. Second, we used the total monthly page number of each newspaper as a proxy for the total number of news articles. Third, we used a business-oriented newspaper in the sample.

1.3. PREVIOUS RESEARCH ABOUT THE EPU INDEX

In this part, we first reviewed the previous research on the EPU Index prepared by Baker, Bloom and Davis (2013, 2015, 2016) and then provided country-specific examples of the application of the EPU index.

1.3.1 Indices of Baker, Bloom and Davis

Baker, Bloom and Davis (2013) developed a composite index for the United States of America that illustrates economic policy uncertainties for the period 1985 to 2010. This EPU index is made up of three components: The first component is based on newspaper coverage frequency. The second component uses "the number and projected revenue effects of federal tax code provisions" that will expire in future years, and the third component uses forecaster disagreement about inflation and government purchases (Baker, Bloom and Davis, 2013, p.4).

For the first component, their purpose was to find the articles that discuss something about economic policy uncertainty. For this purpose, they searched for articles that included at least one term in each of the three categories, which are economy, uncertainty and policy in ten major U.S. newspapers. After collecting news, they divided monthly raw counts by the total number of articles in each newspaper to control the changing volume of the articles over time. As Baker, Bloom and Davis point out, this operation created a monthly EPU series for each newspaper over the data period. As the next step, they normalized monthly EPU series of each newspaper. Normalization eliminates the unit of measurement, which makes it easier to compare data from different places. Following that, they summed up the normalized values of 10 newspapers per month and lastly rescaled the series to an average value of 100 over the sample period. They then assessed whether the news index provides a good indicator of actual economic uncertainty by comparing index values with real events.

For the second component, they proxied uncertainty with scheduled tax code expirations. They argued that scheduled tax code expirations were an uncertainty source, as Congress usually waits until the last hour to decide whether to extend the tax provision (p. 6). They used the Congressional Budget Office reports as the data source. These reports contain the federal tax code provisions' scheduled expirations and their projected revenue effects for the current year and for the next 10 years (Baker, Bloom and Davis, 2013). To develop an index using this dataset, they calculated the absolute dollar value of the expiring tax provisions for each year and discounted these future expirations with a rate of 50 % per year. They added the discounted tax provisions for each year and provided an index value for January, which would be constant throughout the year.

For the third component of the index, they used the dispersion of three variables' expectations, which were obtained from the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters (SPF). These three variables are inflation, purchases of goods and services by the federal government, and purchases of goods and services by state and local governments. In the article, the dispersion of expectations of the variables are named inflation forecast disagreement and government purchases forecast disagreement. They used only three variables among a range of variables since they believed that these variables are heavily influenced by monetary and fiscal policy decisions and the data for those three variables were available during the sampling period. For the inflation variable, they used individual forecasts of one-year ahead consumer price index (CPI) inflation rate and calculated the dispersions in expectations of this variable over the sampling period. For the other two variables, they calculated the dispersions of each of them, expressed each of them as a ratio of nominal federal purchases to nominal GDP and then summed up two measures to create a dispersion measure for government purchases.

The weights of each element to produce the composite index are given as follows. 1/2 on news-based index, 1/6 on the present value of future scheduled tax code expirations, 1/6 on inflation forecast disagreement among professional forecasters and 1/6 on government purchases forecast disagreement among professional forecasters.

In their later research, Baker, Bloom and Davis (2015; 2016) excluded the second and third components of the index, leaving just the first component, which is news-based index. This monthly news-based index counts the frequency of the articles that contain at least one term among the three groups of terms over the given data period. They used "economic" or "economy" from the first group, "uncertain" or "uncertainty" from the second group and at least one term from the third group that contains the terms "congress", "deficit", "Federal Reserve", "legislation", "regulation" or "White House" (Baker, Bloom and Davis, 2016, p. 1594). Results show that the EPU index spikes with "tight presidential elections, Gulf Wars I and II, the 9/11 attacks, the 2011 debt-ceiling dispute and other major battles over fiscal policy" (Baker, Bloom and Davis, 2016, p. 1594). They also prepared the EPU index not only for U.S. but also for other countries such as Australia, Canada, Germany, Mexico, Russia, U.K, France, India, Italy, South Korea, and Singapore. In addition, they host indices of EPU prepared by other researchers on their website at www.policyuncertainty.com. Besides monthly index, they constructed a daily EPU index using Newsbank archive that supplies around 1,500 U.S. newspapers. While collecting data, they relied not only on computer-based news, but also on human audits composed of student teams supervised by Baker, Bloom and Davis for the accuracy of the news. The student team read and coded 2,000 randomly selected news.

Duca and Saving (2017, p. 129) found the following three stylized facts in the EPU index:

> *"First, there have been upward trends in their historical "news-based" EPU since the early 1970s, suggesting that some shifts in public discourse emanating from the underlying structure of the political environment may affect the range in which EPU fluctuates. Second, both the historical and the broader post-1984 based EPU series of Baker, Bloom and Davis (BBD) tend to rise after business cycle peaks and remain elevated during the early stages of subsequent economic recoveries. Third, and consistent with the second stylized fact, EPU tends to be positively correlated with short-run indicators of*

macroeconomic distress such as the misery index, which sums the inflation and unemployment rates."

1.3.2 Country Specific Examples

Following the methods of Baker, Bloom and Davis, researchers have developed EPU indices for several countries, some of which are covered by this research.

Zalla (2017) developed an EPU index for Ireland using the BBD method for the period from 1985 to 2016. For this reason, he used one of the leading Irish newspapers and searched articles that include EPU terms in three groups. These terms are "economy", "economics" and "economic" from the first group, "uncertainty", "uncertain" from the second group and "regulation", "legislation", "Dáil", "deficit", "government", "central bank" and "Taoiseach" from the third group. He used web-scraping to collect the articles. Zalla found that the EPU index spikes with events such as Brexit, The Great Recession of 2008, elections, September 11 terrorist attacks and 2014 budget. In order to determine whether the index is valid, Zalla compared this index with VIX (Volatility S&P 500) and the indices prepared by Baker, Bloom and Davis (2016). The correlation between the Irish EPU index and VIX is 0.12 and the correlations between the Irish EPU index and U.S., U.K., European and Spanish EPU indices were 0.48, 0.62, 0.49, and 0.38, respectively.

Arbatlı *et al*. (2017) constructed a monthly news-based index for Japan for the period from January 1987 to March 2017. They counted articles in four Japanese-language newspapers namely, Yomiuri, Asahi, Mainichi, and Nikkei. They used four database access platforms to obtain the data. In particular, they used Nikkei Telekom to access the archives of the four newspapers and other platforms to count the total number of articles and to determine the number of articles that satisfy the economy, policy, and uncertainty criteria. To decrease sampling errors, they excluded local newspaper editions of national papers. They determined EPU terms by using the steps as they call it "small-scale audits" (p. 39). Economy terms in the study are "economic" or "economy" and uncertainty terms are "uncertain", "uncertainty" or "concern". The policy set they determine consists of major policy-making institutions and major policy areas. Major policy institutions set includes the terms such as "upper house", "lower house", "diet",

“central bank”, “Bank of Japan” and “Prime minister’s office”. Major Policy areas set includes the keywords such as “tax(es), “taxation”, “government spending or government expenditure”, “government revenue(s)”, “government budget”, “public debt”, “government debt”, “government deficits”, “regulation(s)” or “regulatory” or “regulate” or “deregulation” or “deregulate”, “structural reform” or “legislation”. After determining the terms, they identified the articles that contain the EPU terms. They divided the total number of articles by the articles that match the criteria to control volume changes over time. As the next step, they standardized each series to unit standard deviation over the given period and made seasonality adjustments. Then, they took the average of four series monthly and rescaled these series to an average value of 100 from 1987 to 2015. The results of the study show that the EPU index spikes with Black Monday, the Asian Financial Crisis, the Lehman Failure, the resignation of Prime Minister Hatoyama, the Greek Crisis and the Eurozone crisis.

Baker, Bloom and Davis (2016) has prepared a news-based EPU index for Australia, where the index data is available at https://www.policyuncertainty.com. They used the archives of eight Australian newspapers over the period 1998 to 2017. The newspapers are Daily Telegraph, Courier Mail, The Australian, The Age, The Advertiser, Mercury, Sydney Morning Herald, and The Herald Sun. The terms used are “economic” or “economy” from the first category, “uncertain” or “uncertainty” from the second category, and “regulation”, "Reserve Bank of Australia", “RBA”, “deficit”, “tax”, “taxation”, “taxes”, “parliament”, “senate”, "cash rate", “legislation”, “tariff” and “war” from the third category. They followed the same method to construct the index. EPU index spikes on the dates of geopolitical and local events that may create uncertainty. Some examples are the beginning of election fought over Goods and Services Tax (GST), 9/11 attacks, invasion of Iraq and Lehman Failure.

Luk et al. (2018) developed an EPU index for Hong Kong for the period 1998 to 2017 following Baker, Bloom and Davis (2016) methodology. They used Wisers Information Portal to collect the data from ten local Chinese newspapers, namely Wen Wei Po, Sing Pao, Ming Pao, Oriental Daily, Hong Kong Economic Journal, Sing Tao Daily, Hong Kong Economic Times, Apple Daily, Hong Kong Commercial Daily, and

Tai Kung Pao. They used four categories to classify the terms. These categories are domestic or variant, economy or variant, uncertainty and variant, and policy or variant. The policy terms are given as “policy (or variant)”, “public”, “expenditure (or variant)”, “investment”, “budget”, “fiscal”, “SAR Government”, “politics”, “chief executive”, “interest”, “reform”, “optimize”, “deficit”, “tax”, “regulation (or variant)”, “Hong Kong Monetary Authority”, “reserves”, or “linked exchange rate system.” The results show that the EPU index rises with both national and local events. In particular, it rises with the Asian financial crisis, the 9/11 terrorist attacks, the SARS outbreak, the 2006 goods and services tax plan, the announcement of the pilot program of direct investment in overseas securities markets by domestic individuals, the US subprime crisis, the bankruptcy of Lehman Brothers, the European debt crisis, the change in RMB fixing mechanism, the weakening of the local economic environment in 2016, Brexit, and Trump’s election victory (Luk et al., 2018, p. 4). They also compared the EPU index to another uncertainty proxy based on the realized volatility of the stock market. They found that the EPU index had a higher predictive power for real GDP growth compared to the other uncertainty proxy.

Ghirelli, Pérez and Urtasun (2019) constructed an EPU index for Spain for the period from 1997 to present by using the method of Baker, Bloom and Davis (2016). They considered seven Spanish national newspapers, which are El País, El Mundo, La Vanguardia, ABC, Expansión, Cinco Días and El Economista as the news data source. They searched the relevant keywords in three categories, namely “uncertainty”, “economy” and “policy” that are given on page 65. They found that the index rises mainly with the U.S. Iraq invasion, Lehman Brothers bankruptcy, the Greek bailout, Spain’s demand for financial support from the European institutions in 2012, Brexit, and the Catalan crisis in October 2017.

Cerda et al. (2018) developed an economic uncertainty index for Chile using a local newspaper, “El Mercurio”, for the period from 1993 to the present. The economic uncertainty index consists of news that include terms in two categories namely economic and uncertainty. The economic terms are any word beginning with “econ” and the uncertainty terms are “uncertain” or “uncertainty”. They found that the economic

uncertainty index rises mainly with the Asian crisis, the Dot-Com Bubble, the Iraq War, the Gulf War II, the subprime mortgage crisis, the eurozone crisis, tax and labor reforms in 2014 and 2015, and China's economic slowdown in 2015, but in different proportions.

Fountas, Karatasi and Tzika (2018) constructed a monthly EPU index for Greece for the period 1998 to 2018 following the Baker, Bloom and Davis (2016) methodology. They used the digital archive of the daily newspaper Kathimerini to obtain data. They searched the keywords in three categories: uncertainty, economy, and policy. Keywords that exist under the category of uncertainty are "uncertain", "uncertainty" and "uncertainties"; keywords that exist under the category of economy "economic" or "economy" and keywords that exist under the category of policy are "policy", "congress", "deficit", "federal reserve", "The FED", "legislation", "regulation", "regulatory" and "The White House" (Fountas, Karatasi and Tzika, 2018, p. 84). They found that the EPU index mainly rises with the Russian Crisis in 1998, the 9/11 terrorist attacks, the beginning of the Second Gulf War, the 2011 elections that did not lead to the formation of a new parliament, the elections won by SYRIZA, the first left-wing party ever to govern Greece and Brexit. They also calculated the correlations between the Greek EPU index and those of some European countries like France, Germany, Ireland, Italy, Russia, Sweden, and UK, which they named Europe-5. They found that the Greek EPU index is highly correlated with these indices, in particular with those of France and Germany. They also computed the correlations between the Greek EPU index and the European, US and global indices. They noted that the correlation between the Greek EPU and the European EPU decreased with the onset of the Greek crisis, as the weight of the national events in Greece increased after that.

To the best of our knowledge, three news-based EPU indices are developed for Turkey. These are Ermişoğlu and Kınık (2013), Sahinoz and Cosar (2018), and Jirasavetakul and Spilimbergo (2018).

Following Baker, Bloom and Davis (2013), Ermişoğlu and Kınık (2013) developed a monthly composite EPU index for Turkey for the period from July 1997 to January 2013. The index components are news-based uncertainty measure and disagreement about inflation expectations, each of which has equal weights. For the news-

based component, they searched the predetermined terms in three newspapers. They predetermine the following terms for each group: “ekonomi” (economy) or “ekonomik” (economical) for the economy group, “belirsiz” (uncertain) or “belirsizlik” (uncertainty) for the uncertainty group and “politika” (policy) or “bütçe” (budget) or “vergi” (tax) or “merkez bankası” (central bank) or “meclis” (parliament) or “yasa” (legislation) or “mali” (fiscal) for the policy group. Results indicate that the news-based EPU index spikes with major events such as 2001 crisis, September 11 terrorist attacks, resignations from the ruling party and election negotiations in 2002, the closure case of the Justice and Development Party, global crisis in 2009, and Eurozone crisis. For the second component of the index, Ermişoğlu and Kınık used the Survey of Expectations as the data source and computed the standard deviation of post-12 month inflation expectations. They took the weighted average of these two components and created the index. To assess the validity of the EPU index, they compared it with other uncertainty related indicators such as the Emerging Market Bond Index spread for Turkey (EMBI), Turkey credit default swap spreads (CDS), USD / TL realized volatility, EURO / TL realized volatility and the CNBC-e consumer confidence index. Results indicate that there is a positive relationship between the EPU index and all other indicators except the CNBC-e consumer confidence index, which generally decreases with uncertainty. Based on the results, they argued that the EPU index could be a measure of uncertainty.

Sahinoz and Cosar (2018) developed a monthly news-based EPU index using six Turkish daily newspapers for the period from January 1998 to onwards. The newspapers used are Cumhuriyet, Hürriyet, Milliyet, Sabah, Türkiye, and Yeni Şafak. They used two different data sources. For the period from 1998 to 2014, they used the digital text archives of the newspapers at the Grand National Assembly of Turkey (TBMM) and for the period from 2015 to onwards, they used the digital press archives of Interpress (Sahinoz and Cosar, 2018, p.1). The results indicate that the EPU index spikes with the 2001 financial crisis, political uncertainty in 2002, global monetary policy uncertainties in 2006, political uncertainty created by parliamental and presidential elections in 2007, political uncertainty in 2008, global financial crisis in 2009, European debt crisis, and parliamental elections in 2015.

Different from Ermişoğlu and Kınık (2013) and Sahinoz and Cosar (2018), Jirasavetakul and Spilimbergo (2018) developed a monthly EPU index for Turkey using foreign newspaper archives instead of national newspaper archives for the period 1996 to 2017. They used Factiva as the data source. They used a broader term set for policy and uncertainty terms available in the Appendix of that study. The results indicate that the Turkish EPU index rises "*during the 2001 Turkish economic crisis, the 2002 general elections (when the AKP came to power), the 2003 crisis in Turkish-American relations, the 2011 general elections, the 2013 Gezi Park protest, the large depreciation in 2014, the 2015 sanctions by Russia and general elections, and the 2016 Istanbul Airport bombing and the failed coup attempt*" (Jirasavetakul and Spilimbergo, 2018, p. 8).

Ahir, Bloom and Furceri (2020) prepared a quarterly world uncertainty index for 143 individual countries for the period 1996 to onwards. Apart from other studies in the literature that use newspapers, they used the Economist Intelligence Unit country reports, where the use of this source has both advantages and disadvantages. The advantages are presented as follows (Ahir, Bloom and Furceri, 2018, p. 2): First, the index is constructed from a single source with a specific coverage of the economic and political developments. Second, the reports adopt a standardized process and structure. On the other hand, they depend on a single source, which increases sampling noise. They counted the frequency of uncertain or its variants in the country reports. They found four stylized facts based on the results. First, there is a significant increase in global uncertainty since 2012. Second, uncertainty is higher in emerging and low-income economies compared to developed countries. Third, uncertainty peaks in advanced economies are more synchronized than in emerging and low-income countries. Fourth, across advanced and developing economies, the average uncertainty is higher in the years of recession.

1.4 INDEX METHODOLOGY AND DATA

We followed the Baker, Bloom and Davis (2016) methodology to construct EPU index. We benefited from information content of newspapers to calculate the index values. This approach can be defined simply as textual analysis that has been commonly used in the fields of accounting, finance and economics. We grouped the EPU terms into three categories: economy, uncertainty and policy as in line with Baker, Bloom and Davis

(2016). As the next step, we searched for predetermined terms in the newspapers, collected the relevant news and calculated their frequency.

The steps for creating an EPU index are defined as follows in Baker, Bloom and Davis (2016; p. 1599):

1. Getting raw monthly EPU article counts from the chosen newspapers,

2. Dividing the articles that contain raw EPU terms by total number of articles in the same newspaper on a monthly basis to have a relative EPU frequency count,

3. Standardizing the relative EPU counts of each newspaper to unit standard deviation from 2000 to 2018,

4. Averaging across 5 newspapers by month and creating only one monthly series,

5. Normalizing the EPU time series index.

Our sample set consists of five leading Turkish daily newspapers, namely Hürriyet, Milliyet, Cumhuriyet, Sabah, and Dünya that are in the domain of both rightist and leftist newspapers. We use five different newspapers to decrease the effect of the idiosyncratic newspaper-level noise. Dünya is the only business-oriented daily newspaper amongst the chosen newspapers. Hürriyet and Sabah are some of the highest-circulation newspapers. As the data source, we used PrNet[1]'s database access platform. This platform supplies the digital archives of the Turkish newspapers beginning from February 2000. Due to the availability of data, our data period begins from February, 2000 and lasts until December, 2018. We also eliminated newspapers such as Habertürk, Radikal and Sözcü from the sample set because the dataset is not available for the period between February, 2000 and December, 2018.

We prepared the index on a monthly basis and used the following EPU terms that are suitable for Turkey:

[1]PrNet is a media company that makes the transfer of all local and national newspaper and magazine news to digital media.

1. Economy terms: ekonomi (economy) and variants

2. Uncertainty terms: belirsiz (uncertain) and variants

3. Policy terms: faiz (interest rate), cari açık (current account deficit), döviz kuru (exchange rate), merkez bankası (central bank), vergi (tax), bütçe (budget), kamu harcama (public spending), mali (fiscal), hükümet (government), (meclis) parliament, yasa (legislation), reform (reform), politika (policy), terör (terror) and variants of these terms

We searched for news that simultaneously include at least one term in each of the categories stated above. On the search platform, when we put the sign of (*) at the end of the word, the search engine brings variants of the terms because of the structure of Turkish, which is an agglutinating language. We chose general policy terms that are related with fiscal policy, monetary policy and policy makers. We also chose terms specific to Turkey such as current account deficit and terror. Turkey has a current account deficit problem for many years that should be considered by the policy makers. Figure 1.1 shows Turkey's current account balance over the period from 2000 to 2018. Terror is also another specific term for Turkey that should be emphasized because of the burden it creates on public spending on security and defence.

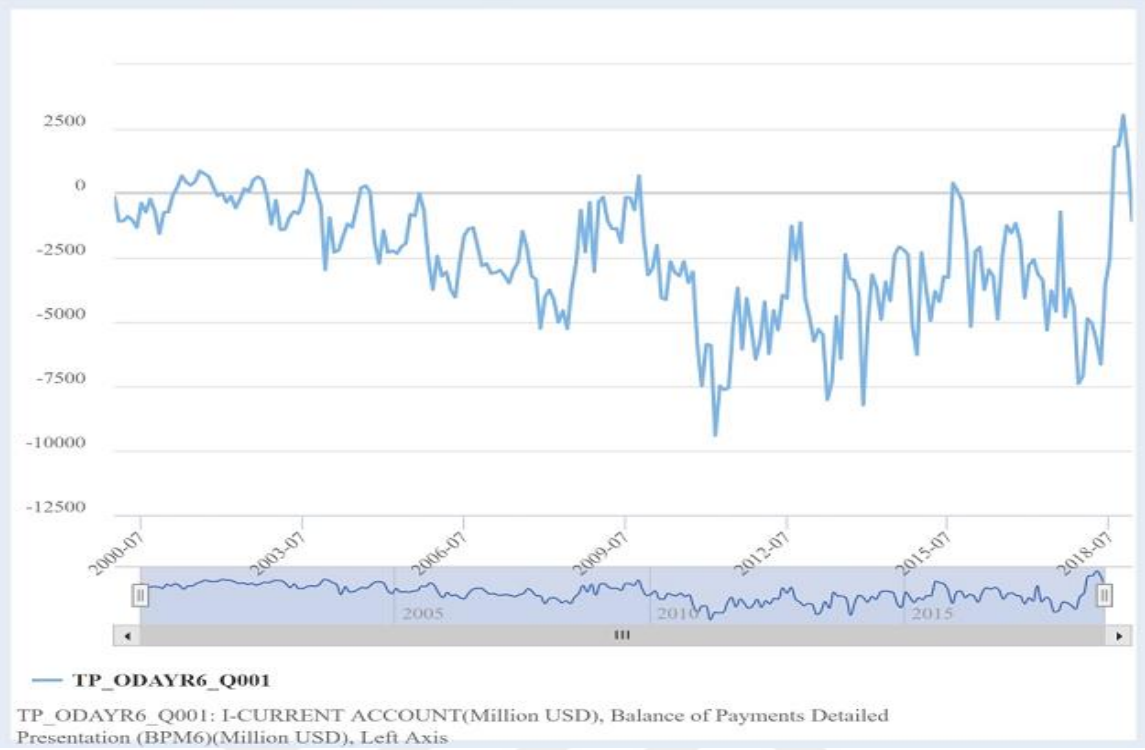

Figure 1.1. Turkey's Current Account Balance from 2000 to 2018

Source: CBRT, Balance of Payment Statistics, 2019.

For consistency purposes, we did not take into account all sections of the newspaper, such as arts, fashion and sports. We eliminated the editions of local newspapers as well for the same reason.

We used another source, the digital archive of Cumhuriyet Newspaper, available at Çanakkale Onsekiz Mart University to check whether PrNet database platform accurately retrieves all related news. If the number of news from both search platforms is different, we accepted the news in Cumhuriyet Newspaper as the basis.

Although search engine brings all news together that contain at least one term from each group, it does not mean that the news are all related with economic policy uncertainty. To reach the set of correct news, we audited each news and removed false positives. False positives are defined as incorrectly detected news by computer as EPU = 1 when a news is in fact not related with economic policy uncertainty. We coded news as EPU = 1 if it is related with economic policy uncertainty and EPU = 0 if it is not. We

used the following evaluation criteria to classify the news as EPU = 1 (Baker, Bloom and Davis, 2014, p. 7):

– "Uncertainty over who makes or will make policy decisions that have economic consequences

– Current and past uncertainty over what economic policy actions will be undertaken

– Uncertainty regarding the economic effects of policy actions – past, present and future

– Economic uncertainty induced by policy inaction

– Economic uncertainty related to policy developments motivated by non-economic considerations – e.g., national security concerns."

Furthermore, following Baker, Bloom and Davis (2014), we coded as EPU = 1 not only national news but also foreign country news related with economic policy uncertainty. We prepared the index following the steps on page 16 after collecting the data. As we stated on page 16, creating an EPU index consists of five steps. There is a difference between the method used by Baker, Bloom and Davis (2016) and this study at step 5 as follows. We approached the total number of articles in a newspaper by using total page number of newspapers due to the limitations of the search platform. We therefore normalized the total number of EPU news by the total number of pages.

1.5 EMPIRICAL RESULTS

We present the results of the EPU index in Figure 1.2. Figure 1.2 shows that the EPU index rises with both domestic and foreign events. The index rises mainly with the uncertainty about the new economic program in 2001, The September 11 terror attacks in the U.S., political uncertainty that began with the then Prime Minister Bülent Ecevit's health, political uncertainty caused by presidential and coming general elections in 2007, Justice and Development Party closure case, December 17-25 corruption investigations,

postelection uncertainty in 2015, the U.S. presidential election in 2016 and political uncertainty created by early presidential elections in 2018.

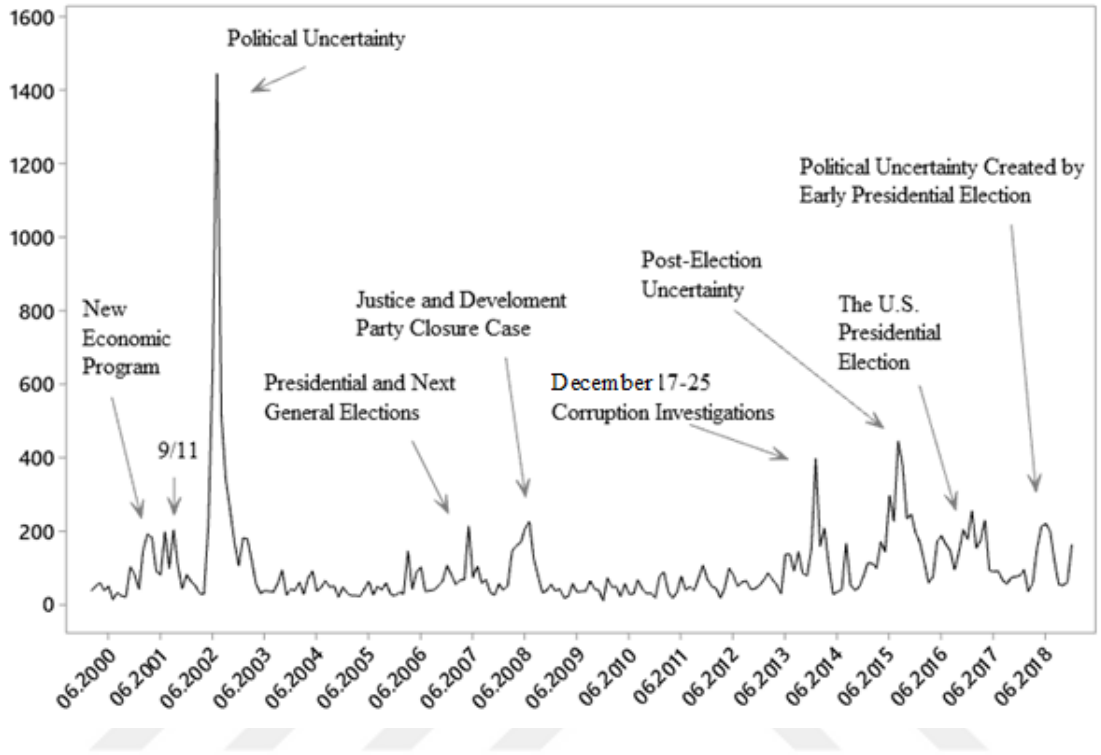

Figure 1.2. Economic Policy Uncertainty Index for Turkey
Source: Authors' own calculations

We also summarized the main events that caused a spike in the EPU index below. Table 1.1 provides the list of main events that cause a spike in the EPU index.

Before the disinflation program of 2000, the volatility in interest rates and growth were high. Chronic inflation, persistent fiscal imbalances, and balance-of-payment crises with the high volatility in interest rates and growth resulted in macroeconomic instability and, therefore, complicated bank management (Alper, Berument and Malatyalı, 2001). Besides, Turkish banks became too fragile due to deregulation and given deposit insurance without effective supervision (Akyüz and Boratav, 2003). Maturity mismatch risk in banks' balance sheets increased and in 2001, as banks tried to close their open positions, interest rates soared leading to funding loss. With the political crisis between the then Prime Minister Bülent Ecevit and President Ahmet Necdet Sezer in the National Security Council meeting in February, Turkey experienced an economic crisis in 2001.

To alleviate the effects of the crisis, Kemal Derviş was appointed as the Turkish Minister of the Economy and, under his leadership, a new economic program called the "Güçlü Ekonomiye Geçiş (GEG) Programı" ("Transition to the Strong Economy Program") was put into effect. There were some question marks about the details of this program, which would be announced in April. There were policy uncertainties about (1) the structural reforms, (2) wage increases, (3) inflation targeting, (4) interest rates and exchange rates and (5) how external financing would be provided. Moreover, it was not certain whether all coalition partners would support the new economic program. Due to these uncertainties, the EPU index spiked in March, 2001.

The transition to the floating exchange system also created another uncertainty at the outset, due to unstable markets yet. Along with the lack of confidence in the government's economic policies, the EPU index increased in July, 2001.

The EPU index spiked also with the September 11 attacks due to the uncertainty as to when and how U.S. will respond to terrorist attacks.

During the period from 2000 to 2018, the highest peak occurred in July, 2002, following the political uncertainty created by then Prime Minister Bülent Ecevit's health. Country risk and uncertainty increased in financial markets due to political uncertainty created by Ecevit's health. As political uncertainty increased, the treasury auction rates rose to more than 70 %, Euro appreciated 22 % against Turkish lira, and the Istanbul Stock Exchange index fell sharply within two months. In order to overcome political uncertainty and therefore these economic difficulties, early election possibility was considered; however, in this case, since elections generate uncertainty by their nature, along with its date and potential impact on the economy, it contributed to another form of uncertainty. Turkish Economy Minister Kemal Derviş, who was deemed the guarantor of the GEG program, resigned on July 12. Devlet Bahçeli, the leader of the Milliyetçi Hareket Partisi (Nationalist Movement Party), which is the coalition partner, also addressed the need for early elections. Political uncertainty reached its peak level with the resignation of then Deputy Prime Minister Hüsamettin Özkan, as well as several other ruling party ministers and deputies. Markets were sceptical about the continuity of

economic policies, and whether changes requested by the IMF, which lent $30 billion to Turkey, would be pursued under the current macroeconomic instability.

The threat of U.S. military action against Turkey's neighbouring country Iraq and the length of such military action generated uncertainty in February 2003, which may adversely have an impact on macroeconomic measures such as inflation and GDP growth rate.

The term of Süreyya Serdengeçti, governor of the Central Bank of Turkey expired in March, 2006. Uncertainty about his reappointment contributed to speculation over the future of monetary policy.

In April, 2007, presidential elections were held. The candidate of Adalet ve Kalkınma Partisi (Justice and Development Party) received 357 votes out of 361 and won a majority. Since the majority of the votes are not 357 but 367, the main opposition party, Cumhuriyet Halk Partisi (The Republican People's Party) applied to the court. In the meantime, a declaration about the elections was published on the website of General Staff of the Republic of Turkey. On May 1, 2007, the first round of voting was cancelled by the Constitutional Court of the Republic of Turkey. However, the majority of the votes could not be reached again in the next round and Abdullah Gül withdrew his candidacy. The ruling Justice and Development Party applied to TBMM for early elections and early elections occurred on July, 22.

The EPU index rose again with the appeal of the Chief Public Prosecutor of the Supreme Court to the constitutional court to close the Justice and Development Party and to ban the political activities of 71 politicians for five years, including the then Prime Minister Recep Tayyip Erdoğan and the then President Abdullah Gül. As we observe from the Figure 1.1, uncertainty increased from May to July, 2008 and took its highest peak at the end of July, 2008, before the closure decision was given. The ruling Justice and Development Party was not closed.

In June 2013, due to Gezi Park's protests and FED's announcement that it would begin to taper its purchases, the EPU index slightly spiked again. Although a single party

was ruling Turkey for 11 years, Gezi Park protests showed that political risk have not declined yet.

In January 2014, political uncertainty increased because of the corruption investigations on December, 17-25, that are "allegedly launched by Gülenist prosecutors and police officers against the government" (Saatçioğlu, 2016). Political uncertainty caused a rise in interest rates, country risk and depreciation of Turkish lira.

The EPU index spiked again in 2014 and 2015 with the uncertainty caused by local, general, and presidential elections in Turkey. Following the June 2015 general election, the Justice and Development Party was unable to obtain the majority of the votes to form a government on its own, even though it received the highest vote. As a result, other options such as coalition government was considered; however, the option of coalition brought uncertainty as it was unclear which parties would form a coalition, the duration of the negotiations and the economic policies of the new government. Even two months after the June 2015 general election, political parties could not succeed in forming a government, which increased macroeconomic instability. In order to reduce political uncertainty, after the discussions with the TBMM (ingilizcesini de yaz) speaker, the President Recep Tayyip Erdoğan programmed early elections on November. As before, the election brought with it another form of uncertainty, since with repeated elections, the same outcome may arise that would prevent formation of the government, the new government may not be long lasting and it may not be found favorable by the financial markets.

In May 2016, the Prime Minister Ahmet Davutoğlu resigned that caused an increase in the EPU index. The resignation of a policy maker created uncertainty due to the possible revisions in the economic team and its prospective economic policies. After this event, the EPU index decreased; however, its decline slowed down with the failed coup attempt in July, 2016. Aftermath of the failed coup attempt, Turkish government announced state of emergency (OHAL) that would impose some restrictions on companies operating in Turkey.

The U.S. presidential elections in February, 2016 where Donald Trump was running for presidency also caused an increase in the EPU index. There were uncertainties in the financial markets about economic policies that Trump would follow, in particular, about trade policy.

The spike in the EPU index in January, 2017 occurs due to Trump's policies, Brexit, CBRT's monetary policy, and constitutional amendment referendum that would be held in April, 2017.

In April 2017, the EPU index increased again due to the political uncertainty generated by the constitutional amendment referendum. With this referendum, Turkey's governance structure has switched to presidential governance system. Some of the changes introduced in the referendum came into effect with the next elections. The next elections were held in June 2018 and the index spiked again on May due to the uncertainty caused by elections, which was the first election under the presidential system.

Table 1.1
List of Main Events

April, 2001:	Uncertainty about the new economic program (Güçlü Ekonomiye Geçiş Programı)
July, 2001:	Distrust in the government and uncertainty due to shifting floating exchange rate regime.
September, 2001:	The September 11 terror attacks in the U.S.
July, 2002:	Political uncertainty that began with the then Prime Minister Bülent Ecevit's health.
February, 2003:	Probability of military action to Iraq by the U.S.
March, 2006:	The Governor of the CBRT, Süreyya Serdengeçti's term ended.
May, 2007:	Political uncertainty caused by presidential and prospective general elections.
June - July, 2008:	The closure case of the Justice and Development Party
June, 2013:	Gezi Park Protests
September, 2013:	Uncertainty about FED's monetary policy
January, 2014:	Political uncertainty caused by corruption investigations on December 17-25.
March, 2014:	Local general elections
August, 2014:	Presidential elections
April, 2015:	Political uncertainty created by general elections that would be held on June 2015.
June, 2015:	General elections
August, 2015:	The Justice and Development Party could not get majority of the votes to form a government alone.
October, 2015:	Political uncertainty created by early elections on November 1, 2015.
May, 2016:	Prime Minister Ahmet Davutoğlu resigned.
July, 2016:	Failed Coup Attempt in Turkey
November, 2016:	The U.S. Presidential Elections
January, 2017:	The U.S President Donald Trump's policy uncertainty, CBRT's monetary policy, coming Constitutional Amendment Referendum in Turkey
April, 2017:	Constitutional Amendment Referendum in Turkey, Trump's policy uncertainty
May, 2018:	Political uncertainty created by early elections on June 24.

*Source: Authors' own calculations

1.6 DISCUSSIONS

Findings suggest that the EPU index increases both with national and global uncertainties. We observed that political uncertainties, in particular elections, are the main causes of spikes in the Turkish EPU index. Elections increase economic policy uncertainty because policy makers may change with elections. Local elections are also a

source of uncertainty as they may signal a change in the ruling party in the coming general elections.

Results show that the 2008 global financial crisis did not lead to a notable spike in the EPU index. The reason for the spike in 2008 was the closure case of Justice and Development Party. The low levels of EPU index during the global crisis of 2007 – 2009, is also supported by Jirasavetakul and Spilimbergo (2018). Their argument is as follows:

> "*From Figures 1 to 4, immediate questions arise as to why the EPU index, on a monthly, quarterly, and annual basis, is relative low during the Global Financial Crisis of 2007-2009, and whether the EPU index accurately represents the degree of economic policy uncertainty in the country. The eye-ball audit suggests that the search algorithms perform well in selecting articles related to economic policy uncertainty in Turkey during the Global Financial Crisis. The relatively low index can be explained by the fact that all countries experienced a large increase in uncertainty and Turkey did not stand out. This is evident by a much larger number of total article counts, i.e. the normalizer, over this period, in part driven by the number of articles related to the implications of the crisis in the U.S. and Europe. Therefore, the normalization implies that our EPU index reflects perceived economic policy uncertainty in the Turkish economy relative to other economies globally" (p. 10).*

The EPU index spiked most with the political uncertainty caused by the then Prime Minister Ecevit's health problems as in line with other studies in the literature.

When the predetermined EPU terms are searched in digital archives, the search engine may yield unrelated news as well. Only relying on the machine-created series may bias the results of the study. To prevent such bias, we reviewed all news obtained from the search engine and excluded unrelated ones from the dataset. However, we could not detect the news that are related with EPU but do not contain the EPU terms, which can be considered as one of the limitations of this study.

2. THE IMPACT OF UNCERTAINTY ON CORPORATE INVESTMENT PLANS

In this section, we provided a theoretical background on the impact of uncertainty on corporate investment and reviewed the literature on this subject.

2.1 THEORETICAL FOUNDATION

Marshalian law or the Net Present Value (NPV) rule states that if the investment's present value of future net cash flows is higher than its initial cost, the investment should be accepted. In this case the decision-making rule of the firm is linear. If the firm's decision-making model is linear, then uncertainty does not affect firm's investment level (Stein and Stone, 2012). However, the assumption of the linearity of the decision-making rule of the firm does not hold in real life due to the existing uncertainties that create non-linearity. Baker (1984) (as cited in Gough, 1988, p. 8) provides the characteristics of decision-making under uncertainty as follows:

> ***1.*** *"the physical outcome (or value attached to the physical outcome) of some action is not completely known beforehand;*
>
> ***2.*** *the uncertainty (associated with the outcome) may be affected by the action taken;*
>
> ***3.*** *each action has an associated set of possible outcomes each with a probability or likelihood that only one of these outcomes will eventuate; and*
>
> ***4.*** *a decision is a choice between actions."*

Dixit and Pindyck (1994) state that most investment decisions share three characteristics. These are 1) irreversibility of investment, (2) uncertainty of future market conditions, and (3) timing of investment. In the following paragraphs, we will explain these investment characteristics.

2.1.1 Irreversibility of Investment

Irreversibility means initial cost of investment is at least partially sunk. It occurs when firms cannot dispose used capital without cost (Chirinko and Schaller, 2009). The factors that affect irreversibility are limited resale markets, low depreciation, high uncertainty, and negative wide shocks (Chirinko and Schaller, 2009). Dixit and Pindyck (1994, p. 4) state that investment expenditures are sunk cost when they are firm or industry specific. They add that even though the investments are not firm or industry specific, they are often partly irreversible due to asymmetric information in the market. For example, if investors decide to disinvest and sell used machines such as office equipment, cars, trucks and computers on the market, buyers will offer an average price. Sellers of good quality machines leave the market in response, which will reduce the average quality and therefore the market price of the used machines, as Akerlof (1970) points out as lemons problem.

Irreversibility is also related with option to invest. “When a firm makes an irreversible investment expenditure, it exercises, or "kills," its option to invest. It gives up the possibility of waiting for new information to arrive that might affect the desirability or timing of the expenditure; it cannot disinvest should market conditions change adversely” (Dixit and Pindyck, 1994, p.3). “As with the financial call option, this option to invest is valuable in part because its net payoff is a convex function of the future value of the asset obtained by investing, which is uncertain. And like the financial option, one must determine the optimal "exercise" rule” (Pindyck and Solimano, 1993, p.4). Besides, when investments are irreversible, firms are more sensitive to bad states since the cost of disinvestment is more than investment. Kim and Kung (2017) state that even though investment opportunities stay constant, an increase in uncertainty leads firms to purchase more protection by postponing their investments for firms that have more irreversible investments.

Nickell (1978) hypothesizes that, under risk-neutrality assumption, firms tend to take higher risks in expansion periods due to higher expected profits (as cited in Baddeley, 2003). Hence, they increase their capacity in order to exploit good outcomes. However, this is valid if investments are reversible because they don’t have any loss in bad outcomes if they can quickly reverse their investment decisions (as cited in Baddeley, 2003). Bloom

(2014; p. 167) provides an example of this topic as follows. "*A factory is elastic at its production volume, that is, it can halve its production volume if the price of the products decreases, and doubles if the price increases. Increase in uncertainty level that the firm desires should be mean-preserving because its payoff is 50 percent during bad outcomes and 200 percent during good outcomes. Basically, the firm partly insures itself by being able to cut down its production level when market conditions are bad and it has an option to increase its production level by being able to expand when market conditions are good.*"

Pindyck and Solimano (1993) specify that according to the irreversible investment literature, credibility and stability are more important than particular levels of tax rates and interest rates if the aim of macroeconomic policy makers is to encourage investment over the short or medium-term.

2.1.2 Uncertainty of Future Market Conditions

The second characteristic of investment decisions is uncertainty of future market conditions. The kind of uncertainty, which is not reduced to a single probability distribution but to a set of probability distributions, is called Knightian uncertainty and has already been covered in the Section 1. Pindyck (1988) points out that uncertainty about future market conditions affects investment decisions through the options that firms hold. Nishumura and Ozaki (2007) argue that the effect of uncertainty on irreversible investments differs greatly between risk and Knightian uncertainty: While an increase in Knightian uncertainty reduces the value of irreversible investment opportunity, an increase in risk in the form of an increase in variance increases it. On the other hand, both increase the value of waiting, which makes firms more likely to delay investment.

2.1.3 Timing of Investment

> *"But although men have the power to purchase, they may not choose to use it. For when confidence has been shaken by failures, capital cannot be got to start new companies or extend old ones. Projects for new railways meet with no favour, ships lie idle and there are no orders for new ships... The chief cause of this evil is ant of confidence."*

Alfred Marshall, 1879 (as cited in Ferderer, 1993, p. 30)

Investment opportunities do not disappear immediately. Investments may be delayed; therefore, the timing of the investment becomes an important decision. When uncertainty levels are high, firms use the option value of waiting to gain new information. This creates "wait and see" approach, which affects the timing of investment. Bernanke (1983) argues that only unfavourable outcomes are important at whether to undertake or delay an investment. When a firm makes irreversible investments, it "kills" its option to invest and lose the value coming from the prospective information that will improve investment decision. This implies that uncertainty and irreversibility create an opportunity cost. The lost option value is then added to the cost of investment as an opportunity cost. Therefore, the simple NPV rule, which states that "if the investment's present value of future net cash flows is higher than its initial cost" should be changed (Pindyck and Solimano, 1993). McDonald and Siegel (1986) is among the studies, which show how much the NPV rule should be changed. McDonald and Siegel constructed a model that compares the advantages of investing today with those of waiting. Their results show that it is optimal to delay investing until the present value of future cash flows is higher than the cost of investment by an amount of threshold that can actually be much larger than the initial cost of investing.

New information is important in the evaluation of long-term project returns in the sense that it eases right decision-making. However, there is a trade-off between the extra returns from early commitment against waiting for new information to arrive (Bernanke, 1983): On the one hand, new information may show that the investment undertaken was a mistake that cannot be undone if early commitment happens. On the other hand, waiting is assumed to increase the cost of the project.

2.2 THE IMPACT OF UNCERTAINTY ON INVESTMENT

The impact of uncertainty on investment can be either negative or positive, depending on which effect predominates the other. The characteristics that affect the sign and the magnitude of the impact of uncertainty on investments are the risk attitude of firm, the degree of irreversibility, the option value of investment opportunities, the degree

of financial constraints, the competitiveness in product markets in combination with the production technology, the shape of adjustment costs, and the importance of investment lags (Bo and Lensink, 2005; Guiso and Parigi, 1999).

Bloom, Bond and Van Reneen (2007, p. 393) explain a typical model of investment under uncertainty in the literature:

> *"The typical model in the literature considers investment in a single partially irreversible capital good, with a Cobb–Douglas revenue function and demand conditions that follow a Brownian motion process with constant variance. Investment only occurs when the firm's marginal revenue product of capital (MRPC) hits an upper threshold, given by the traditional user cost of capital plus an option value for investment. Similarly, disinvestment only occurs when the marginal revenue product hits a lower threshold, given by the user cost for selling capital less an option value for disinvestment. The firm chooses to wait and do nothing if its MRPC lies between these two thresholds."*

Stein and Stone (2012) classified theoretical literature on investment under uncertainty into three groups of models according to the assumed source of curvature. These are (1) the firm's profit function (2) adjustment costs, and (3) utility functions over profits. Another classification is based on the theories that investigate the causal effect of uncertainty on investment. These theories are the real options theory of investment, financial frictions, and incomplete contracting. In this part, first, we will review the literature about the models based on the assumed source of curvature, and then review the theories based on the cause-effect relationship between uncertainty and investments.

2.2.1 The Models Based on the Assumed Source of Curvature

The models based on the assumed source of curvature are the firm's profit function, adjustment costs and utility functions over profit.

2.2.1.1 The Firm's Profit Function

These kinds of models consider a curvature in the profit function of firms. Baddeley (2003) argues that the debate on the relationship between investment and uncertainty began with the assertion that they are positively related. In the literature, as Bloom (2014) points out, the positive relationship between investment and uncertainty is known as the Oi-Hartman-Abel effect (after Oi, 1961; Hartman, 1972; Abel, 1983). Oi (1961), Hartman (1972) and Abel (1983) indicate that the marginal revenue product of capital is a convex function of output prices as long as firms have a flexibility to adjust inputs after the investment decision is made (as cited in Stein and Stone, 2012). According to this approach, increased price uncertainty causes competitive risk-neutral firms to increase their investment levels due to Jensen's inequality (Ferderer, 1993). Jensen's inequality states that for any convex function f and a given random variable y, we have E [f (y)] > f (E [y]), which implies that the mean of function y is always greater than function of the mean of y. Ferderer (1993, p. 30) explains the reason for the increase in investment due to the increase in price uncertainty as follows: "*If the marginal revenue product of capital is convex in price, then a mean-preserving increase in price uncertainty raises the expected payoff to marginal units of capital and stimulates investment*." This argument is valid under perfectly competitive markets and the increased uncertainty in output prices stimulates an increase in current investments regardless of the curvature of the marginal adjustment cost function (Abel, 1983). Flexibility of firms to adjust their inputs after the investment decision is made makes them risk loving under uncertainty. They expand to exploit good outcomes and contract to avoid negative effects of bad outcomes.

The arguments for convex returns are stated in Lensing and Sterken (1998, p. 9) as follows.

> ***1.*** "*Risk neutrality. This is the case studied by Hartman (1972).*
>
> ***2.*** *The option to abandon a project. Roberts and Weitzman (1981) show that if a firm has the option to abandon a project, an increase in uncertainty increases the incentive to invest.*
>
> ***3.*** *Costly entry and exit and time to build (see Bar-Ilan and Strange (1996)).*

4. *Bankruptcy limit downside risk, so uncertain investment projects might be more attractive from an information economics point of view. In this case, firms have limited liabilities. See Stiglitz and Weiss (1981).*

5. *Flexibility of labor relative to capital. If labor can adjust to price shocks fluctuations lead the firm to change the labor-capital ratio, so the marginal product of capital changes more than the price change. See Abel (1983).”*

Leahy and Whited (1996) argue that it is the flexibility of labor relative to capital that causes the convex returns in Oi’s (1961), Hartman’s (1972) and Abel’s (1983) models. Lee and Sheen (2000) support the findings of Leahy and Whited that labor convexifies the profit function that creates the positive effect of uncertainty on investments. They state the reason as follows: “*Since the profit function becomes more convex as the labor share increases, the elasticity of investment with respect to uncertainty increases in the labor share of the technology. This elasticity result sheds new light on the source of the positive relationship*” (Lee and Sheen, 2000, p. 668).

Bloom (2014) states that the Oi-Hartman-Abel effects are commonly not very strong in the short-run because of the adjustment costs. It may work better in the medium or long-run (Bloom, 2014).

2.2.1.2 Adjustment Costs

Nickel (1977, p. 30) defines adjustment cost as the “costs over and above the purchase price associated with the acquisition and installation of new capital goods.” Examples of adjustment costs are the costs of disruption, the training of workers, installing new equipment or structures, the irreversibility of many projects due to a lack of secondary markets for capital goods, and management problems (Nickel, 1997; Cooper and Haltiwanger, 2006). Pindyck (1982) found that uncertainties about a risk-neutral competitive firm’s future demand and costs depend on the curvature of firm’s marginal adjustment cost function. If the function is convex, then increased output price uncertainty may lead to increased investment. However, if it is concave, then increased output price uncertainty may lead to decreased investment.

It is adjustment costs that make an investment costly to reverse (Bloom, 2014).

> "*With adjustment costs, not investing allows the firm to maintain the option to invest only if future business conditions are sufficiently attractive; uncertainty increases the value of this call option. In "real options" models such as that of Dixit and Pindyck (1994) and Abel and Eberly (1996), the combination of uncertainty and irreversibility in investment generates regions of inaction where firms prefer to "wait and see" rather than immediately invest. Greater uncertainty expands this region of inaction, generating a negative relationship between uncertainty and investment. The strength of these effects is likely to be higher for inputs that are characterized by a high degree of adjustment costs*" (Stein and Stone, 2012, p. 6).

The literature about adjustment-costs assumes that firms are perfectly competitive and operate under constant returns to scale, which implies that the marginal contribution of capital to operating cash flow and installed capital stock are independent of each other (Bertola, 1998, p. 4).

2.2.1.3 Utility Functions over Profit

This group of models assumes curvature in managers' or investors' utility function and predict a negative relationship between investment and uncertainty (Stein & Stone, 2012, p.7). Some examples are managerial risk aversion (Panousi and Papanikolaou, 2012) and ambiguity risk aversion (Ilut and Schneider, 2012) (as cited in Stein & Stone, 2012). According to this group of models, firms with greater risk aversion have a tendency towards having lower output and inputs (Ghosal and Loungani, 2000).

A risk-averse investor will be interested in undiversifiable risk, and hence covariance of firm and market returns rather than a single firm's idiosyncratic risk. An increase in the covariance of firm returns with market returns increases the riskiness of investment, which leads to an increase in the required rate of return and therefore a decrease in the desired level of capital stock. The Capital Asset Pricing Model (CAPM), where the required rate of return on an investment should be positively related with the

investment's risk, predicts that an increase in covariance of firm returns leads to a decrease in investment (Leahy and Whited, 1996). Pindyck (1993) argues that the positive effect of uncertainty on investment arises from the firm's idiosyncratic risk.

As Bloom (2014) states, in some models there are pessimistic individuals that cannot form a probability distribution because they are too uncertain about the future. Rather than having a probability distribution, they have a range of possible outcomes and behave as if the worst scenario would occur. This behaviour is called ambiguity aversion. As uncertainty increases, the worst possible outcome becomes worse. Therefore, agents reduce investment spending (Bloom, 2014).

As the theories show, the effect of uncertainty is to create an opportunity cost of investing now rather than waiting for better conditions in the future under the conditions that the investments are irreversible and can be delayed (Pindyck and Solimano, 1993). "*Hence the net effect of uncertainty on irreversible investment depends on the size of this opportunity cost relative to the increase in the value of the marginal unit of capital*" (Pindyck and Solimano, 1993, p. 10).

Another classification of the theoretical literature on investment under uncertainty is based on the causal effect of uncertainty on investment. These theories are the real options theory of investment, financial frictions, and incomplete contracting. In the rest of this section, we will review these theories.

2.2.2 The Theories Based on the Cause-Effect Relationship between Uncertainty and Investment

The theories based on the cause-effect relationship consist of the real options theory of investment, financial frictions and incomplete contracting. We will explain these theories in the following sections.

2.2.2.1 The Real Options Theory of Investment

The conventional investment evaluation methods namely the NPV, the payback period and the internal rate of return have some shortcomings such as the timing of investment decisions, irreversibility of investment expenditure, ignorance of outcome

uncertainty and ignorance of managerial flexibility. Besides, according to these methods, the future return on investment is a deterministic variable. Abel's (1983) finding that the positive impact of uncertainty on investments is also sensitive to assumptions such as perfect competition and constant returns to scale. This positive impact decreases its effect under imperfect competition and decreasing returns to scale (Caballero, 1991). To counter the shortcomings of these theories, real options theory was developed that optimizes managerial choices under uncertainty.

Firms have two kinds of assets that determine its value: (1) assets in place, which the firm has already invested in and (2) growth options, which the firm is expected to invest in the future (Myers, 1977). The value of most firms comes from growth options, which are investment opportunities in the future. Dixit and Pindyck (1994) emphasize the importance of not only physical capital but also intangible factors through research and development as investment opportunities. Investment opportunities, that is options to invest, originate from patents and the ownership of land and national resources. They also arise from "a firm's managerial resources, technological knowledge, reputation, market position, and possible scale, all of which may have been built up over time, and which enable the firm to productively undertake investments that individuals or other firms cannot undertake" (Dixit and Pindyck, 1994).

Options are grouped under two main categories: financial and real options. In financial options the underlying asset is financial assets such as stocks and bonds, whereas in real options the underlying asset is a real asset. The options for financial assets are listed in exchanges such as Montreal Stock Exchange, Chicago Board Options Exchange, and Boston Options Exchange. In contrast, real options may involve real estate, projects, and intellectual property, which may not be traded (Kodukula and Papudesu, 2006).

> *"Thales, a famous Sophist philosopher circa 600 B.C., gazed into the star-studded sky one evening and predicted an outstanding olive harvest the next season. For a small up-front fee, he bought the right from the owners of the olive presses to rent them for the usual rate during the harvest season. If the harvest turned out to be meager, there would be less need for the presses and Thales would not rent them,*

losing the up-front fee. But if the harvest was bountiful, he would rent the presses at the regular agreed-upon price and turn around and rent them out to the farmers at a significant margin. Sure enough, it was an outstanding harvest, and Thales rented the in-demand presses and made a fortune. He was apparently more interested in proving the wisdom of Sophists than making money, as Aristotle tells this story in Politics" (Kodukula and Papudesu, 2006, p. 1).

As Kodukula and Papudesu (2006) state, this is one of the earliest examples of a real options contract, where Thales used a call option. Here, the underlying risky asset is the presses and Thales bought a right but not an obligation by buying the option to rent the presses.

Real options are investment opportunities in the future and are seen as "call options" (Myers, 1977). They give managers a choice to invest now or to "wait and see" until the market conditions turn favourable in the future and until uncertainties get resolved. During the postponement period new information that decreases the uncertainty in the market conditions arrive. This new information creates a more informed future decision that decreases premature investment. However, a higher value as a result of "wait and see" approach necessitates a higher critical investment threshold, that is, the project value must be higher than the required investment cost at a significant premium before investing and sacrificing the option to wait is confirmed (Trigeorgis, 2002). The implication of this is that higher uncertainty leads to lower investing or a delay in investment (Trigeorgis, 2002). Therefore, when compared with NPV approach, options theory approach determines investment rule as so: "Invest when the value of the project exceeds its cost by an amount equal to the option value of waiting to invest" (Sarkar, 2000, p. 220). An example of deferring the investment decision is provided in Kodukula and Papudesu (2006, p. 8) as follows:

"MobileVDO, a telecom company, paid $20 million to buy a patent for ultrawide band wireless technology that can transfer streaming video at high speeds with minimal power requirements. MobileVDO estimates that it will take another $200 million to develop and

commercialize this technology, but there is great uncertainty about the payoff. It therefore plans to wait for the uncertainty to clear before investing in development and commercialization. Buying the patent gives MobileVDO an option to develop and commercialize the technology. In the next three years, if the market uncertainty clears and the payoff from commercialization is expected to be greater than $200 million, MobileVDO would make the investment. It may even fund initial studies such as focused market surveys to clear some of the uncertainty to facilitate a more informed decision. However, if the uncertainty does not clear in a reasonable time, the telecom may let the patent expire."

Option to delay investment becomes valuable only if the following two conditions are satisfied: (1) The net revenue function should not be linearly homogeneous; (2) Adjustment costs should not be strictly convex in investment (Bond and Cummins, 2004, pp. 2-3).

According to real options theory, the negative effect of uncertainty on investment spending is also affected by the firm's degree of investment irreversibility. The firms with more irreversible investment projects tend to delay their investments more when they encounter with a common positive shock (Gulen and Ion, 2016). In contrast, uncertainty shocks do not affect completely reversible investment projects since they do not have an incentive to wait (Gulen and Ion, 2016). In addition, delaying irreversible investments do not preclude option to abandon the project in bad states of nature since they are not profitable in those states.

Bloom (2014) states that real option effects are not universal. Reasons for this are presented in Bloom (2014) as follows: First, they emerge only when investment decisions are at least partially irreversible. Second, in order to use it, firms should have an ability to wait. For example, if they compete with other firms to be the first to patent a new idea, the option disappears. Third, the markets that the firms sell into should be imperfectly competitive.

2.2.2.2 Financial Frictions

Studies using this theory investigate the relationship between financial constraints and investment in incomplete markets. Generally, they investigate the impact of financial constraints on investments through cash flow sensitivity (Stiglitz and Weiss, 1981; Fazzari, Hubbard and Petersen, 1988; Jaffe and Russell, 1976). Modigliani and Miller (1958) suggest that capital structure of a firm does not have an impact on the overall value of the firm. However, this proposition is valid under perfectly competitive frictionless markets. As Brunnermeier, Eisenbach and Sannikov (2012, p. 3) state, in a frictionless economy funds are liquid and it flows in the most efficient way, that is they flow to the most profitable projects. In contrast, with financial frictions, liquidity matters, and external funding becomes more expensive than internal funding. The cost difference between external and internal funding affects firms' investment policies. The main market frictions that have an impact on corporate investment policies are asymmetric information, agency problems, transaction costs and liquidity risk (Please see Stein (2003) for a detailed survey on this topic). The impact of uncertainty on investments can be through financial frictions channel. As idiosyncratic uncertainty of a firm increases, its default probability increases as well since "*financial frictions prevent the firm from perfectly insuring itself again downside risk*" (Seiler, 2017, p. 2). As a result, the firm decreases its investment level.

By using panel data on manufacturing firms, Fazzari, Hubbard and Petersen (1988) investigated the investment behaviour of firms that are subject to varying degrees of financial frictions. They found that firms that have difficulties in raising external funds exhaust their cash flow to finance desired capital expenditures. Gilchrist, Sim and Zakrajšek (2014) found that uncertainty affects investment through changes in credit spreads, which are commonly used as an indicator of the degree of financial market frictions. They found that a rise in firm risk causes an increase in bond premium, which implies an increase in the cost of capital. As a result, a decrease in investment activity occurs regardless of investment irreversibility or managerial risk aversion.

2.2.2.3 Incomplete Contracting

Hart (2017, p. 1732) defines complete contract as follows: “These are contracts where everything that can ever happen is written into the contract. There may be some incentive constraints arising from moral hazard or asymmetric information but there are no unanticipated contingencies.” On the other hand, incomplete contracts may leave out important things: There are uncertainties about who would be the decision maker about the missing things, ownership and residual control rights. The effect of incomplete contracts on investments arises with specific investments where “specific investment refers to investment which has very little or no value in alternative uses” (Mastandrea, 2000, p. 43). For example, a company develops a product that only fulfils specific needs of a particular customer (Schmidt, 2010). Specific investments are at least partially sunk, and investments lose value if the relationship breaks up (Schmidt, 2010). When specific investments exist, one party in the contract is held up by the other party and that party cannot find another partner without a loss on the value of the investment.

The theories that rely on firm-level inflexibility to adopt conditions under uncertainty and thus lead to a contraction in business activities are called contractionary theories of uncertainty; whereas the theories that rely on firm-level flexibility to adjust conditions under uncertainty and thus lead to an expansion in business activities are called expansionary theories of uncertainty (Sun and Samaniego, 2016).

2.3 PREVIOUS RESEARCH ON CORPORATE INVESTMENT UNDER UNCERTAINTY

In this section, we will review the studies covering the impact of uncertainty on investments. As stated in the previous section, the sign of the relationship between uncertainty and investment may be either negative or positive depending on the underlying theories and assumptions.

Leahy and Whited (1996) investigated the relationship between uncertainty and investment using firm-level data from 1981 to 1987. Their aim was both to explore the sign of the relationship between investment and uncertainty for U.S. corporations and to determine the relative importance of variances and covariances. They measured uncertainty with the variance of firm’s daily stock return. They regressed the rate of

investment on uncertainty measure and as the estimation technique; they adapted Vector Auto Regression (VAR) estimation to panels with a short-time dimension. Results of this study indicate that there is a negative relationship between investment and uncertainty. They also stated that they could not find a positive relationship between investment and uncertainty through the channel of the convexity of the marginal product of capital, which implies that the negative relationship arises from irreversibility of investments.

Guiso and Parigi (1999) investigated the impact of uncertainty on investment decisions of the 549 Italian firms in the manufacturing sector on the assumption that the investments made by these firms are irreversible. When investment is irreversible, the demand threshold that triggers investment increases with uncertainty. They used expected demand, standard deviation of expected demand as the uncertainty variable, an interaction term between expected demand and uncertainty and various control variables in their model. They found that while the expected demand has a highly significant positive effect on investment decisions, the interaction term has a negative effect in line with irreversible investment models. By adding cash flow to the equation as a control variable, they also illustrate that credit constraints are not the reason for the negative relationship between investment and uncertainty.

Pindyck and Solimano (1993) focused on empirically examining the impacts of irreversibility and uncertainty on aggregate investment behaviour in industrialized and developing countries. They investigated the dependence of investment on volatility because changes in volatility of the marginal profitability of capital affect investment through the threshold that firms use in their investment decisions. They used panel regressions over the period 1962 to 1989 for a sample of 30 countries. They expected that an increase in the standard deviation of annual percentage changes in the marginal profitability of capital would increase the required return on investment, leading to a decrease in investment. Results show that an increase in volatility led to a decrease in investment and the magnitude of the decrease in investment is greater for developing countries.

Using a sample of A-share manufacturing firms listed on the Shanghai and Shenzhen Stock Exchanges, Xu, Wang and Xin (2010) analyzed the relationship between

uncertainty and investment over the period 1999 to 2008. They grouped the firms under two categories: government-controlled and privately-controlled. They defined the investment variable as sum of the changes in capital assets and amortization in the current year. As the uncertainty variable, they used the annualized standard deviation of daily stock returns. As the control variables, they used Tobin's Q, operating cash flow, debt ratio, and a dummy variable that takes the value of one if the firm is controlled by government. They used panel data regression analysis, in particular the fixed effects model, to test the effect of uncertainty on investments. They found that total firm uncertainty had a significant negative impact on investment. As the next step, they ran the regression equation for government and privately-controlled firms separately. They found that there was no relationship between investment and total firm uncertainty for government-controlled firms; however, the significant negative relationship between investment and total firm uncertainty remained for privately-controlled firms. The reason for the neutral relationship is given as follows: The risk appetites of government-controlled firms are higher due to administrative intervention, weak corporate governance, and lack of an effective incentive system.

Bulan (2005) investigated the relationship between uncertainty and firm-level investment using panel data analysis. He used a sample of 2,901 U.S. manufacturing firms for the period from 1964 to 1999. As the dependent variable, he used firm investment normalized by the capital stock at the beginning of the period. As the uncertainty variable, he used realized volatility of a firm's stock returns since realized values of volatility may be a proxy for the expected volatility based on the assumption of rational expectations. As the control variables, he used Tobin's Q, cash flows and marginal profitability of capital. He estimated the regression equation by using the two-stage least squares method. He found that greater uncertainty in a firm's environment significantly reduces investment, in line with the theory of real options and the negative relationship remains after controlling investment opportunities.

Rosenberg (2004) examined the relationship between the firm-level risk and investment intensity of 93 Finnish firms for the period from 1986 to 2000. As the dependent variable, he used investment to total capital ratio of the firms and as the

independent variables, he used risk, leverage, employment growth, sales growth, Tobin's Q, size and cash flow variables. He estimated the firm risk with the volatility of equity returns and classified it as total risk, systematic risk and unsystematic risk. He decomposed total risk into systematic and unsystematic components through a market model regression. He measured systematic risk with beta-coefficient squared multiplied by variance of market returns, and unsystematic risk with residual variance from the market model regression. He estimated panel regression equations with ordinary least squares (OLS), fixed-effects model and generalized method of moments (GMM). Results of this study show that there is a significant negative relationship between total firm risk, unsystematic risk and investment intensity. However, there is not a significant relationship between systematic risk and investment intensity of firms. All the regression equation results indicate that leverage and cash flow to assets do not have a significant impact on investment intensity. In contrast, there is a significant positive relationship between Tobin's Q and investment intensity based on the results of the OLS and fixed effects models, and between size and investment intensity based only on the results of the OLS.

Ghosal and Loungani (2000) estimated the impact of uncertainty on investment by controlling the size variable for the period 1958 to 1991. Instead of using firm-level data, they used industry data that spans a longer time period. Therefore, they can calculate uncertainty measure from a relatively long time series. They grouped firms into seven categories based on their sizes. As the uncertainty variable, they used profit uncertainty and measured this variable by taking the standard deviation of the residuals of the profit-forecasting equation. In particular, they created a time series for profit uncertainty and estimated the profit-forecasting equation for the sample period. As the next step, they collected the residuals over overlapping five-year periods and used the standard deviation of the residuals over the five-year periods as the uncertainty measure. They obtained a time series of 27 observations of standard deviation of residuals for each industry. They used panel data regression analysis to measure the effect of this uncertainty variable on investment. As the dependent variable, they used gross industry investment normalized by the capital stock at the beginning of the period. As the independent variables, they used standard deviation of residuals, cash flow scaled by capital stock, its one-year lagged

value, dependent variable's lagged value and current and lagged aggregate real net private domestic investment growth. The results of this study show that there is a significant negative relationship between uncertainty and aggregate investment for all size groups; however, the effect is higher for the smallest size group. For the largest size group, although the negative relationship continues to exist, its effect decreases. Moreover, there is a positive relationship between investment and industry cash flow as expected.

Bianco et al. (2013) investigated the impact of uncertainty on Italian family firms' corporate investments over the period 1996 to 2007. The number of firms in their dataset is 2,959. As the dependent variable, they used planned investment scaled by the stock of capital. As the independent variables, they used expected demand, uncertainty about the firm's future demand, cash flow and financial debt. To estimate the parameters of the regression equation, they used Arellano and Bond's (1991) difference GMM. They found that there is a negative relationship between family firms' investments and uncertainty and that family firms' investments are more sensitive to uncertainty than those of nonfamily firms. They stated two reasons for this negative relationship. First, the opaqueness of the family firms increases their degree of irreversibility due to less information available for family firms. They proxied opaqueness with two variables, which are related to trust and law enforcement. High trust and a good law enforcement are expected to reduce irreversibility of firms' investments. As a result, the firms' capital goods value is likely to be more easily accessed by the market and become less sunk. The results show that the negative impact of uncertainty on investments is higher for family firms where trust is lower, or law enforcement is worse. Second, unobservable risk aversion is higher for family firms because the owner of the firm has a high share of the firm and the owner may have an intention of keeping control of the firm within the family.

Minton and Schrand (1999) investigated the impact of cash flow volatility on firm level investment. The sample of the study consists of non-financial firms in different industries. As the uncertainty variable, they used cash flow volatility. They defined cash flow volatility as "the coefficient of variation in a firm's quarterly operating cash flow over the six-year period preceding each of the seven sample years from 1989 through 1995." They used regression analysis to test the impact of uncertainty on investment and

estimated the regression equation with OLS for each year in the sample. They proxied investment with capital expenditures, R&D costs, and advertising expenses. As the independent variables, they used cash flow volatility, and two more control variables namely sales growth and average annual book to market ratio besides the uncertainty variable. They found that there is a negative relationship between cash flow volatility and investment, and a positive relationship between sales growth and investment.

Bell and Campa (1997) examined the effect of uncertainty on irreversible investments in the global chemical processing industry. As a proxy for uncertainty, they used volatility in exchange rates, input prices, and product demand, and investigated their effects on new investments in capacity. They detected 267 investments in production capacity built in both U.S. and Europe for a sample of 16 chemical products for the period from 1977 to 1989. They chose chemical processing industry because "production technologies are product specific and capital intensive, which causes expensive and irreversible investments in capacity" (p. 79). They found mixed results depending on the uncertainty measures. The effects of input price and product demand volatilities on new investment capacity are not statistically significant in U.S. and Europe. However, they found a negative significant impact of exchange rate volatility on investments.

Ferderer (1993) examined the impact of uncertainty on corporate investments. He used two investment models, i.e. the neoclassical model and the Tobin's Q investment model to investigate the relationship between the two variables. As a proxy for uncertainty, he used the term premium embedded in the term structure of interest, which is perceived as a forward-looking measure of uncertainty compared to stock return volatility. To measure investment, Ferderer used two proxies. These are the "real gross expenditure on producers' durable equipment" and "the real value of contracts and orders for new plant and equipment" (p. 38). He used quarterly data that spans the period from 1968 Q3 to 1989 Q1. He found that the lagged values of the risk premium have a significant and negative impact on investment spending in both models.

Bo and Lensink (2005) argue that the relationship between investment and uncertainty is not linear but follows an inverted U curve, which means that the investment-uncertainty relationship is positive for low levels of uncertainty whereas it

turns out to be negative for high levels of uncertainty. To test this relationship, they used a sample of 57 listed Dutch manufacturing firms spanning the period from 1984 to 1996. As a proxy for uncertainty, they used the volatility of individual firms' daily stock returns. They analyzed the data by panel data analysis and estimated the regression equation with the system GMM. To understand whether the shape of the relationship between the two variables is an inverted U curve, they add both a linear uncertainty term and its quadratic term to the regression equation. If the regression results give a positive coefficient for linear term but a negative coefficient for the quadratic term, it can be concluded that the relationship between the two variables is U-shaped. The results of the regression equation confirmed the existence of the U-shaped relationship. That is, while the coefficient of the linear term was significantly positive, it was significantly negative for the non-linear term.

Güven and Akkoyunlu-Wigley (2018) investigated the impact of uncertainty on investment for a panel of Turkish manufacturing industries over the period 1992 to 2001. They assumed that the Turkish manufacturing industry has an imperfectly competitive market structure. In order to measure the extent of competition in the product markets, they constructed a dummy variable, which takes the value of one depending on the four-firm concentration ratio. They also divided industries as more competitive and less competitive. Their aim was to test the theoretical argument that the impact of uncertainty on investment is more prominent in non-competitive industries. To estimate the panel regression equation, they used system GMM method. The regression results show that the impact of uncertainty on investment is negative and it becomes stronger in non-competitive industries. They also found that irreversibility has no impact on investment in all industries; however, it has an impact on investment behaviour in imperfectly competitive industries.

Riem (2016) analyzed the impact of political uncertainty on the investment decisions of German manufacturing firms for the period 1994 to 2012. Riem used an unbalanced panel of survey data and annual balance sheet data. Survey data includes firm-specific responses about the realized investments and investment plans of the 2,500 firms existing in Germany. Riem used political uncertainty as a proxy for uncertainty and used state election years as a source of uncertainty. The number of state elections held in the

sample period was 43. In addition to uncertainty variable, Riem used firms' revenue growth, GDP growth, and cash flow as explanatory variables. As the dependent variable, Riem used two investment variables, which are realized investments, and the planned investments, and ran two different regression equations for each of these variables. The results of the study illustrate that the uncertainty caused by elections lead to a decrease in both realized and planned investments; however, only the decrease in realized investments was statistically significant.

Kim and Kung (2017) investigated how variation in asset redeployability affects firm investment under uncertainty. As asset redeployability, they imply "the extent to which assets have alternative uses" (p. 246), which is mostly related to investment irreversibility due to the spread between the purchase and liquidation values of capital. They calculated the asset-level redeployability score to measure firm-level asset redeployability. This score is computed as "the proportion of firms that use a given asset" (p. 246), which takes into account asset specifity, asset market thickness, the financial constraints of potential buyers, and lastly the correlation of output within industries. For example, if an asset is highly specialized for a given firm, and hence has no saleability outside the firm, its redeployability score is zero. They also calculated industry-level asset redeployability by taking the weighted average of the firm-level asset redeployability scores. In addition to uncertainty variable, they also used Tobin's Q, cash flow, and sales growth as firm-level explanatory variables. They used difference in difference method to estimate regression equation around Gulf War I and 9/11 Terrorist Attacks, which are determined as shocks to uncertainty. They found that the variation in asset redeployability has a statistically significant and negative impact on capital investments, and that impact is stronger for transportation and manufacturing firms where less redeployable capital is used.

Demir (2009) investigated the impact of uncertainty on the fixed investment spending of real sector firms for the three countries namely Argentina, Mexico, and Turkey under the context of financial liberalization. He chose these three countries because financial liberalization programmes were tested at a full scale in those countries. Demir used panel regression analysis separately for each country and estimated the

regression parameters with the Arellano and Bover (1995) system GMM. The dependent variable was the real net fixed investment, and the explanatory variables were the lagged values of the dependent variable, capital to output ratio, and level and lagged uncertainty variables such as country risk, manufacturing inflation, and real exchange rates volatilities. The results of the regression estimates show that on average an increase in country risk has a significant and negative impact on private sector firms' investment decisions in all countries.

Julio and Yook (2012) investigated the effects of political uncertainty on corporate investments for a large panel of countries. They hypothesized that the decrease in investment expenditures will be larger when the election outcome is less certain. As the sample, they considered 248 national elections in 48 countries during the period from 1980 to 2005. To measure the election outcome, they first observed the election results and vote counts for the candidates, and then used "the size of the margin of victory as a proxy for the degree of outcome uncertainty in any given election" (p. 50). They found that firms reduce corporate investment in election years, and that political uncertainty has a significant impact on the firm's real investment and savings decision.

Seiler (2017) analyzed the impact of economic policy uncertainty on capital expenditures. He used a panel of U.S. firms for the period from 2005 and 2015. Apart from other studies in the literature, he used firm-level measure of policy uncertainty. In his own words: "I match the fiscal year averages of the categorical policy uncertainty indices from Baker, Bloom and Davis (2016) to individual firms. These indices offer a measure of economic policy uncertainty in nine different policy classes and will serve as a key input for my firm-level index. The indices are based on monthly counts of newspaper articles that relate to economic policy uncertainty and a specific policy class" (p. 5). Seiler used panel fixed effects regressions to identify the effect of EPU on investments. He found that after an increase in EPU, investment rates fall in the next year. In particular, twofold increase in economic policy uncertainty leads to a 25 % decrease in capital expenditure rates.

Ender and Demir (2016) analyzed the impact of the EPU index on stock returns of tourism companies listed in Borsa İstanbul over the period from 2002 to 2013. Due to publicly

unavailable data for the Turkish EPU index, they used the European EPU index developed by Baker, Bloom and Davis (2013) and put dummies for the main events that create domestic economic policy uncertainty in Ermişoğlu and Kınık (2013). They analyzed the data with multiple regression analysis, and besides uncertainty variables, they used six macroeconomic factors as control variables. The macroeconomic control variables are monthly percentage changes in confidence index, gross industrial production, consumer price index, M1 index, discount rate, and oil prices. They found that while the European EPU index has a significant negative impact on stock returns of BIST-listed tourism companies, macroeconomic variables do not have a significant impact.

De Juan and Corinna (2019) investigated the impact of political uncertainty on corporate investments. Uncertainty caused by possible changes in government policies may lead firms to postpone investment in order to obtain new information, or it may prevent firms from investing due to increased risk aversion. They defined political uncertainty as "situations characterized by increased dispersion in agents' expectations about governments' future policy stands" (p. 8). In their model, they used an investment equation that controls both firm-specific investment predictors and macroeconomic conditions. The sample includes annual firm-level data for the period 1997 to 2016, not only from listed Spanish firms but also from small and medium-sized enterprises (SMEs) in Spain. They used an aggregate index developed by Gil, Pérez and Urtasun (2017) as a measure of policy uncertainty. The aggregate index is composed of five indicators. These are (1) an indicator of individuals' opinions about the current political situation; (2) an indicator of individuals' expectations about the future political situation; (3) an indicator of political risk; (4) the EPU index for Spain; and (5) an indicator of disagreement about public deficit forecasts (De Juan and Corinna, 2019, p. 14). With the principal component analysis, they combined all the information in those five indicators and formed an aggregate index. As the firm-level data, they used variables such as debt burden, debt rate, cash flows, return on asset (ROA), future growth opportunities, being a SME, being an exporting firm, and belonging to a corporate group. They found that an increase in policy uncertainty of one standard deviation lessens investment rate about 3.2 %.

Kang, Lee and Ratti (2014) investigated the relationship between firm-level investment and uncertainty by using a sample of more than 2,700 U.S. publicly traded manufacturing firms over the period between 1985 and 2010. They used the overall index of economic policy uncertainty in Baker, Bloom and Davis (2013) as the uncertainty variable. The components of the index are news-based policy uncertainty, CPI forecast interquartile range, tax legislation expiration, and federal expenditure forecast interquartile range. As the investment rate, they used capital expenditure that is normalized by lagged capital stock. They used the dynamic panel regression model and estimated the parameters of the equation with the Arellano-Bond two-step system GMM method. The results indicate that the lagged investment rate, sales growth and the lagged cash flow were highly significant when the aggregate overall economic policy shock was introduced into the investment model. Overall, they found that there is a negative relationship between investments and the EPU. In particular, the effect of EPU on firm-level investment is larger for firms with high firm-level uncertainty.

Wang, Chen and Huang (2014) used a sample of Chinese listed companies to examine the short-term effects of the EPU on investment. They used quarterly data for the period from 2003 to 2012. As the dependent variable, they used corporate investment and measured corporate investment as capital expenditure divided by total assets. As explanatory variables they used Chinese EPU index developed by Baker, Bloom and Davis (2013), cash flow, Tobin's Q, company size, sales revenue and leverage ratio. The EPU index prepared by Baker, Bloom and Davis is in monthly frequency. Wang, Chen and Huang used the geometric mean of monthly EPU index data to convert it into quarterly data. Cash flow is calculated as the net cash flow divided by the total assets of the previous period. Tobin's Q is computed as the market value of traded and non-traded shares plus total debt divided by total assets in the previous period. Firm size is calculated by taking the natural logarithm of the total assets at the beginning of the period. Sales revenue is measured as cash received from sales of goods and services divided by total assets, lagged one period. Leverage ratio is computed as dividing total liabilities to total assets, lagged one period. They used fixed effects model to estimate the parameters of the regression equation. The results show that the EPU has a significant and negative impact on corporate investments. As the implication of this finding, they state that, in order to

create a favourable corporate investment environment, political uncertainty should be reduced, and policies should be transparent, continuous, and stable.

Gulen and Ion (2016) investigated the effect of political uncertainty on investment decisions of U.S. public firms. They used a simple firm or industry-level panel regression and quarterly data to investigate the relationship between fixed investment and policy uncertainty. As the dependent variable, they used the capital investment variable, which is proxied by the capital expenditure scaled by the total assets. They used the EPU index prepared by Baker, Bloom and Davis (2013), as a proxy for political uncertainty. As the independent variables, in addition to EPU variable, they used both firm level and macroeconomic variables. Firm level variables are Tobin's Q, operating cash flow, and sales growth. Macroeconomic variable is gross domestic product (GDP) growth. To prevent possible seasonality in capital investment, they used a set of calendar and fiscal quarterly dummy. Their findings are in line with the effects of real options theory on investments. They found that political uncertainty has a significant negative impact on corporate investments, and this impact becomes stronger up to 4-5 quarters into the future. Moreover, the effect of uncertainty is higher for firms operating in industries that are more dependent on government spending and firms with higher investment irreversibility. Their results show that wait and see approach may be an important channel for U.S. publicly listed firms.

Akron et al. (2020) examined the impact of EPU on the investment policy of 305 hospitality firms in the U.S. over the period from 2001 to 2018. They tested two hypotheses: The first hypothesis was about the negative effect of EPU on the investment decisions of the hospitality firms, and the second hypothesis was about the impact of EPU on corporate investment at different quantiles of the capital expenditure to total assets ratio. They chose hospitality firms because in bad states, customers in this industry tend to delay their consumptions in favour of basic needs, and hospitality industry firms are considered capital intensive. They used airline services, hotels and resorts, leisure and recreation, and tourist services as the sub-industries. To measure uncertainty, they used the EPU index developed by Baker, Bloom and Davis (2016). As the dependent variable, they used corporate investment. They measured corporate investments with both capital

expenditures scaled by lagged total assets and capital expenditures scaled by lagged total revenues. As the independent variables, they used the return on assets ratio, size, leverage, market to book asset ratio, yearly change in GDP and consumer confidence index (CCI). They used panel data analysis and estimated the regression equation with the system GMM method. They found that an increase in economic policy uncertainty has a statistically significant and negative impact on corporate investment, and this impact is higher for firms with higher capital ratios, which implies that firms that are less capital intensive are those that can change their corporate investment policies better immediately after the economic decision has been taken (Chen, 2016 as cited in Akron et al., 2020).

Jirasavetakul and Spilimbergo (2018) investigated whether economic policy uncertainty has any impact on corporate investment of Turkish firms at aggregate level by using quarterly data from 1999 to 2015. For this purpose, they developed an EPU index for Turkey and used this index as a proxy for economic policy uncertainty. They used an investment model that includes both sectoral and macroeconomic variables. Sectoral firm specific variables are sales growth, operating cash flows, real borrowing costs, short-term debt to total asset ratio and long-term debt to total asset ratio. They gathered aggregate sectoral information from financial statement positions and income statements that exist in the Central Bank of Turkey's database. Macroeconomic variables are one-year ahead GDP forecast, CDS spread, and inflation. They also used the European EPU index prepared by Baker, Bloom and Davis (2016) as a control variable in the regression equation. They used a standard reduced-form firm-level investment model. The baseline regression results indicate that an increase in the EPU index of first-quarter by one standard deviation leads to 5 % decrease in real annual investment rate in the same year. They also estimated the regression equation with difference in difference approach to mitigate endogeneity problems. The results show that the negative and significant impact of uncertainty on investment becomes stronger, which is around 9 to 13 % with difference in difference approach.

As the empirical literature on corporate investments under uncertainty shows, most of the studies aforementioned above found a significant negative relationship between uncertainty and investments. These studies are motivated by the theories of real

options, financial frictions, curvature of the functions and ambiguity aversion. The results of these studies also show that the proxies used to measure uncertainty are the standard deviation of daily stock returns, the standard deviation of annual percentage changes in the marginal profitability of capital, the standard deviation of the residuals of the profit-forecasting equation, the coefficient of variation in a firm's quarterly operating cash flow, volatilities in input prices, exchange rates, product demand, term premium embedded in the term structure of interest, economic policy uncertainty and policy uncertainty. Besides these proxies, Merton's distance-to-default (DD) model, the volatility index created by the Chicago Board Options Exchange, variation in inflation rates, energy prices and real wages are also used in the literature as a proxy to measure uncertainty (Huizinga, 1993; Caggiano, Castelnuovo and Groshenny, 2014; Ferderer, 1996; Gilchrist, Yankov and Zakrajšek, 2009).

3. EMPIRICAL EVIDENCE ON IMPACT OF UNCERTAINTY ON CORPORATE INVESTMENT DECISIONS

In this section, we presented the data, methodology, empirical results about the impact of uncertainty on corporate investment decisions and limitations and ideas for further research.

3.1 DATA

The data section consists of the sample, the dependent and independent variables, the variable definitions, and the data source.

3.1.1 Sample

In order to measure the effect of economic policy uncertainty on corporate investment, we used a sample of Borsa İstanbul (BIST) – listed manufacturing firms' quarterly financial statements data. The data period is from 2005 Q1 to 2018 Q4. We chose firms in manufacturing sector because firms with high levels of physical assets tend to be manufacturing firms and these firms tend to disinvest in large discrete amounts of physical capital in bad times because of their high adjustment costs (Gulen and Ion, 2016, p. 22). The main segments within manufacturing sector are food products and beverages, textiles, coke and petroleum products, chemicals, wood and cork products, fabricated metal products, machinery, and motor vehicles ("State Institute of Statistics", 2017). We reached the list of BIST firms that are in the manufacturing sector on the website of the Public Disclosure Platform. Although the number of manufacturing firms on the website of Public Disclosure Platform is 178, the total number of firms used in this study is 107, as the data for all of these 178 firms are not available for the given data range. The list of firms is available in Appendix II, Table B. Following the literature (see for example Ion and Gulen, 2016; Wang, Chen and Huang, 2014; Jirasavetakul and Spilimbergo, 2018), we used quarterly data instead of annual data to better capture the impact of uncertainty on corporate investment. In their study, Jirasavetakul and Spilimbergo (2018, p. 17) state

that the findings of the studies[2] focusing on the effect of uncertainty illustrate strong impacts of uncertainty up to four quarters in the future.

3.1.2 Variables

We considered an economic policy uncertainty variable, five firm-level variables, namely corporate investment, Tobin's Q, operating cash flow, leverage ratio and firm size, a macroeconomic variable, i.e. GDP growth and a calendar quarter dummy variable to measure the impact of uncertainty on corporate investment decisions.

3.1.2.1 The Dependent Variable

The dependent variable in this research is corporate investment that is proxied by capital expenditures scaled by total assets lagged one period. The capital expenditure variable might have been calculated by taking the difference between the current and previous year's property plant and equipment and then by adding the depreciation of the current year. However, property plant and equipment item that exists in the statement of financial position of the Turkish firms disclosed to the public is net of the depreciation of the current year. Moreover, the property plant and equipment item has other sub-items, such as foreign currency conversion adjustments, which are not directly related to the amount of fixed investment. Therefore, as a proxy for capital expenditure, we used the sum of cash paid for the acquisition of fixed assets and intangible assets that exist in the quarterly statement of cash flow, which is directly related to the investments realized in the given period.

3.1.2.2 The Independent Variables

Independent variables consist of economic policy uncertainty variable, firm-specific control variables, macroeconomic control variables, and the dummy variable.

3.1.2.2.1 The Economic Policy Uncertainty

[2]These studies are given as Caggiano, Castelnuovo and Groshenny, 2014; Banerjee, Kearns and Lombardi, 2015; Baker, Bloom and Davis, 2016; Moore, 2016; and Kim and Kung, 2017 at Jirasavetakul and Spilimbergo (2018).

The main independent variable that is under investigation in this research is uncertainty, which is not in general observable. As stated by Guiso and Parigi (1999), indirect indicators of uncertainty are often distorted by measurement problems or troubled by issues of identification. We measured uncertainty with economic policy uncertainty as a solution to these problems. As a proxy for economic policy uncertainty, we used the Turkish EPU index that was prepared in the first part of this research using the Baker, Bloom and Davis (2016) methodology. Compared to other uncertainty proxies in the literature, the EPU index has both strengths and weaknesses as a proxy for uncertainty: The Turkish EPU index can capture particularly political events such as national elections that create uncertainty in the economy on a timely basis. In addition, the measure is high frequency and it can go back decades (Luk et al., 2018). On the other hand, it is difficult to quantify economic policy uncertainty since it is not directly observable (Sweet, Ozimek, and Asher, 2016). In addition, the digital search engine may retrieve false positives. However, this possibility has been substantially eliminated in this research since we audited all the news.

As an alternative proxy for uncertainty, quartered standard deviation of daily stock returns might have been used. In this case, to see the effect clearly, the uncertainty variable might be decomposed into its systematic and unsystematic risk components. However, as cited by Ferderer (1993), Pindyck (1986) argues that stock return variances do not reflect changing perceptions of uncertainty associated with possible future events, such as policy changes.

The Turkish EPU index we developed in the first part of this research was calculated on a monthly basis. We, therefore, transformed the original monthly data into quarterly data using the geometric mean method (Wang, Chen and Huang, 2014). Then, following Wang, Chen and Huang (2014), we divided the numbers by 100.

The effect of uncertainty on investments may not be instantaneous, i.e. there may be a time lag between the decision to invest and the ultimate completion of investment project. One of the reasons for this time lag is related with the irreversibility of investment. Firms with irreversible investments gain from waiting because the arrival of new information resolves some of the existing uncertainty (Gulen and Ion, 2016). Malkiel

et al. (1978, p. 549) state "This year's investment is generally started to implement plans formed last year about the desired stock of capital a firm wishes to have in place in future years." The decision of Volkswagen to invest in Turkey is also evidence of the time lag between the decision to invest and the ultimate completion of the investment project. The decision by Volkswagen to set up its new car factory in Manisa city was announced in the Turkish Trade Registry Gazette[3]on 2 October 2019 and it plans to begin production in 2022[4].

Due to the possible time lag between the decision to invest and the ultimate completion of the investment project, we used the lagged values of the EPU index to test the impact of economic policy uncertainty on investment plans. Based on the hypothesis of this research, we expect to find a negative relationship between the EPU index and the current corporate investment level.

3.1.2.2.2 Firm-Specific Control Variables

To investigate whether uncertainty has a marginal explanatory power on corporate investments, we used Tobin's Q, cash flow, firm size, and leverage ratio as firm-specific control variables.

3.1.2.2.2.1 Tobin's Q

Tobin's Q is defined as the ratio of market value of physical assets to the replacement costs of those assets (Tobin, 1969). In the literature, Tobin's Q is used to measure the expected future profits of a company on the existing capital stock. As cited in Yoshikava (1980, p. 739), Tobin and Brainard (1977, p. 242) state the Q theory of investment as follows:

> "*The neoclassical theory of corporate investment is based on the assumption that the management seeks to maximize the present net worth of the company, i.e. the market value of the outstanding common*

[3]http://www.ticaretsicil.gov.tr/gosteryeni.php?guid=3c010c25-e8f1-11e9-9262-48df373f5970
[4]https://www.dw.com/tr/t%C3%BCrkiyede-vw-yat%C4%B1r%C4%B1m%C4%B1ndan-beklenti-y%C3%BCksek/a-50703077

shares. An investment project should be undertaken if and only if it increased the value of the shares. The securities markets appraise the project, its expected contributions to the future earnings of the company and its risks. If the value of the project as appraised by investors exceeds the cost, then the company's shares will appreciate to the benefit of existing stockholders. That is, the market will value the project more than the cash used to pay for it. If new debt or equity securities are issued to raise the cash, the prospectus leads to an increase of share prices".

In reality, it is difficult to estimate the replacement value of physical assets. Therefore, different proxies exist in the literature to calculate Tobin's Q. Tobin's Q is commonly measured by dividing the market value of a company's equity and liabilities by the book value of its equity and liabilities. In its simplest form, it is calculated by dividing the market value of equity into its book value. In this study, we measured Tobin's Q variable by dividing the market value of the company's equity and total liabilities into the book value of the total assets. We lagged this variable by one period.

According to the Q theory of investment, Q represents investment opportunities and investment is an increasing function of Q. We therefore expect to find a significant positive relationship between Tobin's Q and the level of corporate investment.

3.1.2.2.2.2 Cash Flow

The cost of financing for debt and equity is not the same due to market imperfections and therefore constraints. There is a financing hierarchy, that is internal finance has cost advantages over external finance and debt is cheaper than equity because of its lower cost of capital. Cash flow can therefore be a major determinant of capital spending for firms with difficulties in raising external funds (Fazzari, Hubbard and Petersen, 1988). This leads to the conclusion that investment is sensitive to internal cash flows. Moreover, cash flow is an important investment determinant for firms that face incentive and information problems (Jensen and Meckling, 1976; Myers and Majluf, 1984). These two problems increase the cost of external finance, which in turn cause

managers to use internal funds to finance investments. Based on the arguments above, a positive relationship is expected between cash flow and corporate investment.

On the other hand, Kaplan and Zingales (1997) argue that firms that are classified as less financially constrained have greater investment-cash flow sensitivity than firms that are more financially constrained. They found that despite the availability of additional low-cost funds, the most financially successful and least constrained firms tend to rely primarily on internal cash flow to invest and thus show a high sensitivity to investment-cash flow. Chen and Chen (2012) investigated the investment-cash flow sensitivity and found that investment-cash flow sensitivity decreased and disappeared completely even during the 2007-2009 credit crunch. They reached the conclusion that since financial constraints continue to exist, investment-cash flow sensitivity is not a good proxy for financial constraints. They also checked whether investment is sensitive to cash flow by analyzing the cash flow sensitivity of R&D firms as investments of firms shift from physical investment to R&D. The results were robust, i.e. in nine out of twelve quarters, R&D and cash flow sensitivities were negative and they were insignificant in the rest of the quarters.

We measured the cash flow variable by dividing the operating cash flow by the total assets of the previous period. Operating cash flow is calculated by adding the depreciation of current year to the net income and subtracting the increase in net working capital from that value.

3.1.2.2.2.3 Firm Size

Firm size may also have a mixed effect on investment. On the one hand, based on the following argument, a positive relation is expected between size and corporate investment: Large firms have some advantages over small firms in terms of financing corporate investment. First, they are better diversified and hence they have less risk for bankruptcy. Second, they have more assets to offer as collateral, which decreases their borrowing costs. Third, they may have a longer credit history with banks due to their longer operating history, which also lowers their borrowing costs (Lee, 2005). In contrast, small firms are at higher risk of bankruptcy during uncertain times, because their access

to capital during those periods is more restricted than that of large firms. Small firms do not issue commercial paper, and most of their short-term borrowing is from banks (Gertler and Gilchrist, 1994). Since their access to capital deteriorates during uncertain times, there will be a decrease in their capital investment.

On the other hand, Ghosal and Loungani (2000) note that sunk costs create an entry barrier, and entry barriers are more likely to lead to markets with few large firms. Sunk costs are higher in large firms, which means that the irreversible investment of large firms is also higher. During uncertain periods, larger firms invest less than small firms do because of sunk costs. Therefore, a negative relationship is expected between size and corporate investment. The relationship between two variables may also change with respect to firm characteristics. Using a sample of 246 BIST-listed firms, Özdemir (2016) found a significant relationship between leverage and investment, and this relationship was stronger for firms with low growth opportunities. However, Aivazian, Ge and Qiu (2005) argue that, regardless of the growth opportunities, firms with large debt commitments invest less.

We measured the size variable as deflating total assets by the Consumer Price Index (Demirci, 2018), where base year is 2003. The objective here is to remove the effect of inflation and to measure the real value of total assets. As the next step, we took the natural logarithm of this variable.

3.1.2.2.2.4 Leverage

The leverage ratio may have a mixed effect on investment. On the one hand, debt financing has tax advantages compared to equity financing, i.e. interest expenses are tax deductible. Debt financing can therefore increase the level of corporate investment.

On the other hand, rising debt levels increase the likelihood of default, which may lead to financial distress. If financial distress increases, the cost of debt will also increase or credit rationing may occur (Gebauer, Setzer and Westphal, 2018). In this case, firms face difficulties while financing their investments. Besides, debt financing may lead to underinvestment and asset substitution due to agency costs between shareholders and debtholders (Jensen and Meckling, 1976; Myers, 1977). Under high levels of debt, the

conflict of interest between shareholders and debtholders leads to the rejection of positive NPV projects, because if good states occur, the debtholders will benefit from the project return while the shareholders will bear the costs. Debt financing may also lead to a decrease in overinvestment by reducing the agency costs between managers and shareholders due to its disciplining effect (Jensen and Meckling, 1976). Based on the arguments above, a negative relationship between the level of debt and corporate investment is expected.

Gebauer, Setzer and Westphal (2018) found that, in normal periods, the negative effect of debt on corporate investment happens only for high debt levels. For example, yearly forgone investment in a firm with a debt-to-asset ratio of 90 % is, ceteris paribus, 0.7 % compared to a firm with a debt-to-asset ratio of 80 %. The effect of debt on corporate investment of firms with debt levels below a threshold is not robust and changes with the characteristics of firms. They also observed that the negative effect of debt occurs not for large firms but for micro, small and medium-sized firms. Odit and Chittoo (2008) examined the impact of leverage on investment for the listed Mauritius firms. They classified firms as high – growth and low – growth. They found that while the relationship between the two variables was significant and negative for low-growth firms, the relationship was insignificant for high-growth firms.

As the leverage variable, we chose the debt-to-asset ratio and computed it as dividing the total liabilities by the total assets. As the next step, we lagged this variable for one period.

3.1.2.2.3 Macroeconomic Control Variables

3.1.2.2.3.1 GDP Growth

We included GDP growth as the only macroeconomic variable to control the impact of economic conditions on the environment in which firms operate. GDP is one of the most important macroeconomic indicators to capture economic activity. It is "the standard measure of the value added created through the production of goods and services in a country during a certain period. As such, it also measures the income earned from that production, or the total amount spent on final goods and services (less imports)" (The

Organisation for Economic Co-operation and Development [OECD], 2019). As the sample of this research is composed of data from firms in the manufacturing sector, which are directly related to the production of goods and services, GDP growth can be a good proxy for current macroeconomic conditions under which these firms operate. We expect to find a positive relationship between GDP growth and corporate investment.

To measure GDP growth, we used the seasonally adjusted quarterly real GDP growth rate of Turkey, which shows the percentage change from the same quarter of the previous year. We lagged this variable one period.

3.1.2.2.4 Dummy Variable

The present research also uses a calendar quarter dummy variable to control possible seasonality in corporate investment. The base is the fourth quarter.

The variable descriptions and expected effects of the explanatory variables on the dependent variable are provided in Table 3.1.

Table 3.1
Main Variable Descriptions and Expected Effect of Independent Variables on Corporate Investment

Variable	Notation	Measure	Expected Effect
Dependent Variable			
Corporate Investment	**CI**	(Sum of cash paid for the acquisition of fixed assets and intangible assets) / total assets in the previous period	
Independent Variables			
Firm-specific			
Economic Policy Uncertainty	**EPU**	Geometric mean of monthly EPU index	Negative
Tobin's Q	**TQ**	Market value / book value	Positive
Cash Flow	**CF**	(Net income + depreciation - increase in net working capital) / total assets in the previous period	?
Size	**SIZE**	Natural logarithm of total assets / the consumer price index	?
Leverage	**LEV**	Total liabilities /total assets in the previous period	?
Macroeconomic			
GDP Growth	**GDP**	Real GDP growth rate in the previous period	Positive

*__Source__: Authors' own calculations

3.1.3 Data Sources

This study consists of EPU index data, firm-level accounting data and macroeconomic data. The source of the EPU index data is authors' own calculations. We obtained the data for all firm-level variables except corporate investment variable from Finnet, which has an online platform that provides financial data. Corporate investment variable is composed of two parts: capital expenditure (CAPEX) and total assets. We collected the data for total assets from Finnet and the data of CAPEX for the period from 2005 to 2009 from cash flow statements of firms, which are available on the website of Borsa İstanbul. The data exist under the section of "financial statements archive". We

obtained CAPEX data for the period from 2010 to 2018 from cash flow statements of firms on the website of Public Disclosure Platform. The data is available under the section of "Financial Statements". We collected the consumer price index data from the website of The Turkish Statistical Institute. We obtained GDP growth rate data for Turkey from The Organisation for Economic Co-operation and Development website.

3.2 METHODOLOGY

The methodology section consists of the hypothesis development, the econometric model, and the estimation technique.

3.2.1 Hypothesis Development

The investigation of the impact of uncertainty on corporate investment plans for this research is motivated by the predictions of the real options theory, which is based on irreversibility assumption and forward-looking feature of investments. When there is no uncertainty, irreversibility does not make any difference to investment behaviour; however, the irreversibility premium increases with the degree of uncertainty (Chirinko and Schaller, 2009). Companies with more irreversible investments tend to postpone their investment in uncertain times because the existing uncertainty decreases with the arrival of new information and sunk costs make it more costly to reverse the investment once it has been made. However, the "wait and see" approach increases critical investment threshold where the investment rule becomes "invest when the value of the project exceeds its cost by an amount equal to the option value of waiting to invest" (Sarkar, 2000, p. 220). The user cost of capital is adjusted to consider irreversibility and uncertainty. Along with irreversibility, uncertainty increases the user cost of capital and decreases the elasticity of decision to invest and the level of investment (Bianco et al., 2013). The prediction of the real options theory thus illustrates a negative impact of uncertainty on investment. Empirical studies also support the prediction of real options theory that uncertainty is likely to have a negative impact on investment (Mohn and Misund, 2009; Bloom, 2000; Carlsson, 2007; Brenner and Schwartz, 1985; Bernanke, 1983; Leahy and Whited 1996; Caballero and Pindyck, 1996; McDonald and Siegel, 1986).

As a proxy for uncertainty, we used economic policy uncertainty, which has a significant effect on corporate investment policy. Economic policy uncertainty increases systematic risk, which leads to an increase in the rate of return that affects the investment threshold. The results of some of the empirical studies also support the negative impact of economic policy uncertainty on corporate investment (see for example, Gulen and Ion, 2016; Wang, Chen and Huang, 2014; Kang, Lee and Ratti, 2014; Jirasavetakul and Spilimbergo, 2018; Seiler, 2017). Based on the predictions of the real options theory and the findings of the studies above, we formulated our first hypothesis as follows:

H1: "Economic policy uncertainty has a negative impact on the investment decisions of Turkish manufacturing firms listed in Borsa İstanbul."

While we expect economic policy uncertainty to have a negative impact on corporate investment decisions, this impact may change over the time and over the long-term, the impact may become positive as firms adjust their inputs after the investment decision is made in line with the expectations of the Oi-Hartman-Abel effect. The reason is that firms' input adjustments after investment decision is made make them risk loving as they seek to exploit good outcomes and avoid the negative effects of bad outcomes. Therefore, we formulated our second hypothesis as follows:

H2: "The impact of economic policy uncertainty on corporate investment decisions changes over time."

3.2.2 Econometric Model

To examine the impact of economic policy uncertainty on corporate investment decisions, we introduced the lagged values of the EPU index, firm-specific variables and the macroeconomic variable into the Q theory of investment model. According to this theory, the market value of firm reflects all relevant expectations of future probability; therefore, investment can be explained as a function of Q. Fazzari, Hubbard and Petersen (1988) state that the empirical implementation of Q theory of investment relies on cost-of-adjustment approach. However, with the existence of financial frictions, decreasing returns to scale, inefficient equity market valuations and measurement problems, it is found that Tobin's Q may not explain investment data well (Andrei, Mann and Moyen,

2019, p. 251). Therefore, the impact of other firm specific variables, such as cash flow, on investment were started to be investigated.

The main empirical specification used in this research is a firm level panel regression of the following linear form:

$$\left(Corp_{i,t}/TA_{i,t-1}\right) = \alpha_i + \sum_{h=0}^{H} \gamma_h EPU_{i,t-h} + \beta_1 Tobin's\ Q_{i,t-1} + \beta_2\left(CF_{i,t}/TA_{i,t-1}\right)$$

$$+\beta_3 Firm\ Size_{i,t} + \beta_4 Leverage_{i,t-1} + \delta GDP_{t-1} + QRT_t + \varepsilon_{i,t}, \qquad (1)$$

where

$Corp_{i,t}$ is corporate investment of firm i at time t, with i=1, ….., N, t=1, α_i's are firm fixed effects, $TA_{i,t-1}$ stands for total assets at the beginning of the period, $EPU_{i,t-h}$ is the economic policy uncertainty index for Turkey with $h \in$ {0, 1, 2, ……20}, h corresponds to the lag between corporate investment variable and the economic policy uncertainty variable, $Tobin's\ Q_{i,t-1}$ is measured at the beginning of the period, $\left(CF_{i,t}/TA_{i,t-1}\right)$ stands for operating cash flow scaled by the total assets at the beginning of the period, $Firm\ Size_{i,t}$ presents the firm size at the current period, $Leverage_{i,t-1}$ is the leverage ratio in the previous period, GDP_{t-1} is the GDP growth rate in the previous period and QRT_t stands for a quarter dummy.

We estimated this single equation at multiple horizons, that is for quarterly horizons from h=0 to h=20, and each time, we extended the lag between the corporate investment and the uncertainty variable by one quarter (Gulen and Ion, 2016). Based on the previous literature (Nickel 1977; Malkiel et al., 1978), since we assume that the impact of EPU on corporate investment occurs over time rather than all at once, i.e. it spreads over future time periods, we have used a finite distributed-lag model. We calculated the long-run multiplier of the EPU index for each regression. In total, we ran 21 regressions. The control variables stayed the same in all 21 regression equations.

As equation one shows, corporate investment and operating cash flow variables are scaled by lagged values of total assets instead of current values. Normalizing variables

by lagged values prevents potential problems that might appear because one of the variables may depend on another. For example, current corporate investment and current total assets may be determined together or current corporate investment may be a function of current total assets.

3.2.3 Estimation Technique

The present research uses a balanced panel of manufacturing firms listed in BIST spanning the period 2005 Q1 – 2018 Q4. Panel data have both space and time dimensions that create an advantage over cross sectional and times series data. As stated in Baltagi (2005; pp. 6-8), Hsiao (2003) listed some advantages of using panel data as follows:

1. It controls for individual heterogeneity, that is, with panel data, the patterns on individual subjects such as individuals, firms, states, or countries can be predicted together by keeping their individuality over time.

2. "*Panel data give more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency*." When the data is more informative, parameter estimates become more reliable. In addition, collinearity also decreases because with cross-sectional dimensions, the data becomes more informative.

3. "*Micro panel data gathered on individuals, firms and households may be more accurately measured than similar variables measured at the macro level.*" In other words, it reduces the errors due to data aggregation.

On the other hand, panel data have some disadvantages such as short-time series dimension and cross-section dependence (Baltagi, 2005, p. 8).

A panel data regression model takes the following form (Baltagi, 2008, p. 13):

$$y_{it} = \alpha + X'_{it}\beta + u_{it}, \; i = 1, \ldots, N; \quad t = 1, \ldots, T \qquad (2)$$

In this general form, *i* denotes the i^{th} cross-sectional unit and *t* denotes the t^{th} time period. "α is a scalar, β is K x 1 and X_{it} is the i^{th} observation on *K* explanatory variables." The error term in this equation is:

$$u_{i,t} = \mu_i + \nu_{it}, \tag{3}$$

where μ_i stands for the unobservable individual specific effect and ν_{it} is the remainder disturbance.

The estimation of the equation (2) depends on the assumptions that are made about the intercept, the slope coefficients, and the error term. The possibilities are given in Gujarati (2003, p. 640) as follows:

1. "*Assume that the intercept and slope coefficients are constant across time and space and the error term captures differences over time and individuals.*

2. *The slope coefficients are constant but the intercept varies over individuals.*

3. *The slope coefficients are constant but the intercept varies over individuals and time.*

4. *All coefficients (the intercept as well as slope coefficients) vary over individuals.*

5. *The intercept as well as slope coefficients vary over individuals and time*."

In the panel data analysis, four main models are used. These are pooled regression, fixed effects, random effects, and random parameters (Greene, 2002). As regression estimation techniques, two main estimation approaches exist in the literature. These are fixed effects approach and random effects approach (Kutlar, 2017).

3.2.3.1 The Fixed Effects Approach

$$y_{it} = \alpha + X'_{it}\beta + u_i + e_{it} \quad , \quad e_{it} \sim IID\ (0, \sigma_u^2) \tag{4}$$

In the equation above, although the intercept u_i may vary across individuals, it is fixed over time for each individual. The term "fixed effects" takes its name from this explanation. The intercept differs across individuals because each individual may have special characteristics and the focus of the fixed effects model is differences "within" individuals. The allowance for intercept to differ between companies occurs by a main technique called differential intercept dummies. In the literature, using dummies to estimate fixed effects is referred to as least-squares dummy variable model (LSDV) (Gujarati, 2003, p. 642). Fixed effects model can be tested by evaluating the joint significance of the used dummies by performing an F-test (Baltagi, 2008, p. 15). On the other hand, LSDV has some problems (Gujarati, 2003, p. 646): First, the existence of too many dummy variables may lead to degrees of freedom problem. Second, with the inclusion of so many variables in the model, multicollinearity problem may exist. Third, LSDV approach may not identify the effects of time-invariant variables such as gender, color, and ethnicity.

3.2.3.2 The Random Effects Approach

$$y_{it} = \alpha + X'_{it}\beta + u_i + e_{it}, \quad u_i \sim IID\ (0, \sigma_u^2) \quad e_{it} \sim IID\ (0, \sigma_e^2) \tag{5}$$

The error term,$u_i + e_{it}$, can be decomposed into two components in the equation above. These are an individual specific component that does not change over time,u_i, and a remainder, the combined cross-section and times series component that is assumed to be uncorrelated over time, e_{it} (Verbeek, 1999).

As Verbeek (1999, p. 347) points out, in a regression equation, all factors that affect the dependent variable but are not written in the regression equation as an independent variable can be summarized by a random error term. This leads to the assumption that the u_i's are random factors, which are identically and independently distributed. This means that the difference between individuals arise from individual specific error terms, which are not directly observable. The random effects model is the unobserved effects panel data model where it is assumed that there is not a correlation between the unobserved effect and the explanatory variables for each time period

(Wooldridge, 2013, p. 856). The random effects model is estimated by using OLS or generalized least squares (GLS) methods.

3.2.3.3 Selection of Estimation Model

In the literature, the Breusch Pagan (1980) Lagrange multiplier (LM) test is used to choose between pooled OLS and random effects model and the Hausman specification test is used to choose between fixed effects and random effects model. The null hypothesis of the Breusch Pagan LM test implies that there are no random effects. The null hypothesis of the Hausman specification test is that fixed effects model and random effects model estimators do not differ significantly (Gujarati, 2003). Therefore, if the null hypothesis is not rejected, random effects model should be selected since random effects estimators are more efficient than fixed effect estimators (Woolridge, 2013). We applied these two tests to our data and selected our model based on the test results.

We used STATA 13 program to apply the panel estimation procedure. Table A1 in Appendix I shows the results of the model specification tests. The results indicate that, for all periods, the Breusch Pagan LM test yields LM statistics, which are statistically significant at 1 % level. The rejection of null hypothesis of this test implies that the model can include individual random effects. According to the Hausman specification test, for all periods except the 16^{th}, 18^{th}, 19^{th} and the 20^{th} periods, the null hypothesis was rejected at 1 % significance level. For periods 16, 18, 19 and the 20, the null hypothesis was rejected at 5 % significance level. These results indicate that the fixed effects model is preferred to the random effects model for the estimation of the equation parameters. In overall, the results of the Breusch Pagan LM test and the Hausman specification test indicate that fixed effects model is the most appropriate to estimate the parameters of the regression equation. Therefore, we used fixed effects model to estimate the parameters.

4. EMPIRICAL FINDINGS AND DISCUSSION

This section presents the empirical findings on the impact of economic policy uncertainty on the corporate investment decisions of BIST-listed manufacturing firms. Specifically, in this section, we will provide descriptive statistics, correlation matrix, unit root test results, regression estimation results, and limitations and ideas for further research. We will also discuss the results of the analyses.

4.1 DESCRIPTIVE STATISTICS

Table 4.1 reports descriptive statistics on firm-specific and macroeconomic control variables along with the EPU index variable used in this research. The data are quarterly and cover the period from 2005 Q1 to 2018 Q4. The number of manufacturing firms in the study is 107, and the total number of observations for each variable is 56 x 107 = 5,992. There is not a big difference between the mean and the medium values of the variables, which implies that the data is not seriously skewed. Table 4.1 shows that corporate investment is on average 1.6 % of total assets, and the number ranges from 0 % to 178.20 %. The mean of the EPU index at level is 0.863. The difference between the mean and the median values of EPU index at level indicates that the EPU index data is positively skewed. While the maximum value is 3.342, the minimum value is 0.248. The mean value of the Tobin's Q is 1.41, which may imply that BIST-listed firms have valuable growth opportunities. Tobin and Brainard (1977, p. 238) state that "*Values of Q above 1 should stimulate investment, in excess of requirements for replacement and normal growth, and values of Q below 1 discourage investment*." The mean of the operating cash flow scaled by the total assets is 5.80 %. The ratio of total debt to total assets is 49 % on average, ranging from 2 % to 342.70 %. GDP growth also has an average value of 5.58 %.

Table 4.1
Descriptive Statistics

Variable	Observations	Mean	Median	Standard Deviation	Maximum	Minimum
Corporate Investment	5,992	0.016	0.008	0.037	1.782	0.000
EPU	5,992	0.863	0.672	0.629	3.342	0.248
Tobin's Q	5,992	1.406	1.152	1.039	13.447	0.350
Cash Flow	5,992	0.058	0.053	0.154	1.156	-0.968
Size	5,992	6.200	6.158	0.663	8.123	4.079
Leverage	5,992	0.490	0.457	0.256	3.427	0.020
GDP Growth*	5,992	5.576	6.150	4.390	11.492	-12.526

Source: Authors' own calculations
*The variable with an asteriks is in percentage.

4.2 CORRELATION MATRIX

Table 4.2 presents the correlation matrix that shows the correlation coefficients between the seven variables. As we observe from the Table 4.2, while corporate investment is negatively correlated with leverage and EPU index at level, it is positively correlated with Tobin's Q, operating cash flow, size, and GDP growth.

Table 4.2
Correlation Matrix

	CI	EPU	TQ	CF	Size	Leverage	GDP Growth
CI	1						
EPU	-0.004	1					
TQ	0.024	0.052	1				
CF	0.018	-0.028	0.163	1			
Size	0.061	0.036	-0.119	0.101	1		
Leverage	-0.017	0.086	-0.063	-0.225	0.030	1	
GDP Growth	0.042	0.060	0.086	-0.066	0.009	-0.018	1

Source: Authors' own calculations

Multicollinearity among the variables may exist. Although the regression coefficients are still unbiased in the case of multicollinearity, they have large standard errors, which means that the coefficients cannot be estimated with great precision or

accuracy. In other words, in the presence of multicollinearity, inferences about the significance might be misleading. Gujarati (2003, p. 359) states that multicollinearity creates a problem only when the correlation coefficients are above 0.80. As we observe from the correlation matrix in Table 4.2, none of the correlations is above the limit. Except for the coefficient between operating cash flow and leverage, which is -0.225, the correlation coefficients are relatively small.

4.3 ECONOMETRIC RESULTS

Econometric results consist of unit root test results, regression estimation results and limitations and ideas for further research.

4.3.1 Unit Root Test Results

We first tested whether the variables are stationary before beginning the estimation process. We used Im, Pesaran and Shin (IPS) (2003) panel data unit root test for this purpose. The null hypothesis for this test is the existence of the unit root.

Table 4.3 presents the results of the panel unit root test for macroeconomic and firm specific control variables as well as the panel unit root test for the EPU index variable. In this table, we found that the null hypothesis of unit root was rejected for all variables. In particular, all variables were stationary at 1 % significance level.

Table 4.3
Panel Unit Root Test Results

IPS Test Results	
	Level
Variables	**Im, Pesaran and Shin**
Corporate Investment	-41.629***
EPU	-29.329***
Tobin's Q	-10.601***
Cash Flow	-20.557***
Size	-3.267***
Leverage	-5.484***
GDP Growth	-15.750***

Source: Authors' own calculations
*IPS denotes Im, Pesaran and Shin.
** "***" denotes significance at the 1% level.

4.3.2 The Regression Estimation Results

Before interpreting the parameters of the equation 1, we checked whether our model passed the diagnostic tests, which are heteroskedasticty, autocorrelation and cross dependency. We have already discussed multicollinearity while calculating correlation matrices. We ran 21 regressions in total to perform diagnostic tests. The results are summarized in Table A2 in Appendix I.

We used the modified Wald test for groupwise heteroskedasticty in fixed effects regression model following Greene (2002). The stata command we used to test the presence of heteroskedasticity is *xttest3*. The output test statistic has a Chi-squared distribution under the null hypothesis of homoskedasticty of the error variances. The results of the modified Wald test show that for all periods the null hypothesis of homoskedasticty of the error variances was rejected with 1 % significance level, which shows the presence of heteroscedasticity in the data.

It is assumed in panel data models that error terms are cross sectionally independent (Pesaran, 2004). To diagnose the cross-sectional dependence in the data, we used Pesaran (2004) Cross-section Dependence (CD) test and used the *xtcsd* command in stata. For all periods, the null hypothesis of the non-existence of cross-sectional dependency was rejected with 1 % significance level, which proves the existence of cross-sectional dependency in the data.

We also conducted The Wooldridge (2002) test for autocorrelation in panel data, where the null hypothesis implies the non-existence of first-order autocorrelation. We used the command *xtserial* in stata for this purpose. For all periods, we fail to reject the null hypothesis, which indicates that the data is free from serial correlation.

When there is heteroscedasticity and cross-sectional dependency in the data, the standard errors of the regression model are biased. Hence, we used the Driscoll-Kraay (1998) nonparametric covariance estimator to compute the standard errors. This estimator is robust to very general forms of cross-sectional as well as temporal dependence (Hoechle, 2007, p. 284). Besides, standard errors are heteroskedasticity and

autocorrelation-consistent with this estimator (Hoechle, 2007, p. 282). We used the command *xtscc* in stata to run the regression.

After we conducted the diagnostic tests, as the next step, we investigated both the short, medium and long-term effects of the EPU on corporate investment. We reported the results of the regression estimates in Tables 4.4 and 4.5. First, the findings showed that most of the explanatory variables are statistically significant and of the expected sign in all models, indicating that the approach that takes into account various different lags is appropriate.

In order to measure the short-term impact of the EPU on investment decisions, we regressed the EPU index of the first quarter of the current year (EPU_t) and the EPU index of the last quarter of the previous year (EPU_{t-1}) individually on corporate investments along with the control variables. We reported the results in Table 4.4. We found that both EPU_t and EPU_{t-1} have individual insignificant effects on current corporate investment decisions. These results do not support the findings of Jirasavetakul and Spilimbergo (2018), where the EPU index of the first quarter of the current year has a significant and negative impact on current investments. We also investigated whether the EPU index of the fourth, third and second quarters of the previous year had an individual impact on current investment decisions. Although we did not report them, their effect on corporate investments were insignificant as well. Overall, we can conclude that the short-term results did not support the predictions of any of the theories described in Section 2. These findings also do not support the findings of Wang et al. (2014), Gulen and Ion (2016) and Akron et al. (2020).

In order to measure the medium-term impact of the EPU index on corporate investment decisions, we regressed the EPU index on corporate investments, each time extending the lag between EPU and corporate investment by adding a further sequential lag of the EPU index. We used EPU index lags from five to 10 for this purpose. We reported the coefficients of the independent variables in columns from (1) to (4) in Table 4.5. Colum (1) shows when seven lags and level of the EPU index are introduced into the model along with the control variables, Colum (2) shows when eight lags and level of the EPU index are introduced into the model along with the control variables, Colum (3)

shows when nine lags and level of the EPU index are introduced into the model along with the control variables and Colum (4) shows when 10 lags and level of the EPU index are introduced into the model along with the control variables.

Table 4.4
Short-Term Fixed-Effect Estimation Results

Variable	**(1)**	**(2)**
EPU	-0.0009	-0.0014
	(0.0012)	(0.0013)
TQ	0.0021**	0.0021**
	(0.0009)	(0.0009)
CF	0.0031	0.0031
	(0.0039)	(0.0039)
SIZE	0.0247**	0.0250**
	(0.0096)	(0.0100)
LEV	-0.0051*	-0.0047
	(0.0028)	(0.0030)
GDP	0.0003**	0.0003**
	(0.0001)	(0.0001)
Constant	-0.1431**	-0.1447**
	(0.0599)	(0.0603)
Number of Observations	5,992	5,992
Number of Firms	107	107
Quarter Dummy	Yes	Yes
R-squared	0.0211	0.0214
Wald $\chi 2$ test (F Statistic)	20.33***	19.69***

Source: Authors' own calculations
*Time period is from 2005 Q1 to 2018 Q4. Dependent variable is the corporate investment. Column 1 displays the results when EPU_t is individually included in the regression equation along with control variables. Column 2 displays the results when $EPU_{(t-1)}$ is individually included in the regression equation along with control variables. All right hand side variables except economic policy uncertainty are at periods t and (t-1).
** "*", "**" and "***" denote significance levels at 10, 5 and 1 % respectively.
*** The numbers in parantheses are the standard errors.

The regression results indicated that the impact of the main independent variable, i.e. economic policy uncertainty on corporate investment decisions, was statistically significant at 10 % beginning with the inclusion of the seventh lag in the model. The p-value is 0.073, which shows the joint significance of the seven lags and the level of EPU

index. The joint significant impact persists up to the inclusion of the 10^{th} lag into the model. We also reported the p-value and F statistic for a joint test of significance for the model with six lags and the level of the EPU index. The p-value is 0.235, which shows that the six lags of EPU do not jointly affect corporate investment decision plans.

These results indicated that the impact of EPU on corporate investment decisions is not immediate and spread over time. The results confirm Nickel's (1977, p. 249) statement that "…*the investment response of firms, both to current and future expected parameter changes, is not an immediate jump to a new "optimal" level of capital stock but is sluggish and distributed over a considerable period*." Nickel also gives the Mayer's example that the time difference between the decision to invest and the incorporation of the capital stock in the productive process is 17 months for a new plant in U.S.

As the next step, we tested the sign of the relationship for the models where lags of the EPU index have a joint significance in the medium-term. For this purpose, we calculated the long run cumulative effect of EPU index on corporate investment decisions as in line with the finite distributive lag model. This calculation shows how much would corporate investment eventually changes with respect to a permanent change in the EPU index. We observed that the sum of the coefficients of the lags of EPU are significantly negative at 1 % significance level for models with seven and eight lags, i.e. the long run multipliers are -0.0033 and -0.0038 respectively for these models. We also observed that the sum of the coefficients of the lags of EPU is significantly negative at 5 % significance level for the model with nine lags, i.e. the long run multiplier is -0.0034. These results are in line with real options theory, which is based on irreversibility assumption and forward-looking feature of investments. As Bertola (1988) states, investments generally occur in good states, that is, when future marginal revenue product is expected to be high. But if bad state occurs, that is, when firms encounter with a common positive shock (Gulen and Ion, 2016), the firms with more irreversible investment projects tend to disinvest or delay their investments more because of high fixed costs of investments. Irreversibility of investments increases option value of waiting as this value increases during uncertain times. As the new information that resolves uncertainty arrives to the market over time, firms can better decide to invest. However, waiting for new information increases critical

investment threshold, which in turn increases the required project value. Hence, a negative relationship exists between uncertainty and investment.

We also examined the long-term impact of the EPU on the investment decisions of the BIST-listed firms. In this case, we introduced the EPU index with lags from 11 to 20 into the model along with the control variables. We calculated the joint significance of these lags. We reported the results in Table 4.5. The results show that the lags from 11 to 20 have a significant joint impact with the F-statistics of 19.86 and a p-value of 0.000. After finding that the lags of EPU index have a significant impact on corporate investment decisions, as the next step, we analyzed the sign of the long-term impact of economic policy uncertainty on corporate investment decisions. For this purpose, we calculated the long run cumulative effect of EPU index on corporate investment decisions as in line with the finite distributive lag model. We observed that the long run multiplier equals to 0.0074 with a p-value of 0.000, which implies that economic policy uncertainty has a significant and positive impact on corporate investment decisions. The results indicate that the impact becomes weaker and turns into positive when we jointly introduce the lags from 11 to 20 into the model. The significant and positive relationship between the EPU index and corporate investment is in line with the expectations of the Oi-Hartman-Abel effect, as this effect works better in the medium or long-run (Bloom, 2014). In the long-term it is easier for firms to adjust their inputs after the investment decision is made. They become risk loving under uncertainty. As a result, they expand to exploit good outcomes and contract to avoid negative effects of bad outcomes.

The effect of EPU index on corporate investment, which was first negative and then positive, is consistent with the findings of Gulen and Ion (2016). The explanation is as follows: Uncertainty may lead to postponement of investment. During this time, both demand for goods accumulates and new information arrives, which decreases uncertainty. When uncertainty is resolved, investment increases to catch up with pent-up demand (Ion and Gulen, 2016).

Results indicate that when 20 lags were jointly introduced to the model, the joint significance of these lags illustrated that the economic policy uncertainty causes fluctuations on corporate investment.

Table 4.5
Medium-Term and Long-Term Fixed-Effect Estimation Results

Independent Variables	**(1)**	**(2)**	**(3)**	**(4)**
EPU, level	0.0005	0.0002	0.0002	0.0001
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
EPU, first lag	-0.0006	-0.0006	-0.0006	-0.0005
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
EPU, second lag	0.0002	0.0006	0.0006	0.0005
	(0.0006)	(0.0006)	(0.0006)	(0.0007)
EPU, third lag	-0.0003	-0.0002	-0.0003	-0.0003
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
EPU, fourth lag	-0.0002	-0.0001	-0.0001	-0.0001
	(0.0005)	(0.0006)	(0.0006)	(0.0006)
EPU, fifth lag	-0.0010	-0.0010	-0.0011	-0.0010
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
EPU, sixth lag	-0.0005	-0.0004	-0.0004	-0.0003
	(0.0010)	(0.0009)	(0.0009)	(0.0009)
EPU, seventh lag	-0.0013*	-0.0007	-0.0007	-0.0008
	(0.0007)	(0.0006)	(0.0006)	(0.0007)
EPU, eighth lag		-0.0012*	-0.0013*	-0.0012
		(0.0007)	(0.0007)	(0.0008)
EPU, ninth lag			0.0002	0.0004
			(0.0010)	(0.0009)
EPU, tenth lag				-0.0003
				(0.0004)
F statistic, H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$, lags 0 to 7	1.86*			
p-value, lags 0 to 7	0.0733			
Long-run multiplier, lags 0 to 7	-0.0033			
p-value, long-run multiplier, lags 0 to 7	0.0070			
F statistic, H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$, lags 0 to 8		1.92*		
p-value, lags 0 to 8		0.0571		
Long-run multiplier, lags 0 to 8		-0.0038		
p-value, long-run multiplier, lags 0 to 8		0.0020		
F statistic, H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$, lags 0 to 9			1.73*	
p-value, lags 0 to 9			0.0828	
Long-run multiplier, lags 0 to 9			-0.0034	
p-value, long-run multiplier, lags 0 to 9			0.0070	
F statistic, H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = 0$, lags 0 to 10				1.66*
p-value, lags 0 to 10				0.0917

Long-run multiplier, lags 0 to 10				-0.0020
p-value, long-run multiplier, lags 0 to 10				0.1120
F statistic, H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$, lags 0 to 6	1.35			
p-value, lags 0 to 6	0.2354			
F statistic, lags 11 to 20	19.86			
p-value, lags 11 to 20	0.000			
Long-run multiplier, lags 11 to 20	0.0074			
p-value, long-run multiplier, lags 11 to 20	0.000			
F statistic, lags 0 to 20	16.75			
p-value, lags 0 to 20	0.000			
Long-run multiplier, lags 0 to 20	0.0038			
p-value, long-run multiplier, lags 0 to 20	0.064			
TQ	0.0022**	0.0021**	0.0021**	0.0021**
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
CF	0.0034	0.0035	0.0035	0.0035
	(0.0040)	(0.0040)	(0.0040)	(0.0039)
SIZE	0.0264**	0.0265**	0.0265**	0.0264**
	(0.0101)	(0.0101)	(0.0101)	(0.0101)
LEV	-0.0035	-0.0034	-0.0034	-0.0034
	(0.0034)	(0.0034)	(0.0034)	(0.0034)
GDP	0.0002**	0.0002**	0.0002**	0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	-0.1521**	-0.1525**	-0.1524**	-0.1521**
	(0.0623)	(0.0623)	(0.0625)	(0.0624)
Number of Observations	5,992	5,992	5,992	5,992
Number of Firms	107	107	107	107
Quarter Dummy	Yes	Yes	Yes	Yes
R-squared	0.0225	0.0227	0.0227	0.0228
Wald $\chi 2$ test (F Statistic)	44.30***	52.43***	51.34***	44.30***

Source: The authors' calculations

*Time period is from 2005 Q1 to 2018 Q4. Dependent variable is the corporate investment. All right hand side variables except economic policy uncertainty are at periods t and (t-1).

** Column 1 displays the regression results when seven lags are jointly introduced to the model along with the control variables. Column 2 displays the regression results when eight lags are jointly introduced to the model along with the control variables. Column 3 displays the regression results when nine lags are jointly introduced to the model along with the control variables. Column 4 displays the regression results when 10 lags are jointly introduced to the model along with the control variables. Regression results where the joint effects of EPU are insignificant or positive are not reported in this table except the results with six lags.

*** "*", "**", and "***" denote significance levels at 10, 5, and 1 % respectively.

**** The numbers in parentheses are the standard errors.

We also reported the regression results of the control variables. The results in Table 4.5 show that the Tobin's Q ratio, which may be a proxy for the expected profitability of an investment, turned out to be positive at 5 % significance level, as the theory predicts. The results of the regression estimates confirm the Tobin's argument that "the rate of investment - the speed at which investors wish to increase the capital stock - should be related, if to anything, to q, the value of capital relative to its replacement cost" (Tobin 1969, p. 21). As the aim of the management is to maximize the present net worth of the firm, they choose positive net present value investment projects that increase the market value of the shares. As the next step, as Tobin and Brainard (1977) state, the market's appraisal of the project and its evaluation about the expected contributions to the future earnings of the company are also important. An investment project that is not appraised by the market will decrease the firm value. The findings of Demirci (2018), Cetenak, and Vural (2015) also support the positive and significant relationship between Tobin's Q ratio and corporate investment.

The results illustrated that, on average, the effect of cash flows on corporate investment is insignificant, which means that investment is not sensitive to internal cash flows. Reasons for this insignificant relationship may be stated as follows: (1) Most of the manufacturing firms in the sample may not rely on internally generated cash flows to finance their investments, as debt financing has tax advantages. The sector average of the large-sized manufacturing firms' total debt to total assets ratio provides evidence for this as the ratio corresponds to 61.30 % in 2016[5]. The same ratio is 66.50 % for medium-sized firms, and 69.90 % for small-sized firms. (2) Sometimes, cash flows may be correlated with investment opportunities. In this research, the investment opportunities are proxied by Tobin's Q variable, whose coefficient is significant. However, the correlation between Tobin's Q and cash flows is 0.16. The insignificant relationship between cash flows and investments is supported by Cetenak and Vural (2015) for the BIST-listed manufacturing firms affiliated with a major business group and firms with more than %15 foreign shareholders. The findings of Cetenak and Vural (2015) also indicate that small business

[5]http://www3.tcmb.gov.tr/sektor/2017/menu.php

groups affiliated firms and non-affiliated independent BIST-listed manufacturing firms have strong investment-cash flow sensitivity.

The coefficient of size turned out to be positive at 5 % level significance level, which shows that larger firms invest more compared to small firms. This significant and positive relationship between size and corporate investments is in line with the findings of Özen and Erdem (2016). As Ghosal and Loungani (2000) state, firm size can be a proxy for capital market access. In uncertain times, access to capital for small firms is more limited than for large firms, leading to a decline in investment. The 107 firms used in this research are among the largest firms operating in Turkey and therefore may not face financing difficulties such as small firms during uncertain times. Besides, large firms have greater flexibility in timing their investments compared to small firms.

Regression results also revealed that on average, there is not a significant relationship between leverage and corporate investment in line with Jirasavetakul and Spilimbergo's (2018) findings on the relationship between short-term debt to total asset ratio and real investment rate, and long-term debt to total asset ratio and real investment rate. As Gebauer, Setzer and Westphal (2018) state, the negative effect of debt on investment may apply to firms with a high level of debt in normal periods. The average debt level for firms used in this research is on average 49 %, which implies that there may be no negative relationship between leverage and corporate investments for firms with debt levels below a threshold. The results do not support the findings of Demirci (2018), which indicate that the impact of leverage on physical capital investment is significant and negative at 10 % level. However, Demirci measured fixed capital investment by the change in net tangible fixed assets scaled by the capital stock of the previous period, which does not include fixed intangible assets included in this research to measure capital investment.

The impact of the macroeconomic variable, i.e., real GDP growth rate was significant and positive at 5 % significance level, and of the expected sign, in line with Gulen and Ion (2016) and Akron et al. (2020). GDP is important in the investment decision-making process because, as it increases, demand for consumption for goods and services also increases, leading to an increase in production capacity.

According to the regression results, quarterly time dummy was significant as well, which shows that seasonality existed in the corporate investment variable.

4.3.3 Limitations and Ideas for Further Research

We used capital expenditures scaled by total assets lagged one period as a proxy for corporate investments, as stated earlier in the section that includes variable definitions. To calculate capital expenditure, we used the sum of cash paid for the acquisition of fixed assets and intangible assets that exist in the quarterly statement of cash flow. However, this value is aggregate and contains payment for the acquisition of fixed assets and intangible assets not only in Turkey but also in other countries where the firms operate. The payments made only within the Turkish borders are not reported exclusively in the financial statements. For example, if a Turkish company has a factory in Bulgaria, the payment for the acquisition of fixed assets and intangible assets reported in the financial statements includes payments made in both Turkey and Bulgaria. While the EPU index is specific to Turkey and contains information mostly for national events, the corporate investment variable contains information for both Turkey and other countries in which the companies operate. This may be one of the reasons for the lack of a short-term relationship between economic policy uncertainty and corporate investment decisions. Future studies can be carried out with a better proxy for corporate investment.

The current research includes a sample of 107 BIST-listed manufacturing firms. The sample set may be enlarged to include non-financial firms in order to increase the number of observations.

Chen (2016) argues that the time lag between the decision to invest and the realization of cash flows prevents firms from quickly adjusting their investments to changes in cash flows, because when decisions are taken, the level of cash flow level for the coming year is uncertain. As a result, when capital expenditure depends on current cash flows, it can often result in the cessation of investment projects, which may be costly. For future studies, as an alternative to cash flow, cash holdings may be used, which are already realized at the time when the next year's investment decision is made (Chen, 2016). Further research should consider these points.

CONCLUSION

The impact of uncertainty on corporate investment spending is a widely studied topic in the literature beginning from early 1970s (Koetse, Groot and Florax, 2006). In the theoretical literature, the results are not clear-cut about the sign of the relationship between uncertainty and corporate investment decisions. While according to the predictions of the Oi-Hartman-Abel effect this sign is positive, according to the predictions of the real options theory, it is negative. On the other hand, empirical results mostly support the negative impact of uncertainty on investments. This thesis contributes to the literature by investigating the impact of uncertainty on corporate investment decisions of the BIST listed manufacturing firms operating in Turkey by using quarterly financial statements from 2005 to 2018.

The investigation of the impact of uncertainty on corporate investment plans for this research is motivated by the predictions of the real options theory, which gives investors a choice to invest now or "wait and see" until some of the uncertainty is resolved. In addition, according to this theory, the firms with more irreversible investments tend to postpone their investments more when market conditions deteriorate.

We proxied uncertainty by economic policy uncertainty. To measure economic policy uncertainty, we constructed a news-based EPU index by following the method of Baker, Bloom and Davis (2016). The results indicated that the Turkish EPU index could capture main domestic political and economic events that create uncertainty. The index was also affected by major global events such as FED policies, the September 11 terror attacks, and the U.S. presidential elections. The spikes in economic policy uncertainty occurred mainly by the uncertainty caused by national and local elections. During election times economic policy is high because there is a possibility of a change in policy makers and hence a change in economic policy reforms. As Riem (2016) states political forces may have an impact on managerial decisions at the corporate level. If, from a firm's perspective, an election may result in a bad outcome, the possibility of delaying irreversible investments will increase, and the firm may follow a "wait and see" approach to resolve some of the existing uncertainty. The EPU index also rose with central bank

related developments, failed coup attempt, The Justice and Development Party closure case, and December 17-25 corruption investigations.

To investigate the impact of uncertainty on corporate investment decisions, we conducted panel regression analysis and estimated the equation parameters with fixed effects model. Besides the uncertainty variable, as the explanatory variables, we used Tobin's Q, cash flow, size, leverage, and GDP growth. In total, we ran 21 regressions and each time, we extended the lag between the corporate investment variable and the uncertainty variable by one quarter.

We evaluated short, medium and long-term results. The results of the regression estimates showed that, in the short-term, the individual impacts of EPU index of the first quarter of the current year and the EPU index of the last quarter of the previous year on current corporate investment decisions are insignificant. This result does not support the predictions of the real options theory.

On the other hand, when we examined the medium-term impact of the EPU index on corporate investment decisions, we found that the EPU index had a significant negative impact on corporate investment decisions for the regression equations with the EPU index lags from seven to nine. This result is in line with the predictions of the real options theory. Companies with more irreversible investments tend to delay their investments in uncertain times because with the arrival of new information the existing uncertainty decreases, and sunk costs make it more costly to reverse the investment once it is made.

According to the regression estimation results, the delayed negative impact of uncertainty on corporate investment decisions weakens and turns to positive in the long-term. As Gulen and Ion (2016, p. 562) state, this finding is in line with the idea that investment projects cannot be postponed forever, and the cash flows lost from postponing investments can outweigh the benefits of waiting for uncertainty to be resolved as time passes. The positive relationship between the EPU index and corporate investment decisions also supports the Oi-Hartman-Abel effect, as this effect works better in the medium or long-run (Bloom, 2014).

When the other explanatory variables are considered, the results of the regressions showed that while the impacts of Tobin's Q, size, and GDP growth on corporate investment spending were significant and positive at all horizons, the impacts of leverage and cash flow were insignificant.

There are two major implications of our findings. First, the negative impact of economic policy uncertainty on corporate investment in the medium-term shows how important it is for policymakers to preserve macroeconomic policy transparency, continuity, and stability (Wang, Chen and Huang, 2014). A good investment climate can be achieved by reducing economic policy uncertainty. Second, economic policy uncertainty can have lagged and persistent effects that create fluctuations on corporate investment.

APPENDIXES

APPENDIX I

Table A1
Results for Model Specification Tests

Period	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
The Breusch-Pagan LM Test Statistic	689.2	689.65	689.60	689.62	689.71	690.16	690.27	690.71	690.81	690.70	690.85	692.45	692.46	701.76	702.19	704.41	705.45	705.96	705.95	706.26	706.21
Prob > chibar2(01)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
The Hausman Specification Test Statistic	39.55	40.54	40.45	40.97	41.69	42.90	43.61	44.14	44.34	44.30	44.22	44.17	44.21	44.38	44.53	43.89	43.53	43.28	43.29	43.07	42.99
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.008	0.012	0.000	0.024	0.034	0.0446

Source: Authors' own calculations
* LM denotes Lagrange Multiplier.

Table A2
Results for Diagnostic Tests

Period	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
The Modified Wald Test Statistic	8.0e+05	7.6e+05	7.6e+05	7.6e+05	7.9e+05	7.3e+05	6.8e+05	6.7e+05	6.9e+05	7.0e+05	6.8e+05	5.8e+05	5.7e+05	3.2e+05	3.2e+05	3.1e+05	3.1e+05	3.0e+05	3.0e+05	3.0e+05	3.0e+05
Prob > chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pesaran CD Test Statistic	12.763	13.196	13.392	13.788	13.465	12.905	12.213	11.695	11.496	11.541	11.534	14.097	14.068	28.099	28.451	28.115	29.758	29.307	29.400	28.632	28.579
Prob =	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
The Woolridge Test Statistic	0.844	0.841	0.846	0.847	0.850	0.855	0.850	0.851	0.842	0.831	0.783	0.726	0.593	0.648	0.697	0.697	0.703	0.671	0.668	0.678	0.676
Prob > F	0.360	0.361	0.360	0.360	0.356	0.357	0.359	0.358	0.361	0.364	0.378	0.396	0.442	0.423	0.406	0.406	0.404	0.415	0.416	0.412	0.413

Source: Authors' own calculations
* CD denotes cross dependence.

APPENDIX II

Table B
Alphabetical Listing of the BIST-Listed Manufacturing Firms Used in The Sample

No.	BIST Code	Name of the Firm
1	AEFES	Anadolu Efes Biracılık ve Malt Sanayii A.Ş.
2	AKSA	Aksa Akrilik Kimya Sanayii A.Ş.
3	ALCAR	Alarko Carrier Sanayi ve Ticaret A.Ş.
4	ALKA	Alkim Kağıt Sanayi ve Ticaret A.Ş.
5	ALKIM	Alkim Alkali Kimya A.Ş.
6	ANACM	Anadolu Cam Sanayii A.Ş.
7	ARCLK	Arçelik A.Ş.
8	ARSAN	Arsan Tekstil Ticaret ve Sanayi A.Ş.
9	ASUZU	Anadolu Isuzu Otomotiv Sanayi ve Ticaret A.Ş.
10	AYGAZ	Aygaz A.Ş.
11	BAKAB	Bak Ambalaj Sanayi ve Ticaret A.Ş.
12	BANVT	Banvit Bandırma Vitaminli Yem Sanayii A.Ş.
13	BFREN	Bosch Fren Sistemleri Sanayi ve Ticaret A.Ş.
14	BOLUC	Bolu Çimento Sanayii A.Ş.
15	BOSSA	Bossa Ticaret ve Sanayi İşletmeleri T.A.Ş.
16	BRMEN	Birlik Mensucat Ticaret ve Sanayi İşletmesi A.Ş.
17	BRSAN	Borusan Mannesmann Boru Sanayi ve Ticaret A.Ş.
18	BSOKE	Batısöke Söke Çimento Sanayii T.A.Ş.
19	BTCIM	Batıçim Batı Anadolu Çimento Sanayii A.Ş.
20	BUCIM	Bursa Çimento Fabrikası A.Ş.
21	BURCE	Burçelik Bursa Çelik Döküm Sanayii A.Ş.
22	CELHA	Çelik Halat ve Tel Sanayii A.Ş.
23	ÇİMSA	Çimsa Çimento Sanayi ve Ticaret A.Ş.
24	CMBTN	Çimbeton Hazırbeton Ve Prefabrik Yapı Elemanları Sanayi ve Ticaret A.Ş.
25	CMENT	Çimentaş İzmir Çimento Fabrikası T.A.Ş.
26	DENCM	Denizli Cam Sanayii ve Ticaret A.Ş.
27	DERIM	Derimod Konfeksiyon Ayakkabı Deri Sanayi ve Ticaret A.Ş.
28	DEVA	Deva Holding A.Ş.
29	DGKLB	Doğtaş Kelebek Mobilya Sanayi ve Ticaret A.Ş.
30	DITAS	Ditaş Doğan Yedek Parça İmalat ve Teknik A.Ş.
31	DMSAS	Demisaş Döküm Emaye Mamülleri Sanayi A.Ş.
32	DOBUR	Doğan Burda Dergi Yayıncılık ve Pazarlama A.Ş.
33	DOGUB	Doğusan Boru Sanayii ve Ticaret A.Ş.
34	DOKTA	Döktaş Dökümcülük Ticaret ve Sanayi A.Ş.
35	DYOBY	Dyo Boya Fabrikaları Sanayi ve Ticaret A.Ş.
36	EGEEN	Ege Endüstri ve Ticaret A.Ş.

37	EGGUB	Ege Gübre Sanayii A.Ş.
38	EGPRO	Ege Profil Ticaret ve Sanayi A.Ş.
39	EGSER	Ege Seramik Sanayi ve Ticaret A.Ş.
40	EMKEL	Emek Elektrik Endüstrisi A.Ş.
41	EMNIS	Eminiş Ambalaj Sanayi ve Ticaret A.Ş.
42	EPLAS	Egeplast Ege Plastik Ticaret ve Sanayi A.Ş.
43	ERBOS	Erbosan Erciyas Boru Sanayii ve Ticaret A.Ş.
44	EREGL	Ereğli Demir ve Çelik Fabrikaları T.A.Ş.
45	ERSU	Ersu Meyve ve Gıda Sanayi A.Ş.
46	FMIZP	Federal-Mogul İzmit Piston ve Pim Üretim Tesisleri A.Ş.
47	FRIGO	Frigo-Pak Gıda Maddeleri Sanayi ve Ticaret A.Ş.
48	FROTO	Ford Otomotiv Sanayi A.Ş.
49	GENTS	Gentaş Genel Metal Sanayi ve Ticaret A.Ş.
50	GOLTS	Göltaş Göller Bölgesi Çimento Sanayi ve Ticaret A.Ş.
51	GOODY	Doğan Burda Dergi Yayıncılık ve Pazarlama A.Ş.
52	GUBRF	Gübre Fabikaları T.A.Ş.
53	HEKTS	Hektaş Ticaret T.A.Ş.
54	HURGZ	Hürriyet Gazetecilik ve Matbaacılık A.Ş.
55	IHEVA	İhlas Ev Aletleri İmalat Sanayi ve Ticaret A.Ş.
56	IZMDC	İzmir Demir Çelik Sanayi A.Ş.
57	IZOCM	İzocam Ticaret ve Sanayi A.Ş.
58	KAPLM	Kaplamin Ambalaj Sanayi ve Ticaret A.Ş.
59	KARSN	Karsan Otomotiv Sanayii ve Ticaret A.Ş.
60	KARTN	Kartonsan Karton Sanayi ve Ticaret A.Ş.
61	KENT	Kent Gıda Maddeleri Sanayii ve Ticaret A.Ş.
62	KERVT	Kerevitaş Gıda Sanayi ve Ticaret A.Ş.
63	KLMSN	Klimasan Klima Sanayi ve Ticaret A.Ş.
64	KNFRT	Konfrut Gıda Sanayi ve Ticaret A.Ş.
65	KONYA	Konya Çimento Sanayii A.Ş.
66	KORDS	Kordsa Teknik Tekstil A.Ş.
67	KRDMD	Kardemir Karabük Demir Çelik Sanayi ve Ticaret A.Ş.
68	KRSTL	Kristal Kola Ve Meşrubat Sanayi Ticaret A.Ş.
69	KRTEK	Karsu Tekstil Sanayii ve Ticaret A.Ş.
70	KUTPO	Kütahya Porselen Sanayi A.Ş.
71	LUKSK	Lüks Kadife Ticaret ve Sanayii A.Ş.
72	MAKTK	Makina Takım Endüstrisi A.Ş.
73	MERKO	Merko Gıda Sanayi ve Ticaret A.Ş.
74	MNDRS	Menderes Tekstil Sanayi ve Ticaret A.Ş.
75	MRDIN	Mardin Çimento Sanayii ve Ticaret A.Ş.
76	MRSHL	Marshall Boya ve Vernik Sanayii A.Ş.
77	NUHCM	Nuh Çimento Sanayi A.Ş.
78	OLMIP	Olmuksan International Paper Ambalaj Sanayi ve Ticaret A.Ş.
79	OTKAR	Otokar Otomotiv Ve Savunma Sanayi A.Ş.

80	PARSN	Parsan Makina Parçaları Sanayii A.Ş.
81	PENGD	Penguen Gıda Sanayi A.Ş.
82	PETKM	Petkim Petrokimya Holding A.Ş.
83	PETUN	Pınar Entegre Et ve Un Sanayii A.Ş.
84	PINSU	Pınar Su Ve İçecek Sanayi ve Ticaret A.Ş.
85	PNSUT	Pınar Süt Mamülleri Sanayii A.Ş.
86	PRKAB	Türk Prysmian Kablo ve Sistemleri A.Ş.
87	SARKY	Sarkuysan Elektrolitik Bakır Sanayi ve Ticaret A.Ş.
88	SASA	Sasa Polyester Sanayi A.Ş.
89	SELGD	Selçuk Gıda Endüstri İhracat İthalat A.Ş.
90	SERVE	Serve Film Prodüksiyon Eğlence A.Ş.
91	SKTAS	Söktaş Tekstil Sanayi ve Ticaret A.Ş.
92	SNPAM	Sönmez Pamuklu Sanayii A.Ş.
93	SODA	Soda Sanayii A.Ş.
94	TATGD	Tat Gıda Sanayi A.Ş.
95	TBORG	Türk Tuborg Bira ve Malt Sanayii A.Ş.
96	TIRE	Mondi Tire Kutsan Kağıt ve Ambalaj Sanayi A.Ş.
97	TOASO	Tofaş Türk Otomobil Fabrikası A.Ş.
98	TRKCM	Trakya Cam Sanayii A.Ş.
99	TUKAS	Tukaş Gıda Sanayi ve Ticaret A.Ş.
100	TUPRS	Tüpraş-Türkiye Petrol Rafinerileri A.Ş.
101	ULKER	Ülker Bisküvi Sanayi A.Ş.
102	UNYEC	Ünye Çimento Sanayi ve Ticaret A.Ş.
103	USAK	Uşak Seramik Sanayi A.Ş.
104	VESTL	Vestel Elektronik Sanayi ve Ticaret A.Ş.
105	VKING	Viking Kağıt ve Selüloz A.Ş.
106	YATAŞ	Yataş Yatak ve Yorgan Sanayi ve Ticaret A.Ş.
107	YUNSA	Yünsa Yünlü Sanayi ve Ticaret A.Ş.

Source: https://www.kap.org.tr/tr/Sektorler

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