UNCERTAINTY AND ITS IMPACT ON TURKISH ECONOMY

A THESIS SUBMITTED TO
THE INSTITUTE OF SOCIAL SCIENCES
OF
ANKARA YILDIRIM BEYAZIT UNIVERSITY

BY

GÖZDE GÜRGÜN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
DEPARTMENT OF BANKING AND FINANCE

JANUARY 2016

Approval of the Institute of Social Sciences

_____

Assoc. Prof. Dr. Mesut Murat ARSLAN

Manager of Institute

I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy in Department of Banking and Finance.

_____

Assoc. Prof. Dr. Ayhan KAPUSUZOĞLU

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy in Department of Banking and Finance.

_____

Prof. Dr. Nildağ Başak CEYLAN

Supervisor

Examining Committee Members

Prof. Dr. Mehmet Baha KARAN (Hacettepe University, BA) _____

Prof. Dr. Nildağ Başak CEYLAN (YBU, Banking and Finance) _____

Asst. Prof. Dr. Erhan ÇANKAL (YBU, Banking and Finance) _____

Prof. Dr. Dilek DEMİRBAŞ (YBU, International Trade and Business) _____

Prof. Dr. Ramazan AKTAŞ (TOBB ETÜ, BA) _____

I hereby declare that all information in this thesis has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work; otherwise I accept all legal responsibility.

Name, Last name : Gözde GÜRGÜN

Signature :

ABSTRACT

UNCERTAINTY AND ITS IMPACT ON TURKISH ECONOMY

Gürgün, Gözde

Ph.D., Department of Banking and Finance

Supervisor: Prof. Dr. Nildağ Başak Ceylan

January 2016, 139 pages

There has been a renewed attention to measure uncertainty and estimate its effects on the economy following 2008/2009 global financial crisis. This thesis develops an uncertainty measure for Turkey and analyses the macroeconomic effects of changes in this measure for the period of June 2005-August 2015. Two uncertainty measures are formed through principal component analysis by using a number of uncertainty proxies from three main financial markets and Expectations Survey. Aggregating uncertainty derived from varying sources into one summary statistic, the constructed measures capture four important incidents of uncertainty for Turkey in the last decade. These episodes occurred in May 2006 (domestic economic and political issues), October 2008 (collapse of Lehman Brothers), 2011 (Europe crisis), the summer of 2013 (taper tantrum coincided with Gezi events).

A 7-variable vector autoregression model is constructed in order to estimate the impact of uncertainty shocks on Turkish economy. The variables included in the model are uncertainty measure, economic conditions index, unemployment rate, industrial production index, CPI, credit interest rate, and consumer confidence index. Economic conditions index is used to disentangle the effects of uncertainty from deterioration in the economic

outlook. The results present evidence that an unanticipated shock to uncertainty measure is associated with a fall in industrial production, rise in unemployment, inflation and credit interest rate together with worsening in consumer confidence. The results are robust to a series of checks with respect to different ordering of variables, an alternative uncertainty measure, and a shorter variable set and sample period.

Keywords: Uncertainty, principal component analysis, vector autoregression

ÖZET

BELİRSİZLİK VE TÜRKİYE EKONOMİSİNE ETKİSİ

Gürgün, Gözde
Doktora, Bankacılık ve Finans Bölümü
Tez Yöneticisi: Prof. Dr. Nildağ Başak Ceylan

Ocak 2016, 139 sayfa

2008/2009 küresel finansal kriz sonrasında belirsizliği ölçmeye ve etkilerini tahmin etmeye yönelik ilgi yenilenmiştir. Bu tez, Türkiye için bir belirsizlik ölçütü geliştirmekte ve söz konusu ölçütteki değişikliklerin makroekonomik etkilerini Haziran 2005-Ağustos 2015 dönemi için analiz etmektedir. Temel bileşen analizi yöntemi aracılığıyla, üç ana finansal piyasadan ve Belirsizlik Anketi'nden belirsizliği temsil eden bir dizi değişken kullanılarak iki belirsizlik ölçütü oluşturulmuştur. Çeşitli kaynaklardan türeyen belirsizliği özet bir istatistik içerisinde toplayan ölçüt, Türkiye için son on yılda dört önemli belirsizlik olayını yakalamaktadır. Bu olaylar, Mayıs 2006 (yerel ekonomik ve siyasi konular), Ekim 2008 (Lehman Brothers'ın batışı) ve 2013 yazında (FED'in varlık alımlarını azaltacağı açıklamasının Gezi olayları ile çakışması) gerçekleşmiştir.

Belirsizlik şoklarının Türkiye ekonomisine etkilerini tahmin etmek amacıyla 7 değişkenli bir vektör otoregresif modeli oluşturulmuştur. Modelde yer alan değişkenler belirsizlik ölçütü, ekonomik şartlar endeksi, işsizlik oranı, sanayi üretim endeksi, tüketici fiyat endeksi (TÜFE), kredi faiz oranı ve tüketici güven endeksidir. Ekonomik şartlar endeksi belirsizliğin etkilerinin ekonomik görünümdeki bozulmanın etkilerinden ayrıştırmak için kullanılmıştır. Sonuçlar, belirsizlik ölçütü üzerindeki beklenmedik şokların sanayi

üretiminde düşüş, işsizlik oranında, enflasyonda ve kredi faiz oranında yükselişle birlikte tüketici güveninde bozulmayla ilişkili olduğuna dair delil sunmaktadır. Sonuçlar, değişkenlerin farklı sıralanması, alternatif belirsizlik değişkeni, daha az değişken ve daha kısa örneklem dönemine dair bir dizi teste karşı sağlamdır.

Anahtar Kelimeler: Belirsizlik, temel bileşen analizi, vektör otoregresif

To my parents, especially to the memory of my father Mehmet Salih Gürgün

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor, Prof. Dr. Nildağ Başak Ceylan for her leading guidance, boundless support and encouragement throughout this research.

I am also grateful to Prof. Dr. Dilek Demirbaş and Asst. Prof. Dr. Erhan Çankal for their invaluable suggestions and comments during Thesis Examining Committee Meetings. I would also like to thank Prof. Dr. Mehmet Baha Karan and Prof. Dr. Ramazan Aktaş for sparing their time and providing insightful comments.

I would like to express my special thanks to my dear friends Aysun Öztürk and Bilge Bakın for their support and valuable contributions to my study.

I would like to express my deepest gratitude to my mother Emine Hale Gürgün for her love, support and encouragement.

TABLE OF CONTENTS

PLAGIARISM iii

ABSTRACT iv

ÖZET vi

DEDICATION viii

ACKNOWLEDGEMENTS ix

TABLE OF CONTENTS x

LIST OF TABLES xii

LIST OF FIGURES xiii

LIST OF ABBREVIATIONS xiv

CHAPTER

INTRODUCTION 1

UNCERTAINTY CONCEPT 7

2.1 Uncertainty Concept in Economics Literature 8

2.1.1 Cantillon's insight into uncertainty 8

2.1.2 Knightian uncertainty 9

2.1.3 Keynes' views on uncertainty 13

2.1.4 Comparison of the respective theories of Knight and Keynes on uncertainty (including the followers of rational expectations and subjectivists) 17

2.2 Sources and Categorization of Uncertainty 19

2.3 Summary 26

AN UNCERTAINTY MEASURE FOR TURKEY 28

3.1 Revival of Interest to Uncertainty Concept in the Wake of the 2008/2009 Global Financial Crisis 29
3.2 Literature Survey on Measurement of Uncertainty 33
3.3 Constructing an Uncertainty Measure for Turkey 42
3.3.1 Methodology: Principal component analysis 42
3.3.2 Data set 47
3.3.3 Construction of uncertainty measures for Turkey 51
3.4 Summary 58
IMPACT OF UNCERTAINTY ON TURKISH ECONOMY 60
4.1 Literature survey: The Effects of Uncertainty on the Economy 61
4.2 Quantifying the Effects of Uncertainty on Turkish Economy 71
4.2.1. Methodology: VAR model 71
4.2.2. VAR model for Turkey and data set 73
4.2.3. Empirical results 78
4.2.4 Robustness Checks 84
4.3 Summary 89
CONCLUSION 91
REFERENCES 97
APPENDICES 113
A. FIGURES (PCA VARIABLES) 113
B. FIGURES (DAILY UNCERTAINTY MEASURES FOR TURKEY) 116
C. UNIT ROOT TESTS 117
D. AUTOCORRELATION AND HETEROSCEDASTICITY TESTS 118
E. CURRICULUM VITAE 119
F. TURKISH SUMMARY 121

LIST OF TABLES

Table 1 Probability and Uncertainty Notions (Knight, Keynes and the Followers of Rational Expectations and Subjectivists) 18
Table 2 Three Distinctions on Uncertainty 22
Table 3 Selected Variables for PCA 48
Table 4 Components of Uncertainty Measure for Turkey (PCA) 51
Table 5 Kaiser-Meyer-Olkin Measure of Sampling Adequacy (8-variable) 52
Table 6 Results of Principal Component Analysis (8-variable) 52
Table 7 Coefficient of Correlations between Variables and the First Principal Component (Factor Loadings) 53
Table 8 Unique Variances (8-variable) 54
Table 9 Kaiser-Meyer-Olkin Measure of Sampling Adequacy (5-variable) 55
Table 10 Results of Principal Component Analysis (5-variable) 55
Table 11 Coefficient of Correlations between Variables and the First Principal Component (Factor Loadings) 55
Table 12 Unique Variances (5-variable) 56
Table 13 Data Set for VAR Model 75

LIST OF FIGURES

Figure 1 Three Distinctions on Uncertainty 20
Figure 2 Uncertainty Concepts with regard to Degrees of Unknown 22
Figure 3 Uncertainty Types Concerning Different Sources 24
Figure 4 Different Forms of Uncertainty 25
Figure 5 The Frequency of the Phrase "Economic Uncertainty" in News Headlines 32
Figure 6 Volatility of Selected Indicators 50
Figure 7 Uncertainty Measure for Turkey (Monthly, 8-variable) 56
Figure 8 Uncertainty Measure for Turkey (Monthly, 5-variable) 57
Figure 9 Macroeconomic Variables Used in VAR Model 74
Figure 10 Impulse Responses to Uncertainty Shock (The Baseline VAR) 79
Figure 11 The Forecast Error Variance Decompositions (Industrial Production and Unemployment) 81
Figure 12 The Forecast Error Variance Decompositions (Credit Interest Rate and Consumer Confidence) 82
Figure 13 The Forecast Error Variance Decompositions (CPI) 83
Figure 14 The Forecast Error Variance Decompositions (Economic Conditions) 83
Figure 15 Impulse Responses (Uncertainty Ordered Last) 85
Figure 16 Impulse Responses (Alternative Uncertainty Measure) 86
Figure 17 Impulse Responses (Without Control Variable) 87
Figure 18 The Forecast Error Variance Decompositions (Uncertainty) 88
Figure 19 Impulse Responses (Shortened Sample Period) 89

LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
ARCH	Autoregressive Conditional Heteroskedasticity
BIS	Bank for International Settlements
CBI	Confederation of British Industry
CBOE	Chicago Board Options Exchange
CBRT	Central Bank of Republic of Turkey
CCI	Consumer Confidence Index
CDO	Collateralized Debt Obligation
CDS	Credit Default Swap
CPI	Consumer Price Index
DF-GLS	Dickey-Fuller-GLS
ECB	European Central Bank
ECI	Economic Conditions Index
EMBI	Emerging Markets Bond Index
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GT	The General Theory of Employment, Interest and Money
GTE	The General Theory of Employment
HP	Hodrick-Prescott
IMF	International Monetary Fund
INT	Credit Interest Rate
IP	Industrial Production Index
KMO	Kaiser-Meyer-Olkin
OECD	Organization for Economic Cooperation and Development
PC	Principal Component
PCA	Principal Component Analysis
PP	Phillips Perron
RUP	Risk, Uncertainty, and Profit

SPF	Survey of Professional Forecasters
TP	A Treatise on Probability.
TUIK	Turkish Statistical Institute
U	Uncertainty Measure
U.S.	United States
UK	United Kingdom
UNP	Unemployment Rate
VAR	Vector Autoregression

CHAPTER 1

INTRODUCTION

The concept of uncertainty is first introduced to economics by Cantillon in the 1730s in his theory of entrepreneurship. He argues that the nature of competitive market activity is intrinsically uncertain and the function of entrepreneur is to bear uncertainty in a market where prices and quantities are non-fixed, in return for profit.

Knight (1921) refines the concept of uncertainty by articulating the difference between uncertainty and risk based on his analysis of profit and its origins. He describes risk as unknown outcomes whose odds of occurring can be measured, while uncertainty is not measurable because the incident is unique or irregular. This differentiation suggests that there is an opportunity to gain profit in the presence of uncertainty, while profit does not occur in conditions where risks can be calculated. Knight recognizes epistemological notion of uncertainty, which is about the problem of incomplete knowledge of the relevant probabilities rather than their existence.

Keynes (1921) maintains similar ideas on uncertainty, describing it also as a state in which the underlying probability distribution is unknown. However, there are some differences between the views of Keynes and Knight on uncertainty mainly resting on their respective approaches to probability, the former being subjective and the latter being objective.

Since then various understandings of uncertainty concept have been developed in the economics literature. For example, Dequech (2011) clarifies uncertainty concept by making three distinctions between substantive and procedural uncertainty; weak and strong uncertainty; and ambiguity and fundamental uncertainty. Substantive uncertainty is caused by the incompleteness of the information set, while procedural uncertainty is caused by the

limited capability of the agents to comprehend the information (Dosi & Egidi, 1991). Under weak uncertainty, an agent can form a unique, additive and reliable probability distribution, while strong uncertainty is described by the absence of such a distribution. Knightian risk is sometimes categorized under weak uncertainty. Ambiguity and fundamental uncertainty are the two types of strong uncertainty. Ambiguity is uncertainty about probability due to missing information that could be known (Camerer & Weber, 1992). Under fundamental uncertainty some necessary information about future events cannot be known because the future is to be created and there is possibility of structural change (Dequech, 2003).

The interest to uncertainty concept has waned starting from 1950s mainly due to the intellectual influence of mathematical formalization of economics and recognition of model-based approaches to prediction (Hodgson, 2011a). Uncertainty, which is unquantifiable and therefore difficult to fit into models, is either ruled out or given a quantifiable interpretation. Nevertheless, 2008/2009 global financial has reminded that the world is surrounded by enormous uncertainty, and thereby revived attention to uncertainty concept and its effects on the economy.

Uncertainty has been identified as one of the significant drivers of global financial crisis and the causes of slow recovery afterwards (IMF, 2012). In the years leading up to the global crisis, deregulation in financial markets accompanied with the burst of financial innovation led to rise of the originate-to distribute model. New assets were created through a securitization process where loans were tranched, repackaged and sold further in the form of securities, but with little transparency. These securities received high ratings from rating agencies and seemed to provide a very favorable risk-return profile. However, they were not as safe as considered, because their values were dependent on the house price movements (Mizen, 2008). Meanwhile, the originate-to-distribute model induced transformation of risk into uncertainty, creating a black box about the size and distribution of the risks in the financial system. The inability to precisely assess the riskiness of the financial system gave rise to uncertainty, which is Knightian in nature. The complexity of the new structures used in the securitization process aggravated uncertainty about the size and location of losses (BIS, 2008). The shift in risk attitudes together with uncertainty regarding the value of assets and resulting liquidations by uncertainty-averse investors

were among the main culprits of the global crisis. Many financial markets remained impaired for a long time despite aggressive response by major central banks. This combined with the evolutions in the structure of the economy caused by the crisis has led to heightened uncertainty, derailing the recovery process.

All in all, there were several aspects of uncertainty during the global financial crisis: (i) lack of accurate information about the amount and location of risks (ii) inability to precisely assess the value of assets (iii) lack of through information about the current state of the economy, (iv) absence of precise information about how policy actions, particularly unconventional ones, would affect the economy. Accordingly, in the wake of the crisis, the empirical literature on the measures of uncertainty and its impacts on the economy have witnessed a rapid growth.

The unquantifiable nature of uncertainty has led to use of various proxies. Uncertainty measures are obtained in four ways: One common approach is using volatility (either realized or implied) of economic and financial indicators, which are used by Leahy and Whited (1996), Bloom (2009), Basu and Bundick (2012), Bloom et al. (2013), Caggiano et al. (2014), Leduc and Liu (2015), Popp and Zhang (2015) and Knotek II and Khan (2011) among many others. Generalized autoregressive conditional heteroskedasticity (GARCH) models are also utilized in order to obtain the variance series that are regarded as uncertainty measures (Asteriou & Price, 2005; Berument et al., 2007; Bloom et al., 2014).

Another popular approach is using survey based measures that show economic agents' perceived uncertainty about future economic situation. In this strand, uncertainty is measured using forecast disagreements (Baker et al. 2013; Bloom et al., 2014; Bachman et al., 2013), forecast errors (Bachmann et al., 2013; Arslan et al., 2011; Scotti, 2013; Rossi & Sekhposyan, 2015) and utilizing responses to questions with direct references to uncertainty (Leduc & Liu, 2015).

Some studies rely on news-based keywords to construct economic policy uncertainty (Baker et al., 2013; Alexopolous & Cohen, 2009), which is supposed to capture uncertainty about policy actions or inactions and their effects. The number of uncertainty-related

keywords in newspapers is counted with the insight that the unpredictability of future policy actions and their impacts constitutes one of the sources of uncertainty.

Measuring common variability across a number of indicators through statistical techniques such as principal components analysis (PCA) is also widely employed in construction of uncertainty proxies (ECB, 2013; Hadow & Hare, 2013; IMF, 2012; Creal & Wu, 2014). PCA reveals the hidden structures that underlie the different uncertainty indicators. It avoids dependency on a small number of observable variables.

Exploiting these proxies, it is documented in the literature that uncertainty shocks can be significant sources of economic fluctuations. There are a number of channels through which an unexpected uncertainty shock may affect macroeconomic aggregates:

One of the channels emphasizes irreversible nature and real option feature of investments. High uncertainty weighs negatively on investment decisions through "wait and see" approach. (Bernanke, 1983; Dixit & Pindyck, 1994). In the face of heightened uncertainty, firms postpone investment decisions because they are costly to reverse. Making an analogy between an investment opportunity and a stock option in a financial market, Dixit and Pindyck (1994) argue that if investment is irreversible, uncertainty raises the value of accumulating cash and waiting for new developments that would dispel uncertainty. On the other hand, some early studies (Hartman, 1972; Abel 1983) reach a different conclusion. They show that elevated output price uncertainty raises investment under the assumptions of perfect competition and constant returns to scale.

The response of households to high uncertainty is similar to that of firms. Households increase their precautionary savings (Romer, 1990; Carroll, 1996) as they wait for new information to attain more certainty, thereby reduce consumption spending (Knotek II & Khan, 2011) or increase their income, which will cause higher labor supply. Over time, when uncertainty dissipates and households acquire more information about their income and wealth prospects, a temporary rise in the spending may appear as they see that they have fewer big ticket items than the optimal level.

The labor market is also likely to be adversely affected from uncertainty. Firms retard their hiring and firing plans in the presence of elevated uncertainty due to costly adjustment of inputs (Bloom, 2009). In addition, uncertainty may weaken productivity growth by slowing the reallocation of jobs and workforces, and hence worsens future prospects of growth.

Recent literature highlights additional channels whereby uncertainty may influence macroeconomic performance. Some studies suggest that financial channel play an important role in transmission of uncertainty shocks (Arellano et al., 2012; Gilchrist et al., 2013; Popp & Zhang, 2015; Bonciani & Roye, 2015). Among them, some claim that uncertainty may raise the risk premium in financial markets, leading to a rise in the cost of capital and, hence, depress growth. Others provide evidence that frictions intensify the original effects of uncertainty shocks on economic activity and generate more persistent shocks.

International transmission of uncertainty shocks are also examined by a set of papers. These papers mainly aim to identify level of spillovers, exporters/importers of spillovers and dynamics of spillovers. Spillovers are mostly examined in the context of transmission among developed economies (Colombo, 2013; Klossner & Sekkel, 2014; Mumtaz & Theodoridis, 2012) and from developed economies (or global shocks) to emerging economies (Gauvin et al., 2014; Carriere-Swallow & Cespedes, 2013).

A frequently used approach in terms of estimating the effects of uncertainty on the economy is a vector autoregression (VAR). VAR system is particularly useful when the dynamic relationships between variables are analyzed. Recent studies use different VAR specifications to estimate the impacts of uncertainty (Baker et al., 2013, Jurado et al., 2013, Bachmann et al., 2012; Aastveit et al., 2013; Istrefi & Piloiu, 2014; Leduc & Liu, 2015; Rossi & Sekhposyan, 2015).

This thesis is related to three strands of literature. First, it relates to description and sources of uncertainty in the economic thought. Second, it is associated with the recent literature on how uncertainty is measured. Third, it is related to research on the impacts of uncertainty shocks on macroeconomic variables. These three strands of the literature are tied together

by constructing uncertainty measures for Turkey and quantifying the effects of uncertainty on Turkish economy.

What is meant by uncertainty in this study has two main aspects. First one is related to its nature. It is unquantifiable and unobservable. In this sense, it refers to Knightian or Keynesian uncertainty. The second one involves its substance. Uncertainty originates from diverse sources and has different components. To reflect this characteristic, PCA is performed in the formation of uncertainty measures using a number of proxies from three main financial markets and Expectations Survey. In doing so, uncertainty measure encapsulates both economic uncertainty and policy uncertainty. PCA enables to summarize the information content of these proxies within the extracted principal components and in turn, provides a more complete picture.

This study is organized as follows: Chapter 2 elaborates on the description of uncertainty together with its sources and degrees. Chapter 3 starts with a discussion of why uncertainty concept has regained popularity recently. The chapter continues with a literature review on how uncertainty is measured, highlighting the advantages and disadvantages of different methodologies. This part also contains description of PCA and construction of uncertainty measures for Turkey by using PCA, which provides a model-free measure of uncertainty. Two PCA are performed with 8-variables and 5-variables as to use the former in the baseline VAR analysis and the latter in the robustness test. The analyses cover the period of June 2005-August 2005 given the constraints on data availability before 2005. Chapter 4 starts with a literature review on the impacts of uncertainty exploring several channels of transmission. Then, VAR system is introduced with a view to investigate the effects of uncertainty on Turkish economy by utilizing this method. A 7-variable VAR model is formed for Turkey to provide some empirical evidence on which of the above mentioned channels are promising. The variables included in the VAR model are uncertainty measure, economic conditions index, unemployment rate, industrial production index, CPI, credit interest rate, and consumer confidence index. This chapter also reports the results of the VAR analysis. Robustness checks are performed through changing the ordering of variables, using an alternative uncertainty measure, deleting control variable and shortening the time period to cover the post-global crisis period. Chapter 5 concludes.

CHAPTER 2

UNCERTAINTY CONCEPT

Uncertainty concept in economics dates back to Cantillon's theory of entrepreneur. He implicated uncertainty in entrepreneurial behavior and describes entrepreneur as someone who faces uncertainty in exchange for profit. Seminal contributions of Knight and Keynes to the uncertainty concept in 1920s are widely recognized. However, an analysis of electronic archives of ten leading journals by Hodgson (2011a) shows that the use of Knight-Keynes concept of uncertainty has declined dramatically from 1950s and almost disappeared from journal articles after the 1980s with the increased interest to mathematical formalization of economics. Uncertainty concept has regained attention following 2008/2009 global financial crisis.

This chapter aims to contribute to a better understanding of uncertainty concept in the economics literature, especially taking into account the notions of Cantillon, Knight, and Keynes. Sources, degrees and the main forms of uncertainty are also reviewed in order to refine the existing concepts.

The chapter starts with a brief introduction of Cantillon's insight into uncertainty. Then the origins of risk and uncertainty in the writings of Knight and Keynes along with the similarities and differences between their conceptions and different economic strands are discussed. The differences between views of Knight and neoclassicals' are summarized. Last part focuses on classification of uncertainty considering its sources, degrees and forms.

2.1 Uncertainty Concept in Economics Literature

2.1.1 Cantillon's insight into uncertainty

Uncertainty concept gains economic content by Cantillon's pioneering analysis of entrepreneurship in 1730s[1]. He describes three classes of economic agents: 1) landowners: who are financially independent and main consumers in the economy to fulfil their tastes and preferences, 2) wage workers: who guarantee contractual stable income, and 3) entrepreneurs: whose main aim is to involve in arbitrage, motivated by profit-making (Hebert and Link, 2006). Entrepreneurs live on unfixed income and are responsible for production, distribution and exchange of goods in the economy. Marketplace is surrounded by uncertainty rather than encompassing perfect knowledge and perfect certainty (Rothbard, 2006).

Cantillon relates the function of the entrepreneur to uncertainty instead of making a detailed analysis of uncertainty. For him, uncertainty faced by the entrepreneur is of the unknowable type and not of the insurable kind. The future is uncertain due to the dynamic nature of economic actors (e.g. changing tastes and desires) and the elapse of time between production and exchange of goods.

He argues that uncertainty is inherent in nature of competitive market activity and the function of the entrepreneur is to cope with that uncertainty by investing, meeting costs and then expecting a profitable return (Hebert & Link, 2009; Rothbard, 2006). Cantillon does not describe how or why competition arises. He takes the existence of competition for granted and considers it as a source of uncertainty for the entrepreneur (O'Mahony, 1985).

Cantillon's entrepreneur executes business judgment in the face of uncertainty, buying at a certain price to resell at an uncertain price, with the difference being their profit or loss (Rothbard, 2006). Uncertainty, for Cantillon, is an indispensable part of profit-making. Profits are considered as a prize for superior ability in forecasting and uncertainty bearing

[1] Rothbard (2006) named Cantillon "the founding father of modern economics" since he wrote the first complete treatise on economics more than four decades before the publication of the Wealth of Nations by Adam Smith. Cantillon wrote Essai sur la Nature du Commerce en Général (Essay on the Nature of Trade in General) between 1730 and 1734, and published it in 1755.

in the production process. On the other hand, when wrong guessing is made, the price is paid as a loss.

The entrepreneurial class of Cantillon has an equilibrating role within the economic system by participating in arbitrage and dealing with uncertainty. By successfully forecasting and investing resources, the entrepreneur helps balancing supply and demand in various markets.

2.1.2 Knightian uncertainty

Cantillon's insight into the uncertainty of the market is largely ignored, and the topic is not revisited until the 20th century. Knight brings uncertainty back into the scene in 1920s and generates his classic theory of profit. The difference between uncertainty and risk is first defined by Knight (1921) in his Risk, Uncertainty, and Profit (RUP). According to Knight (1921), a measurable uncertainty (or risk), is very different from an unmeasurable one (or uncertainty), and it is not in fact an uncertainty at all.

Risk applies to situations where the outcome of a given situation is not known, but the underlying odds can accurately be measured. Uncertainty, on the other hand, applies to situations where all the information needed in order to set accurate odds is not known in the first place. An example of the former is the chances of winning at the blackjack game, and an example of the latter is the likelihood of peace outcome in a war.

Knight (1921) founds the distinction between risk and uncertainty on a three-fold classification of types of probability: a priori probability, statistical probability and estimates.

A priori probability can be derived mathematically and based on inferences from past experiences. The probability that a die will land with a particular value constitutes a canonical example.

Statistical probability depends upon the empirical classification of instances since the outcomes are not homogeneous. To illustrate, Knight uses an insurance company’s

assessment of the probability of a particular building burning, which is determined by statistical investigation. The main difference between a priori and empirical probability is the greater amount of judgment involved in classifying instances in homogenous groups when forming statistical distributions, while in a priori probability the chances can be calculated with mathematical principles. In Knight's understanding, both a priori and statistical probabilities refer to risk cases.

Statistical study is impossible in situations where the instances are dissimilar to all other known cases. In the absence of a valid basis of any kind for classifying instances, only estimates can be made, which involves in the greatest logical difficulties. Estimated probability, i.e. true uncertainty, is confronted when the instances are too heterogeneous to be placed in any meaningful groups. Judgment should be exercised for the formation of estimates. Knight accepts the fact of probability judgements and also acknowledges the understanding of probability as a feature of external reality because of the indeterminateness in the cosmos itself (Lawson, 1988).

Knight, as an economist investigating the business world and the nature of profit in that world, was most interested in this last type of probability (Janeway, 2006). He argues that people in business situations face "true uncertainty", so they have to rely on subjective judgment, or an estimate of an estimate (Svetlova & Fiedler, 2011). Business decisions are not about calculable probabilities. Success or failure of a business relies on the match between actual outcomes and the outcomes anticipated by entrepreneurs. According to Knight, a successful entrepreneur has the characteristic feature of being a successful uncertainty bearer and judgmental decision maker (Van Praag, 1999).

Knight (1921) argues that a known risk is easily converted into an "effective certainty" for in a considerable number of such cases the results become predictable in accordance with the laws of chance, while "true uncertainty," is not susceptible to measurement.

Risk is described by the reliability of the estimate of its probability and accordingly the possibility of considering it as an insurable cost (Stigler, 1985). In cases of uncertainty, the distribution of outcome cannot be known, so there is unknowable randomness. In this

sense, the term "uncertainty" is referred to cases of the non-quantitive type because the case is unique and/or irregular.

Knight (1921) designates risk and uncertainty with the terms "objective probability[2]" and "subjective probability[3]", respectively. In Knightian sense, risk was used for situations where objective probabilities are defined assuming a frequentist[4] approach, and risk can be eliminated through forming groups of instances and spreading (Simon and Quiggin, 2005). All other situations, including those where individuals have subjective probabilities, are categorized as involving uncertainty.

Knight (1921) proposes that the distinction between uncertainty and risk is crucial for economic theory, since uncertainty provides opportunities for profit that do not occur in situations where risks can be calculated. Knight's argument that risk cannot give rise to profit originates from an assumption that if all means for reducing risk, whether by insurance, hedging or others, are utilized, then all outcomes will be certain for all future conditions of the world (Brooke, 2010). For Knight, uncertainty is an indispensable part of entrepreneurial activity in the sense that without uncertainty there could be no profits in a competitive system, since profits that are predictable would be competed away (Bronk, 2011). In other words, entrepreneurs gain their profits from uncertainty since it cannot be insured as risk can. Knight argues that the entrepreneur uses judgement, common sense or intuition so as to make decisions in an uncertain world. For Knight, managerial and entrepreneurial skills are not about simple information or knowledge, but rather it involves idiosyncratic judgements and inferences in the context of uncertainty (Hodgson, 2001).

Knight (1921) explains how uncertainty is related to knowledge as follows:

> The practical limitation of knowledge, however, rests upon very different grounds. The universe may not be ultimately knowable ... ; but it is certainly knowable to a degree so far beyond our actual powers of dealing with it …(p. 210)

[2] In objective probability, likelihood of occurrence of an event is based on an analysis where each measure relies on a recorded observation, rather than subjective estimates. It is an a priori probability.
[3] A degree of belief or personal judgement in the occurrence of an event.
[4] In frequentist probability, an event's probability is defined in reference to events that occur repeatedly. It is the relative frequency in a large number of trials. In the frequentist interpretation, probabilities are discussed only for well-defined random samples.

That is to say, information exists but individuals have constraints in obtaining all of it. Accordingly, Knightian uncertainty concept is epistemological, rather than being ontological, related to the problem of "knowledge" of the relevant probabilities and not of their "existence".

2.1.2.1 Knight and neoclassical economic theory on uncertainty

Knight is regarded as one of the founders of Chicago School of Economics, which can be referred as one of the main pillars of neoclassical economics[5]. He defends traditional neoclassical economic theory as necessary, but also acknowledges that it is not adequate to understand modern economic organization. According to Knight, the predictive power of neoclassical economics results from its restrictive assumptions. Knight claims that these have to be relaxed, or even terminated, to fully explain the economy (Emmett, 2008).

In his theory of firm, Knight focuses on the indeterminate consequences of entrepreneur decision when confronted with uncertainty. Knight is of the view that unpredictable human action together with uncertainty poses restrictions to the possibility of any predictive science related to human action (Emmett, 2008). However, neoclassical economists typically use utility functions to describe individuals' preferences. Therefore, Knight separates himself from the neoclassical economists who depend on a utility theory to model, describe or predict human action.

Neoclassicals analyze the market in a state of general equilibrium. The classical and neoclassical assumption that the economy is continuously in a state of long-run equilibrium discards the real world of uncertainty (Rothabard, 2006). Instead, it focuses on perfect certainty and perfect knowledge of present and future. For Knight, uncertainty makes the perfect knowledge assumption of neoclassical economics impossible. He is of the view that it is the incomplete knowledge that generates profit or loss. Accordingly, Knight distanced himself from neoclassical economics.

[5] Hodgson (1997) describes neoclassical economics as an approach which (1) assumes rational, maximizing behavior by agents with given and stable preference functions, (2) concentrates on movements towards equilibrium states, and (3) rules out chronic information problems.

Neoclassical economics assumes the ergodic axiom, the belief that the probability of future events can be predicted objectively through statistical analysis from past data (Davidson 2002: 43). However, Knight's world is subject to change in ways that cannot be predicted from the distribution of past outcomes. His discussions of uncertainty acknowledge nonstationarity.

The neoclassicals construct their mathematical models as to make future predictions, allowing only for Knightian risk. In other words, neoclassical economics is all about predictability and risk that can be estimated. Knightian uncertainty cannot be quantified, and hence cannot serve for the mathematical models. That is to say, uncertainty is not convenient for the development of neoclassical economic models as opposed to risk, which is measurable. Therefore, prominent neoclassical economists dismissed uncertainty from economics. Along these lines, Arrow (1951) states that "no theory can be formulated for this case" (p. 417). Similarly, Lucas (1977) is often quoted for his view that "in cases of uncertainty, economic reasoning will be of no value" (p. 15).

2.1.3 Keynes' views on uncertainty

Understanding Keynes' theory for probability is essential in comprehending Keynes's use of uncertainty because it captures all of the underlying motivations. Keynes offers his most comprehensive views about probability in his A Treatise on Probability (TP) published in 1921. His later statements on the issue come in the 1936 The General Theory of Employment, Interest and Money (GT) and in his 1937 article, The General Theory of Employment (GTE). In these writings, there are various aspects of Keynes's views on uncertainty, including a shift in his view towards more focus on its unquantifiable nature (Rosser, 2001).

TP is mainly about individual decision making in an uncertain environment. It brings about different features of Keynes' approach to probability. First of all, Keynes (1921) views probability as a logical relation between a proposition stating a conclusion on the one hand, and a set of evidential propositions on the other (Feduzi, 2007). In his understanding the word probability is used with regard to the truth of propositions (Van den Hauwe, 2011).

Any conclusion, A, is related to a given set of evidences or background knowledge, C, via a probability relation, denoted by A / C. (Lawson, 1988).

Keynes's views on the probability of future events acknowledge the existence of degrees of uncertainty in the sense that all probabilities lie on a range between certainty on the one end (where A / C = 1) and uncertainty on the other (where A / C = 0). If C makes A certain, that is to say, if the conclusion results directly from the evidences, then p = 1. If the relation between C and A is contradictory, then p = 0 (Feduzi, 2007). If C provides some but not conclusive foundations for believing (or disbelieving) A, then p stays anywhere between 0 and 1.

This approach suggests that all probabilities are conditional since the probability of a proposition always depends on its relationship with an actual or hypothetical body of knowledge stated in C. Therefore, considering simply the probability of a hypothesis is trivial.

For Keynes the probability relation expresses the degree of belief, which is rational and can be obtained by processing direct and indirect knowledge. A / C shows the degree of rational belief that the probability relation between A and C justifies. When new evidence, C_1, is gained, the degree of rational belief changes, leading to a new probability relation of A / CC_1.

Secondly, Keynes introduces 'weight' concept to his probability theory as he is interested in not only the logical probability relation between conclusion and evidence but also degree of completeness of evidence. Keynes appears to suggest that certainty can only be attained when weight reaches its highest level, and this in turn seems to describe a situation where the relevant evidence is complete (Lawson, 1987). Accordingly, a decision maker should make an effort to collect as much information as he or she can before making a decision.

Keynes (1921) describes the weight of a probability as a relation between evidence and the confidence in the probability assigned to a particular outcome. The definition of weight as the degree of completeness of the information set is appropriate to understand this relation

(Crocco, 2002). As Keynes (1921) puts it "one argument has more weight than another if it is based upon a greater amount of relevant evidence" (p.85).

According to Keynes, when confronted with uncertainty, economic agents fall back on conventions as guides to action, supported by their degree of confidence (or weight of argument) in those conventions. Keynes's point is that entrepreneurs cannot form rational expectations due to absence of information and the general uncertainty of the future. As a result, their decisions depend on largely conventional judgement, assuming that future will resemble the past. They are subject to spontaneous motivation for action or inaction that is the result of animal spirits. The convention among investors is fragile in the sense that it is vulnerable to changes of mood and incoming information. Therefore, uncertainty notion has a central role in Keynes's explanation of market instability (Hodgson, 2011b).

In TP, Keynes (1921) distinguishes between four cases of probability:

> …in some cases there is no probability at all; or probabilities do not all belong to a single set of magnitudes measurable in terms of a common unit; or these measures always exist, but in many cases are, and must remain, unknown; or probabilities do belong to such a set and their measures are capable of being determined by us, although we are not always able so to determine them in practice (p.33).

Moving from the first case through the second and towards the third, Keynes refers to the argument in question being less 'uncertain'. In the first one Keynes corresponds to fundamental uncertainty. The third is claimed (Lawson, 1988) to refer to Knight's notion of uncertainty. It is associated with the difference between objective versus subjective views of probability, with Keynes having a more subjective view contrary to Knight's objective view (Rosser, 1999). The last one denotes to Knightian risk.

On the other hand, the first case represents an ontological claim, while the other three cases are more epistemological in nature (Davis, 2010). The last one is particularly underlined as representing epistemological problems by Rosser (2001) since it implies "problems of how to know what we know and whose causes may be many" (p.549).

In the GT, Keynes presents uncertainty concept within the discussion of long-run expectations regarding long-term investment decisions. Keynes (1936) underlines the barriers to building confidence in expectations concerning the future value of investments:

> The outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield have to be made. Our knowledge of the factors which will govern the yield of an investment some years hence is usually very slight and often negligible. (p. 149)

In the GTE, Keynes elaborates on the effective demand and issues associated with uncertainty within the context of investment. According to Keynes, volume of employment depends on the level of effective demand in an economy, which has two components, namely investment expenditure and consumption expenditure. He then claims that investment expenditure is the significant factor in determining how well or poorly the economy performs. This is because investment expenditure is prone to fluctuations due to the uncertainty about the future, while consumption expenditure is simply related to aggregate income (Gillies, 2003).

In the GTE, Keynes (1937) describes uncertainty as follows:

> By uncertain knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is merely probable … Even the weather is only moderately uncertain. The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in 1970. About these matter there is no scientific basis on which to form any calculable probability whatever. We simply do not know (p. 113-114).

Considering the focus on knowledge, the distinction between probable and certain events is articulated in epistemic terms by Keynes. Furthermore, the assertion about "no scientific basis to form any calculable probability" is compatible with ontological uncertainty. In Keynes's ontologically uncertain world, agents' awareness of the possibility of future

surprises induces them to seek protection for future outcomes, which may emerge more unfavorable than what knowledge of past history foresees. Therefore, a rational course of action for income earners is to refrain from spending their income entirely and seeking financial savings in the form of liquid assets. (Terzi, 2010).

2.1.4 Comparison of the respective theories of Knight and Keynes on uncertainty (including the followers of rational expectations and subjectivists)

Keynes and Knight have similar definitions of uncertainty, that is, immeasurable probability. However, there are some differences between their views. The difference between views of Knight and Keynes on uncertainty originates partly from the different nature of issues they were involved with and from their respective philosophies of probability.

In his earlier works, Keynes has a philosophical context with the goal of providing a logical foundation for probability that involves inductive reasoning. In his later works Keynes has a broader objective of incorporating uncertainty into economic theory by including it among the initial axioms (O'Donnel, 2015). He explains liquidity preferences and investment fluctuations in relation to presence of uncertainty.

On the other hand, Knight has an economic context with the aim of providing a more satisfactory theory of the origins of profit than existing theories. He relaxes the perfect knowledge assumption of neoclassicals to have a better understanding of profit, rather than to have an idea of what difference this may make to the outcome of standard theory.

Knight holds a frequency approach to the probability, while Keynes bases his vision in logical concept of probability. Table 1, taken from Lawson (1988), systematically illustrates the similarities and differences among probability and uncertainty notions of Knight and Keynes, the followers of rational expectations and subjectivists. The rows of Table 1. differentiate uncertainty as probabilistically, measurable or immeasurable. Each quadrant corresponds to a particular intellectual stance.

Table 1 Probability and Uncertainty Notions (Knight, Keynes and the Followers of Rational Expectations and Subjectivists)

	Probability is a property of knowledge or belief	**Probability is also an object of knowledge as a property of the external reality**
Uncertainty corresponds to a situation where the probability is numerically measurable	Subjectivist (e.g., Savage)	Proponents of the rational expectations (e.g., Muth, Lucas)
Uncertainty corresponds to a situation where the probability is numerically immeasurable	Keynes	Knight

Source: Lawson (1988; p.48)

In commonality, both Knight and Keynes, distinguish between situations where the uncertainty can be measured, and those where this is not possible. Knight founds his theory of uncertainty and risk in the frequency interpretation of probability, wherein the objectively measurable probability is applicable to risk situations.[6] Keynes believes that the frequency definition of probability is too limited to cover what is meant by probability in the sense that many daily decisions of individuals are based on probability statements with no frequency interpretation. Keynes views probability as fundamentally subjective, something that can be formed from internal logic rather than from mathematical calculations of probability distributions from external observations (Rosser, 2001). For Keynes, probability is the degree of belief about a logical relationship, built from a set of propositions (conclusion), and prepositions (premises). In Keynes's approach, agents' uncertainty about probabilities and their degrees of confidence in their own assumptions about probabilities generate a theory of economic behavior. Within this concept of

[6] It should be noted that, as stated in 2.1.2 Knight also used the terminology of "subjective" probability judgment to be made in situations of uncertainty. However, as underlined by Lawson (1988) most economics literature ignores this fact and popular conception of Knight is represented by the lower right quadrant in Table 1.

probability as the degree of belief, probabilities are not necessarily numeric and not even comparable.

On the other hand, subjectivist school supports a personal view of probability (subjective probability). This ultimately gives rise to Savage's approach to the theory of choice under uncertainty, where uncertainty is totally subjective and it is only one's preferences that determine his probabilistic assessment. For example, if the outcome of two gambles is the same and one is preferred to other, then the decision maker assigns a higher probability of winning to the alternative favored (Feduzi, 2007). Subjectivists tend to assume that agents assign probabilities to any event. Strong subjectivists consider all probability estimates as subjective. With this approach, Knight's distinction between risk and uncertainty turns out to be meaningless as the decision maker can behave as if he attaches numerical probabilities to the events, and in turn, all the uncertainties can be reduced to risks.

Realist/measurable probability is the rational expectations stance identified with Muth (1961) and Lucas (1976). With the rational expectations hypothesis, which is first put forth by John Muth and later incorporated into macroeconomics by Robert Lucas, the concept of uncertainty as articulated by Knight and Keynes turns into a concept of measurable risk in the hands of neoclassical economics (Syll, 2012). For advocates of rational expectations, uncertainty refers to a situation of numerically determinate probabilistic knowledge.

All in all, according to Lawson's (1988) categorization Keynes is nonquantifiable-subjective; Knight is nonquantifiable-objective; Savage is quantifiable-subjective and proponents of rational expectationists, such as Muth and Lucas, are quantifiable-objective.

2.2 Sources and Categorization of Uncertainty

There exist different sources, conceptions, and degrees of uncertainty in the economic literature. The differences and similarities are among these notions are often unclear. In order to refine uncertainty concept Dequech (2011) divides it into three subgroups, namely substantive and procedural uncertainty; weak and strong uncertainty; and ambiguity and fundamental uncertainty (Figure 1).

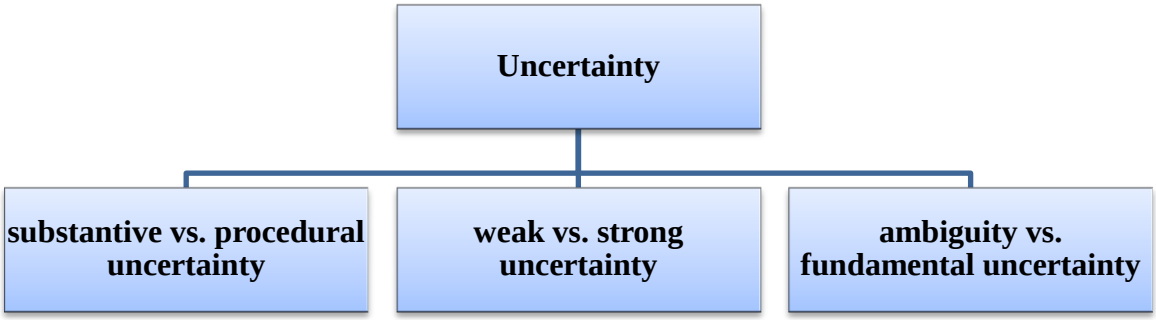


Figure 1 Three Distinctions on Uncertainty

As introduced by Dosi and Egidi (1991), substantive uncertainty arises from the incompleteness of the information set to make decisions with certain outcomes, while procedural uncertainty originates from the limitations on the competence of the agents to identify and interpret the relevant information. Procedural uncertainty arises from the gap between complexity of the situation and capability of agents in dealing with the information.

As proposed by Dequech (1997), in weak uncertainty situations an agent can establish a unique, additive and reliable probability distribution, while strong uncertainty is defined by the lack of such a distribution. Dequech (2011) argues that not only the absence of information but also inadequacy of the mental and computational capabilities of the agent vis-à-vis complexity of the situation prevents the construction of a probability distribution with those characteristics. Therefore, strong uncertainty may be substantive and/or procedural.

Dequech (2011) categorizes Knightian risk and Savage's uncertainty under weak uncertainty. Neoclassical economics has assumed weak uncertainty, in either of its forms. In situations of Knightian risk, the probabilities of various different states are objectively known by the individual. According to subjectivists, objective probabilities may exist and some of them may be known or unknown, thus Knightian risk is regarded as a special case of Savage's uncertainty. Savage's uncertainty includes subjective probabilities, which represent the decision maker's beliefs. Savage developes a theory of decision making

under uncertainty and utilizes that theory to describe choice-based subjective probabilities[7].

Dequech (2011) further differentiates two types of strong uncertainty, which he labels as ambiguity and fundamental uncertainty. As Camerer and Weber (1992) define "ambiguity is uncertainty about probability due to missing information that is relevant and could be known" (p. 330). The decision maker under ambiguity is usually aware of all the possible events, though he or she does not know with full reliability the probability that each event will get. All possible events are predetermined or knowable ex ante; however, the probability is not identified with full reliability at the time of decision making.

Under fundamental uncertainty some essential information about future events cannot be known at the time of decision making because it does not exist. The possibility of non-predetermined structural change characterizes fundamental uncertainty. There is no ex ante knowledge about all possible events since the future is yet to be created. In other words, ambiguity is a special case of uncertainty, to be distinguished from fundamental uncertainty, which is the outcome of lack of quantifiable cardinal probabilities.

On the other hand, procedural uncertainty may or may not be compatible with fundamental uncertainty, depending on the individuals' recognition of the possibility of non-predetermined structural change. If they recognize that possibility, it is compatible with the notion of fundamental uncertainty in the sense that the situation may be complicated and individuals who have limited computational abilities may also be creative (Dequech 2006). Table 2 taken from Dequech (2008; 2011) refines the above mentioned uncertainty concepts.

[7] In Savage's subjective expected utility model a preference structure is proposed that permits: "(a) the numerical expression of the decision maker's valuation of the consequences by a utility function; (b) the numerical expression of the decision maker's degree of beliefs in the likelihoods of events by a finitely additive, probability measure; and (c) the evaluation of acts by the mathematical expectations of the utility of their consequences with respect to the subjective probabilities of the events" (Karni, 2014, p. 11).

Table 2 Three Distinctions on Uncertainty

Type of uncertainty	**Weak uncertainty:** unique, additive, and fully reliable probability distribution	**Strong uncertainty:** absence of such a distribution
Substantive uncertainty: lack of relevant information, which would be necessary in decision making	**Weak uncertainty:** uncertainty regarding which state will attain	**Ambiguity:** uncertainty about probability due to missing information that could be known; predetermined list of all possible states
		Fundamental uncertainty: possibility of non-predetermined structural change; non-predetermined list of states
Procedural uncertainty: Complexity in relation to restricted capabilities of individuals		**Procedural uncertainty**

Source Dequech (2008, p. 2; 2011, p. 624)

Another categorization of uncertainty involves various degrees of unknown, corresponding to respective three classes of 1) aleatory uncertainty, 2) epistemic uncertainty, and 3) ontological uncertainty (Figure 2).

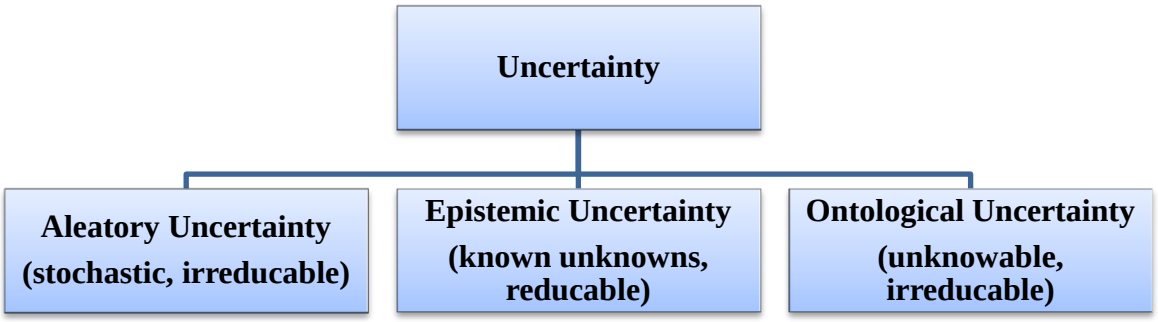


Figure 2 Uncertainty Concepts with regard to Degrees of Unknown

The word aleatory originates from the Latin alea, a dice game, which means depending on the throw of dice. Accordingly, an aleatoric uncertainty is one that is assumed to be the inherent randomness of a phenomenon and it cannot be reduced (Der Kiureghian & Ditlevsen, 2007). Aleatoric uncertainty, also referred to as statistical uncertainty,

variability and stochastic uncertainty, represents unknowns that vary each time the same test is performed. It can be characterized using probabilistic approaches.

The word epistemic originates from the Greek episteme, which means relating to knowledge. Accordingly, an epistemic uncertainty is one that is assumed to be resulted from absence of knowledge or data (Der Kiureghian & Ditlevsen, 2007). This lack of knowledge may be attributable to many sources including inadequate understanding of the underlying processes, imperfect knowledge of the phenomena, or imprecise assessment of the related characteristics. It is also referred as state-of-knowledge. Uncertainties are described as epistemic, if there is a possibility to reduce them by acquiring more data or by improving models, yet the complexity of the system prevents agents from ever obtaining full knowledge. In economic models assuming epistemic uncertainty, it is not important how competently agents make an effort to obtain knowledge about economic reality, their propositions and decisions will inevitably rely on incomplete information (Terzi, 2010).

The word ontological derives from Modern Latin ontologia, which is related to the subject of existence. Ontological uncertainty refers to the possibility of events occurring that we have no knowledge about. In a continuously changing environment, a clear regularity cannot be considered as the basis for a statistical anticipation of the future. Accordingly, there is no option other than using the past as the only source of knowledge, though acknowledging that non-predetermined surprises are likely (Terzi, 2010).

More recently, another common classification of uncertainty with respect to its sources is explained by Sauter (2014) in four groups as additive uncertainty, data uncertainty, multiplicative or parametric uncertainty and model uncertainty (Figure 3).

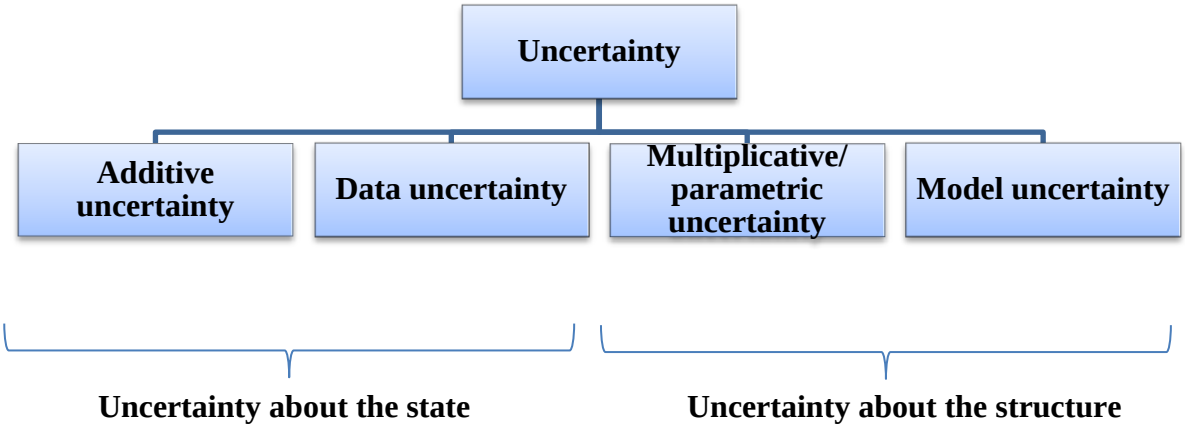


Figure 3 Uncertainty Types Concerning Different Sources

Additive uncertainty is about exogenous shocks, which could affect either demand or supply factors or both. These shocks are stochastic and may result from different reasons, and therefore cannot be anticipated.

Data uncertainty captures estimation errors and measurement errors, which could incompletely or incorrectly reflect the actual state of the economy. Most economic data is released with some delay and revised afterwards. Data revisions, which are motivated by factors such as the inclusion of new information and the recalculation of the estimates, also give rise to data uncertainty.

Multiplicative or parameter uncertainty represents the absence of knowledge, or the incorrectness of knowledge, about parameters of the behavioral model of the economy (Morande & Tejada, 2008). That is to say, transmission process within the economy, impact of one variable to another, cannot be known precisely. Hassett and Sullivan (2015) describe parametric uncertainty as the lack of perfect foresight about which of a known set of events with a known set of probabilities will take place in the future. They underline that parametric uncertainty is used synonymously with risk.

Model uncertainty exists when the parametric uncertainty is extended to uncertainty covering not only the values of parameters but also the functional form of models (Sauter, 2014). It could also be considered as an umbrella form of uncertainty, involving all above three types of uncertainty.

A different categorization of uncertainty could be among uncertainty about the state, the structure of the economy, and the strategic uncertainty (Figure 4).

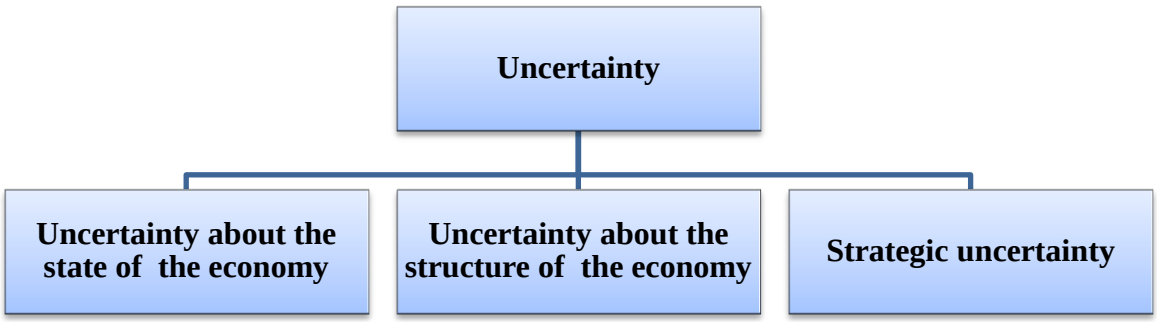


Figure 4 Different Forms of Uncertainty

Uncertainty about the state of the economy arises due to imperfect information, limitations in identifying nature and persistence of shocks, and unobservable variables that have to be estimated. Therefore, uncertainty about the state of economy includes data and additive uncertainty.

Imperfect information results in imprecise interpretation of the prevailing conditions in the economy. The availability, the quality and the reliability of data often varies, leading to imperfect information. Different indicators may also provide conflicting information about the prevailing economic conditions.

There is a need to identify the sources (e.g demand or supply, domestic or foreign) and nature (e.g long-lasting or transitory) of shocks to accurately interpret the conditions in the economy. However, there has been no consensus on the ideal econometric approach in this regard.

Some of the variables, such as output gap, liquidity conditions etc., are unobservable and have to be estimated when making assessment about the state of the economy. Using different approaches in estimation and possible measurement errors may cause uncertainty about economic conditions. For example, the precision with which a business cycle indicator can be forecasted is a significant criterion for determining its usefulness in

macroeconomic policy setting. The more accurate the projection, the less uncertain is the economic outlook leading to appropriate policy settings[8].

Uncertainty about the structure of the economy stems from two sources namely, uncertainty about structural relations within the economy and uncertainty about strength of structural relations relating to parameters within a specific model (Issing, 2002). Accordingly, uncertainty about the structure of the economy encompasses parameter and model uncertainty.

Strategic uncertainty is about changes in behavior and expectations of market participants. It is the uncertainty about the actions and beliefs of others (Moris & Shin, 2002). This type of uncertainty involves the interaction between private agents and policymakers and, especially, the role of expectations (Issing, 2002). The degree of strategic uncertainty may be extensive when some of the uncertainties mentioned in the above paragraphs rise and combine with more widely spread doubts of market participants about the stability of economic relationships.

2.3 Summary

This chapter explains two interrelated topics. First, it starts with description of Cantillon's insights into uncertainty in view of its theory of entrepreneur. Then the respective views of Knight and Keynes on the uncertainty are discussed, in view of their concepts of probability. Commonalities and differences between their views are summarized.

Second, the chapter gives an account of variety of possible sources, degrees and forms of uncertainty in an attempt to refine the concept of uncertainty. It highlights aleatoric, epistemological and ontological dimensions of uncertainty. Three distinctions, between: substantive and procedural uncertainty; weak and strong uncertainty; and ambiguity and fundamental uncertainty are examined. In addition, the chapter elaborates on four main categories of uncertainty with respect to its sources, namely additive, data, parameter and model uncertainty. The chapter also covers different forms of uncertainty that are,

[8] Changes in the stance of macroeconomic policy affect the aggregate economy with a time lag.

uncertainty about the state, uncertainty about the structure and strategic uncertainty. All in all, there are various taxonomies of uncertainty, mostly rooted on the reliability and availability of probability and knowledge.

CHAPTER 3

AN UNCERTAINTY MEASURE FOR TURKEY

Measuring the degree of uncertainty is important because it affects the real economy through several channels; however, it is a challenging task because of its latent nature. The aim of this chapter is to elaborate on the growing interest to uncertainty concept, enrich understanding of uncertainty measures and form an uncertainty measure for Turkey.

The chapter starts with a brief discussion regarding the revival of interest in the uncertainty concept, which seems more diffuse and more Knightian in nature (IMF, 2012; Poloz, 2014; González-Páramo, 2009). Uncertainty has been suggested as one of the key drivers of 2008/2009 global crisis and a contributing factor to the severity of the Great Recession as well. The pervasiveness of uncertainty and, thus, its impacts on the economy lead to the question of "how is uncertainty measured?".

Second part surveys the recent literature on the measures of uncertainty. Various measures are used to proxy uncertainty in the empirical literature. Nevertheless, none of the measures is a perfect proxy for uncertainty as they involve only specific aspects of the economy or specific sources of uncertainty. Pros and cons of different methodologies are covered in this part.

Third part is related to methodology deployed in order to construct uncertainty measures for Turkey. PCA is described with a view to use it in forming the uncertainty measures. This part also covers the description of data set.

Finally, two uncertainty measures for Turkey are constructed through PCA using both implied and realized volatilities of financial indicators as well as survey based data.

3.1 Revival of Interest to Uncertainty Concept in the Wake of the 2008/2009 Global Financial Crisis

The financial turmoil that emerged in the U.S. subprime mortgage market in August 2007 morphed into a global financial crisis following the bankruptcy of Lehman Brothers in September 2008. The rise of uncertainty was at the heart of the financial meltdown[9], and several episodes of elevated uncertainty occurred in the wake of financial crisis. Accordingly, there has been an increased attention to uncertainty concept, particularly to the Knight's distinction between risk and uncertainty.

In the years leading up to the crisis, the deregulation of financial markets accompanied with the rapid financial innovation, enabled financial institutions to shift their investment behavior from originate-to-hold to originate-to-distribute[10] through new financial instruments. These instruments made it possible to repackage assets into different risk classes and to price these risks differently. The originate-and-distribute model was used extensively for two reasons namely, distributing risk across a variety of investors and circumventing regulatory requirements (Stein, 2010). The creditworthiness of the borrower was no longer evaluated by the originator of the loan (European Commission, 2009). The investors depended excessively on the ratings provided by the credit rating agencies, which was subject to conflicts of interest and deficient models (Bernanke, 2010). Lack of close monitoring and short-term funding of long-term investments were among the weaknesses of the originate-to distribute model. In this process, risks spread through the global financial system, but with little transparency. The sheer uncertainty, that is the unknown risks, was one of the flaws of the model (Knight, 2008).

Investors searched for these instruments because they seemed to be safe while providing higher returns in an environment of low interest rates. They were considered to have a very favorable risk-return profile with the excellent ratings granted by the rating agencies. However, along with the growing size of the market, the level of innovation and

[9] There were complex and interconnected factors behind the global financial crisis, including lax monetary policy, large global imbalances, misperception of risk and weak financial regulation (Verick and Islam, 2010). However, these are beyond the purview of this thesis.

[10] The originator of the loan (banks) sells loans to other institutions and/or investors through a securitization process, as opposed to holding the loans until their maturity.
The originate-to-distribute model has, amongst other factors, contributed to the global financial crisis.

complexity has also risen. This, coupled with the opacity of information on complex instruments, posed challenges for appropriate risk evaluation and valuation by investors. Epistemic uncertainty has elevated in the sense that the volume of relevant information has surpassed the capacity of market participants to collect and comprehend it.

There was a process of transformation of risk into uncertainty as investment banks turned a hefty amount of their risky assets into complex financial instruments involving many forms of bundled debts and this, in turn, created a black box about the size and location of the risks (Pol, 2009). For example, it was not possible to compute the risks associated with collateralized debt obligations[11] (CDOs) because the required data either did not exist or was impractical to gather. These two factors, complexity and lack of data, delivered the preconditions for uncertainty, culminating in a freezing up of credit markets. Collapse of Lehman Brothers induced not only direct losses at other financial institutions but also acute rises in funding costs for all financial institutions since there were uncertainty about where the losses might take place (Jacome & Nier, 2012). The FED (2008) describes the situation in the Federal Open Market Committee Meeting as follows:

> "…. functioning in many credit markets remained very poor, a situation that reflected market participants' uncertainty about their liquidity needs and their future access to funding as well as concerns about the health of many financial institutions" (p. 7)

Uncertainty over the valuation of assets, counterparty risks and availability of liquidity resulted in a reversal of risk perceptions from risk seeking to risk aversion. Uncertainty-averse investors liquidated complex debt securities, which had become difficult to value (Rudiger & Schwellnus, 2013). Supposedly safe CDOs ended up valueless, despite having the seal of approval of the ratings agencies.

[11] CDOs are securities that contain different types of debt, such as mortgage-backed securities and corporate bonds, which are sliced into varying degrees of risk and sold to investors.

As Bernanke (2008) puts it:

> "…part of the explanation for the far-reaching financial impact of the subprime shock is that it has contributed to a considerable increase in investor uncertainty about the appropriate valuations of a broader range of financial assets, not just subprime mortgages".

Behavior of investors amid the financial stress in 2009 is well-suited to Ricardo Caballero's[12] explanation (cited by Hermansson, 2012):

> "When investors realize that their assumptions about risk are no longer valid and that conditions of Knightian uncertainty apply, markets can witness destructive flights to quality in which participants rid their portfolios of everything but the safest of investments".

Uncertainty was also at the center stage involving in an adverse feedback loop whereby financial disruptions cause uncertainty to increase, which, in turn, has a dampening effect on economic activity. Such a situation led to greater uncertainty and increased financial disruptions causing further weakness in economic activity (Mishkin, 2008).

Stock and Watson (2012) found that the shocks that produced the 2007/2009 recession in the US were mainly associated with financial upheaval and heightened uncertainty. It was vague how severe the financial and housing problems were, or what their effect would be in the US and globally, or what the appropriate policy responses should be to address the challenges.

In the meantime, policy uncertainty was high, contributing to macroeconomic uncertainty and weighing on growth. Lagarde[13] (2012) underlined that the most important factor weighing the global economy down was uncertainty about whether policymakers in advanced economies will and can deliver on their promises. According to Kose and Terrones (2012) the rise in policy uncertainty between 2006 and 2011 was around five

[12] Chair of Massachusetts Institute of Technology Department of Economics.
[13] Managing Director of the IMF.

standard deviations that may have stalled growth in advanced economies by two and a half percentage points during this period.

One often-cited explanation for the sluggish recovery from the global crisis has become heightened boots of uncertainty, which has been a drag on economic activity (Kocherlakota, 2010). The theme of Carney's (2012) speech was uncertainty and global recovery. Carney (2012) underlined that "elevated global uncertainty is holding back global economic growth and, thus, the demand for Canadian exports. In addition, there is some evidence that global uncertainty is affecting domestic activity" (p. 6). It has also been argued that low growth together with uncertainty about the economic outlook of advanced economies has affected emerging market and developing economies, through both trade and financial channels.

In this process, the frequency of Google searches for the phrase "economic uncertainty" in news headlines increased to an all-time high in February 2009 (Figure 5). The second and third highest levels were recorded in May 2009 and October 2008, respectively[14].

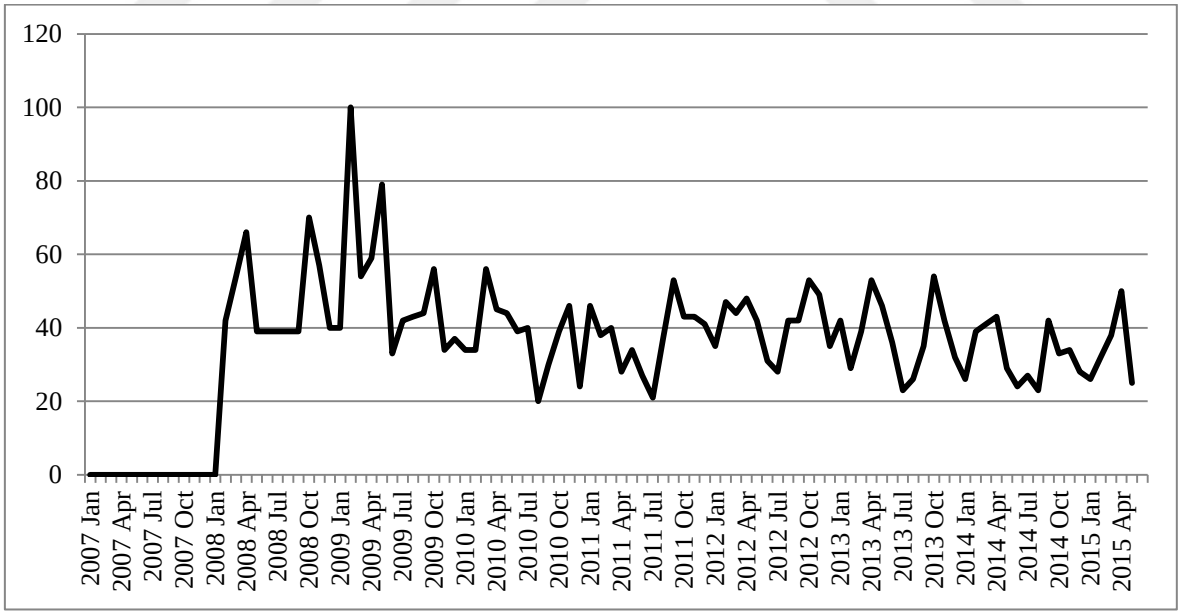


Figure 5 The Frequency of the Phrase "Economic Uncertainty" in News Headlines

[14] These findings are obtained from a figure generated by the website Google Trends, at http://google.com/trends (accessed May 2015)

3.2 Literature Survey on Measurement of Uncertainty

Measuring uncertainty is not a straightforward exercise because of the unobservable nature of uncertainty. A range of proxies are used in the empirical literature, some of which have the advantage of being directly observable, but also have some shortcomings at the same time. There is no one perfect measure of uncertainty, but they provide a useful guide on the degree of uncertainty in the economy.

There has been a renewed interest in search for better proxies to measure uncertainty in the wake of 2008-2009 global financial crisis. Researchers have relied mainly on proxies of uncertainty, such as the implied or realized volatility of financial market indicators, the cross-sectional dispersion of firm earnings or productivity, the survey based measures, or the frequency of newspaper references to uncertainty-related key words. More recently, some studies construct uncertainty measures through statistical techniques such as PCA.

Measures of uncertainty are derived from a set of diverse sources in the recent literature:

1. **Measures of uncertainty based on volatilities of economic and financial market indicators**

Volatility of financial variables is employed as uncertainty proxies for at least three reasons. First, episodes of large volatility, such as the Asian crisis and bankruptcy of Lehman Brothers, are generally considered as uncertain since they incorporate "unknown unknowns". Elevated volatility may reflect more risk and uncertainty surrounding the domestic and global financial markets. Second, people tend to pay more attention to news and incoming information in uncertain times. This induces high volumes of trading and rising volatility in financial markets. Third, uncertainty measures obtained from financial markets are typically available at high frequency and easy reach. As a result, it is possible to capture uncertainty shocks immediately, which makes quick policy response possible, if needed.

On the other hand, an important drawback for using financial indicators is that such a narrow indicator may not accurately reflect broader economic and financial conditions, rather may only reflect concerns in the specific segments of the economy.

In this strand, the most commonly used proxy of uncertainty is stock market volatility either realized or implied. The realized volatility of equity indices provides current volatility in financial markets, while implied volatilities from prices of option contracts contain information about market participants' views on future volatility (ECB, 2009). Implied volatilities contain expectations and assumptions of market participants about future movements in the markets (Sauter, 2012).

Leahy and Whited (1996) utilized daily stock returns to explore the relationship between uncertainty and investment in a panel of firms in the U.S. Bloom (2009) used stock market volatility[15] as a proxy to uncertainty and present evidence that that stock-market volatility is linked to other measures of productivity and demand uncertainty. He identifies 17 uncertainty episodes in the US by counting the points where the stock market volatility index is in excess of 1.65 standard deviations above its Hodrick-Prescott (HP) filtered mean. Bloom et al. (2013) use standard deviation of stock returns as proxy for uncertainty associated with firm profits and aggregate uncertainty as well. Popp and Zhang (2015) also considered realized volatility of stock returns as an alternative uncertainty proxy amongst others.

The VIX and VXO[16] indices, which are measures of implied volatility, are also frequently used as gauges of uncertainty (Bloom, 2009; Basu & Bundick, 2012; Bloom et al., 2013; Caggiano et al., 2014; Leduc & Liu, 2015; Foerster, 2014; Popp & Zhang, 2015; Knotek II & Khan, 2011). It is regarded as a useful indicator of the level of uncertainty, since the stock market responds quickly to new information about the economy. It is negatively related to risk appetite. Higher values of the VIX suggest that market participants are less

[15] Realized volatility from 1962 to 1986 on S&P500, and implied volatility from 1986 to 2009.

[16] The VIX and VXO were introduced by the Chicago Board Options Exchange (CBOE). They are considered to be the world's primary barometer of investor sentiment and equity market volatility. The VIX Index is based on real-time prices of options on the S&P 500 and VXO is based on the S&P 100. They are designed to reflect investors' consensus view of future (30-day) expected stock market volatility and often referred to as the market's "fear gauge." (http://www.cboe.com/micro/vix-and-volatility.aspx and http://www.cboe.com/micro/vxo/).

certain about the future direction of the market and a wide range of possible outcomes for the S&P 500 is expected by investors.

It should be stated that stock market volatility may fail to grasp the uncertainty shocks related to broader economy since the stock market can sometimes behave in an irrational exuberant manner disregarding the economic fundamentals. Stock market volatility can vary due to several factors, such as risk aversion, the leverage effect, and heterogeneity between firms, even if there is no significant change in uncertainty.

Several other proxies, such as GDP, productivity, asset price volatility (Cesa-Bianchi et al., 2014); Credit Default Swap (CDS) spreads over government bond yields and a number of systemic stress indicators like exchange rate volatility, bond market volatility, money market volatility, financial intermediation and a composite systemic stress indicator etc. (ECB, 2013), are also employed depending on the objective of the study. For example: Fernandez-Villaverde et al. (2009) use the time-varying volatility of real interest rates in order to examine whether it is an important factor behind the business cycle fluctuations of emerging economies. They estimate volatility using T-bill rates and country spreads through Particle filter and Bayesian methods. Bloom (2014) examines volatility of growth rates, volatility of stock markets and volatility of bond markets for a panel of 60 countries. He finds that developing countries face one-third higher macro volatility[17].

On the other hand, empirical models are also utilized to generate volatility forecasts. The most common models among these are the autoregressive conditional heteroskedasticity (ARCH) models produced by Engle (1982) and extended to GARCH by Bollerslev (1986). These models measure the uncertainty through the conditional variance of residual. For example, Asteriou and Price (2005) estimate GARCH (1,1) model for GDP per capita growth to acquire the variance series, which are employed as uncertainty proxies in their subsequent analysis. Berument et al. (2007) obtain inflation uncertainty by the conditional variance of inflation through a GARCH model.

[17] He lists three reasons of higher uncertainty in developing countries: 1) having less diversified economies, 2) focusing on goods with volatile prices like commodities, and 3) being more exposed to domestic political shocks and natural disasters, and implementing less effective stabilization policies.

Bloom et al. (2014) utilized the dispersion of firm-level cross sectional productivity shocks as a measure of uncertainty. Productivity shocks are extracted from the first-order autoregressive equation. They also estimate uncertainty through a GARCH (1,1) model using aggregate total factor productivity growth.

2. Measures of economic agents' perceived uncertainty about the future economic situation based on surveys

Three common survey based measures used in the recent literature are ex ante disagreement among forecasters (that is, dispersion of the point forecasts which can be estimated by variance or standard deviation), ex-post individual forecast errors (that is, variance of the difference between the forecast and realization) and explicit references to uncertainty (that is, questions citing uncertainty)

Some surveys involve questions that have direct references to uncertainty as a factor that affects spending and investments decisions (e.g limiting consumers' purchase of big ticket items or firms' decision to increase their capital expenditures). Responses to these questions are compiled to form an uncertainty measure because uncertainty is countercyclical, which means that it increases in recessions and decreases in expansions.

Disagreement among forecasters refers to the clustering of forecasts or point predictions around each other. The greater dispersion among forecasts indicates higher disagreement among the survey respondents. The underlying idea is that high divergence of economic agent's expectations reflects high uncertainty about the future course of the economy. The use of disagreement as a proxy for uncertainty assumes that periods associated with high (low) dispersion of point forecasts are suggestive of a high (low) level of ex ante uncertainty (Abel et al., 2015). Disagreement is easy to calculate and provides a measure of uncertainty around the time the forecast is made.

On the other hand, forecast errors are known only after the release of the actual data. They are an ex-post measure since it is not measurable while making the forecast (Orlik &

Veldkamp, 2014). Incidents characterized by low (high) ex post forecast accuracy[18] are assumed to be suggestive of a high (low) level of ex ante uncertainty (Abel et al., 2015).

Baker et al. (2013) use the disagreement among economic forecasters about future inflation and government purchases as one of the components of their economic policy uncertainty measure[19].

Bachmann et al. (2013) form uncertainty measures for Germany based on both ex ante disagreement and ex-post forecast errors from the IFO Business Climate Survey. They also construct a measure of uncertainty for the U.S. with forecast disagreement from the Philadelphia Fed's Business Outlook Survey. They use survey data of production activity for Germany, and general business activity for US to construct time-varying business-level uncertainty. For example, forecast errors for Germany are formed by associating production change expectation question and the production change realization question.

Arslan et al. (2011) construct proxies of uncertainty for Turkey based on firms' expectation errors employing a confidential data set from Business Tendency Survey. They computed expectation errors of firms by comparing their responses about expectations and realizations on their production volume. For example, if a firm expects a rise in its production for the next three months but does not report an increase when questioned three months later, the firm is considered to made an expectation error. Their firm specific uncertainty measures how the firms depart from overall mean on expectations errors. They also define aggregate uncertainty as the square of average expectation errors made by firms.

Scotti (2013) uses surprises from Bloomberg forecasts to construct measure of economic uncertainty related to the state of the economy for the United States (U.S.), the Euro Area, the United Kingdom (UK), Japan, and Canada. She compares the expectations for indicators like nonfarm payroll and quarterly GDP with their release values. Surprise index gathers the information contained in the surprises to form a summary measure of the deviation of the real economy from consensus expectations. The uncertainty index is

[18] Variance of forecast errors.

[19] The details of their measure are explained under the sub-heading of "Measures of economic policy uncertainty (news-based metrics)" in this study.

calculated as the squared surprises from a set of real activity indicators, where the weights represent the contribution of the associated indicator to a business condition index. Scotti (2013) shows that uncertainty increases during recessions and declines during expansions.

Rossi and Sekhposyan (2015) use forecasts for GDP in the SPF to construct an uncertainty measure. They compare the realized forecast error of a variable with its historical forecast error distribution. If the realization is in the tails of the distribution, they consider macroeconomic environment very uncertain because it is difficult to predict the realization from the existing information. With this distribution based measure, they could identify the upside and downside uncertainty.

Leduc and Liu (2015) form a measure of perceived uncertainty of consumers from the Thomson Reuters/University of Michigan Surveys of Consumers in the U.S. This survey reports the fraction of responses that have direct references to uncertainty as a factor restraining purchase of cars or durable goods.

Survey based measures have the advantage of being free from econometric models. They are likely to reveal uncertainty of actual decision makers, providing a useful proxy to quantify the impact of business uncertainty (Bachman et al, 2013). For these reason they are regarded as good indicators of uncertainty, however they have several shortcomings:

First, the uncertainty measures cannot be used to assess the immediate effects of macroeconomic events or policy responses as some surveys are conducted infrequently (Chang & Feunou, 2014). For example, Survey of Professional Forecasters (SPF) of the Federal Reserve Bank of Philadelphia is released at a quarterly frequency. However, it should be noted that survey-based data available at a monthly frequency have an advantage over balance sheet data (Bachman et al., 2013).

Second, survey data tend to only be available for a limited number of time series (Jain et al., 2013). They also suffer from the critique of small sample size. In addition, using survey data in cross country analyses is almost impossible since the surveys are not uniform.

Third, dispersion of forecasts would not point out the amount of existing uncertainty, when all the respondents submit similar forecasts, even if each is highly uncertain about future incidents.

Fourth, there may be heterogeneity in the cyclical features of firms' business activity, so dispersion in responses may not be related with uncertainty. The expectations may be heterogeneous, but certain (Bachman et al., 2013)

Fifth, differences among forecasters may reflect nothing more than differences in opinion about the future (Alexopoulos & Cohen, 2015).

Sixth, there may be problems with the honesty of responses (Dzielinski, 2012). Since survey respondents are professionals, reputational concerns and fear of consequences may affect their forecasts. Forecast errors are publicly observable within a short period of time; therefore respondents may be reluctant to deviate too much from consensus for the fear of damaging their reputation. They may also play tactical games leading to biased answers. Making the publication of the survey anonymous could encourage the respondent to unveil her actual belief and in turn diminish the risk of wrong forecasts (Sauter, 2012). However, anonymity could also generate less precise responses since the responded will be unaccountable.

Lastly, making a time series analysis is not completely adequate considering the heterogeneity of forecasters who participate in the survey over time (Conflitti, 2011).

3. Measures of economic policy uncertainty (news-based metrics)

Baker et al. (2013) construct an economic policy uncertainty (EPU[20]) measure based on three components: 1) frequency of newspaper references to economic policy uncertainty[21],

[20] There are several studies that used the EPU index by Baker et al (2013) as a policy uncertainty proxy, attempting to quantify the impact of policy uncertainty on other economic variables. See for example: Gulen and Ion (2013), Istrefi and Piloiu (2014), Klößner and Sekkel (2014) and Krol (2014) etc.

[21] In particular, they searched for keywords in three categories: 'uncertainty' or 'uncertain'; 'economic' or 'economy', and one or more of the following terms: 'congress', 'deficit', 'federal reserve', 'legislation', 'regulation' or 'white house' (including words like 'regulatory' or 'the Fed'). The article must contain terms in all three categories relating to uncertainty, the economy, and policy.

2) the number and size of the federal tax code provisions scheduled to expire in future years, and 3) the disagreement among economic forecasters about future inflation and government purchases. These measures are aggregated to compose policy uncertainty indices starting from 1985 for the U.S. and from 1997 for Europe[22]. The weights of the components in the overall index are 1/2, 1/6 and 1/3, respectively. Based on the methodology of Baker et al. (2013), Ermişoğlu and Kanık (2013) introduce economic policy uncertainty index for Turkey from 2001 to 2013. Similarly, Redl (2015) develops an index of policy uncertainty for South Africa using disagreements among professional forecasters, mentions of uncertainty in publications of South African Reserve Bank and a count of the word uncertain in local and international newspaper articles.

Alexopoulos and Cohen (2015) propose a refined and expanded version of the news-based uncertainty measures. They construct new text-based indicators of both general economic and policy-specific uncertainty from the New York Times and use them to document changes in the level of uncertainty in the U.S. for the period 1985–2007, to determine the role of policy in fluctuations, and to evaluate their effect on the economy, equity markets, and business cycles[23]. Knotek II and Khan (2011) also employed uncertainty proxy as measured by the New York Times index to assess the importance of fluctuations in uncertainty on household spending.

These measures are considered to capture uncertainty about possible policy actions the policy makers will undertake and uncertainty about the impacts of these actions and/or inactions. They provide a broad coverage in terms of potential sources of uncertainty and, in turn, enable to assess potentially different impacts.

However, they are not without shortcomings. First, the news-based component is an indirect measure, and reliance on a limited number of keywords could raise questions about the sensitivity of the results to the choice of keywords (Alexopoulos & Cohen,

[22] In a recent study Baker et al. (2015) expand their news-based search approach in time (back to 1900), country coverage (eleven other countries, including all G10 economies) and specific policy categories (such as healthcare and national security). To this end, teams of students read 12000 newspaper articles using a 65-page audit guide.

[23] They form three new indicators of general economic uncertainty and three new economic policy uncertainty indicators based on an examination of about 1.55 million news articles. An enhanced list of words and phrases used to identify articles concerning both uncertainty and economic issues.

2015). It is not clear whether keywords drawn from newspapers accurately identify expectations about the future course of the economy as a whole. Dzielinski (2012) argue that these kinds of measures can, at best, capture the behavior of individual and less sophisticated investors only.

Second issue is about tax code provisions. Many expiring tax code provisions are renewed on a regular basis, so they are unlikely to be a major source of uncertainty (IMF, 2013).

Third, the rise in the forecast dispersion component might result from other factors rather than policy uncertainty. For example, dispersion of inflation forecast may increase due to uncertainty about food or commodity prices.

Finally, another important issue is about assigning weights to components. When constructing their economic policy uncertainty index, Baker et al. (2013) used weights of 1/2 on the news-based policy uncertainty, 1/6 on the taxation legislation expiration and 1/3 on CPI forecast disagreement, and government expenditures forecast disagreement. Considering that the importance of components changes through time, the policy index could better capture uncertainty when different weights are assigned to components across periods.

4. Measures of uncertainty based on the common variability of a number of indicators

In this strand, uncertainty is measured as the factor common to individual measures of uncertainty across a variety of series in order to obtain a more representative picture of these proxies.

ECB (2013) uses a range of measures of uncertainty, together with their first principal component that is used as a single summary indicator of uncertainty. Three sets of indicators are combined using PCA: 1) measures of perceived uncertainty about the future economic situation based on surveys, 2) measures of uncertainty or of risk aversion based on financial market indicators and 3) measures of economic policy uncertainty.

Similarly Hadow and Hare (2013) combine seven uncertainty measures for the UK into a single summary uncertainty index by PCA. These seven measures are FTSE option-implied volatility, sterling option-implied volatility, dispersion of company earnings forecasts, dispersion of annual GDP growth forecasts, Gfk unemployment expectations balance, Confederation of British Industry's (CBI) 'demand uncertainty limiting investment' score, number of press articles citing 'economic uncertainty'.

Concentrating on the macroeconomic uncertainty, IMF (2012) estimates global uncertainty through dynamic common factor of standard deviation of the stock market series of France, Italy, Germany, Japan, the UK, and the U.S.

Creal and Wu (2014) also propose an uncertainty measure based on the first principal component of the yield volatilities across all maturities. Their measure of uncertainty displayed high correlations with measures for policy uncertainty, monetary policy uncertainty, inflation uncertainty, and GDP uncertainty. Therefore, they consider it as a new measure to capture the economy-wide uncertainty.

Jurado et al. (2015) underline that it is important to eliminate the predictable component of variation in macro series as to avoid ascribing predictable variability to uncertainty. With this premise, they define uncertainty as the common variation in the unforecastable component of a large number of macro and financial indicators. They remove the forecastable component of the variation before construction of the uncertainty measure. The common factors are estimated by the method of PCA. Their measure suggests three large incidents of uncertainty in the post-war period in the US: the months of 1973–1974 and 1981–1982 recessions and the Great Recession of 2007–2009.

3.3 Constructing an Uncertainty Measure for Turkey

3.3.1 Methodology: Principal component analysis

PCA is a statistical technique that is utilized to examine, classify and group data. It was first described by Karl Pearson in 1901 and a description of practical computing methods was provided by Hotelling in 1933. As explained by Smith (2002) "it is a way of

identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences". Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analyzing data" (p. 12). PCA reveals the sometimes hidden structures that often lie beneath the data set, while keeping most of the variation in the data set. Therefore it makes easier to operate the data and make predictions.

The goals of PCA are summarized by Abdi and Williams (2010) as:

(1) to extract the most important information from the data set;

(2) to diminish the size of the data set by preserving important information;

(3) to simplify the description of the data set; and

(4) to analyze the structure of the variables.

The dimensionality of the data is reduced through transforming correlated variables into a new set of linearly transformed uncorrelated variables using a covariance matrix or its standardised form – the correlation matrix[24] (OECD, 2008). The extracted components are called principal components (PC), which are ordered so that the first few preserve most of the variation in the original variables (Jolliffe, 2002).

A lack of correlation between PCs is a useful property in order to measure different statistical dimensions in the data set by PCs. There is no point in making PCA analysis if the original variables are uncorrelated. A meaningful reduction can be achieved when the original variables are highly correlated, either positive or negative.

Each PC is obtained by taking a linear combination of an eigenvector of the correlation matrix (or covariance matrix or sum of squares and cross products matrix) with the original variables (X_1, X_2,…, X_p):

[24] Correlation matrix is used when the variables are in different units.

$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots + a_{1p}X_p$

$PC_2 = a_{21}X_1 + a_{22}X_2 + \ldots + a_{2p}X_p$

.....

$PC_p = a_{p1}X_1 + a_{p2}X_2 + \ldots + a_{pp}X_p$

where a_{ij} are known as weights (also called factor loadings) and p is the number of variables. Factor loadings display the strength and direction of the relationship between the original variable and the principal component.

The first PC explains as much of the variability in the data as possible. The weights a_{ij} are the elements of an eigenvector of the covariance matrix of the original data. Coefficients a_{ij} is defined in such a way that variance for that component is maximized and subject to the following constraint:

$a_{i1}^2 + a_{i2}^2 + \ldots a_{ip}^2 = 1, i=1, 2, \ldots p$

Each subsequent component captures as much of the remaining variability as possible. The second component extracts the maximum variance from the residual matrix left over after extracting the first component (therefore orthogonal to). Components altogether explain together 100% of the variability in the data.

The second component will be correlated with some of the variables that do not have strong correlations with the first component. The second component will be uncorrelated with the first component. The remaining components display the same characteristics. Each component accounts for a maximum amount of variance in the variables that is not represented by the previous components, and is uncorrelated with all of the preceding components.

In PCA the number of components extracted is equal to the number of original variables. For example, an analysis of 8 variables would result in 8 components, not fewer. However, since PCA aims at reducing dimensionality, only the first few components will be

important enough to be preserved for interpretation (Keho, 2012). The key question is how many factors to retain.

Several criteria have been proposed for deciding how many components should be kept for interpretation. The most commonly utilized criterion, the so-called Kaiser criterion or latent root criterion uses eigenvalues as a cutoff point.

An eigenvalue measures the amount of variation that is explained by each principal component and will be highest for the first component and smaller for the succeeding components. An eigenvalue greater than 1 means that the principal component accounts for more variance than explained by one of the original variables in data set. A principal component with an eigenvalue less than 1 accounts for less variance than had been contributed by one of the variables. Any component can be kept and interpreted with an eigenvalue greater than 1.

Along with the Kaiser criterion, Hair et al. (2010) summarize the other criteria for deciding the number of components to retain as follows:

(i) A priori specified number of factors based on research objective or previous studies.

(ii) Enough factors to account for 60 percent of the total variance (and in some instances even less).

(iii) The optimum number of factors shown by the scree test[25] and

(iv) More factors than indicated by the previous methods when there is heterogeneity among sample subgroups.

[25] The scree plot graphs the eigenvalues against the number of components. In order to determine the appropriate number of components to retain, an "elbow" in the scree plot is sought. The point at which the curve first begins to flatten is considered to show the maximum number of factors to keep. Interpreting scree plots is subjective, entailing judgement of the analyst. In general, the scree test generates at least one more factor being considered to keep than does the Kaiser criterion.

The original p correlated variables is transformed into p orthogonal variables with decreasing variance. If a small number of components accounts for most of the variation in the data then these components can replace the original p variables without much loss of information and the other components can be considered as trivial variables. In other words, the final components, presenting little residual variance, might be disregarded in the analysis. If these less significant components are left out, the final data set will have fewer dimensions than the original.

The principal components extracted could be used in subsequent analyses (Keho, 2012). For example, in linear regression models, the existence of correlated variables poses the problem of multicollinearity that leads to instable regression coefficients. Using principal components that are orthogonal with one another evades this problem.

PCA has found application in many diverse fields such as economics, finance, engineering, psychology, and meteorology because it reveals simple underlying structures in complex data sets using analytical solutions from linear algebra (Shlens, 2014).

PCA has been widely employed in economics and finance to study changes in stock markets, bond returns, sovereign spreads, economic growth, exchange rates, etc. In an earlier study Feeney and Hester (1964) applied PCA to both stock prices and rates of return to construct three alternative indices to the Dow Jones Industrial Average (DJIA). These alternative indices are extracted by the method of principal components as linear combinations of prices and returns of the 30 DJIA stocks. Their intuition is that if an index is believed to measure the market by movements in stock prices, then it will be most sensitive (informative) if the weights are assigned in such a way that the index captures the maximum variance over all linear combinations of the stocks. The largest principal component provides this combination. Utilizing PCA, Çevik et. al (2013) aggregated exchange market pressure index, bond spreads, default probability of banking sector, volatility of stock market, trade finance and growth rate of short term external debt into an index of financial stress for Turkey.

PCA is also found useful in understanding the dynamics of term structure of interest rates. In their study Litterman and Scheinkman (1991) calculated the first three principal

components from the excess returns over the overnight interest rate (considered as risk free rate) for U.S. bonds for different maturities up to 30-years. They found that US bond returns are mainly influenced by three factors, corresponding to the level of interest rates, the slope of the yield curve and the curvature of the yield curve.

McGuire and Schrijvers (2003) applied principal component analysis to emerging market sovereign bond spreads to investigate their common sources of variation. Their results suggest that the common factor accounts for one third of the total variation in daily spread changes, indicating that idiosyncratic elements provide the most important explanation for spread movements.

3.3.2 Data set

In view of the fact that uncertainty is an unquantifiable and unobserved concept, PCA is preferred in construction of uncertainty measure. The underlying idea is to identify unobserved common elements in a summary statistics.

As a first step, variables that reflect realized (or historical) volatility, implied volatility and dispersion of expectations (survey based) are chosen as proxies of uncertainty[26] (Table 3). In order to calculate monthly volatility of series, daily coefficient of variations are calculated by using 20-trading days (or one-month) moving averages. Then, the frequency of dataset is converted from daily to monthly by picking end of month values.

Realized volatility is an ex-post measure of uncertainty while implied volatility is a measure of an ex-ante expectation of future uncertainty (Chang & Feunou, 2014). Therefore, using both realized volatility and implied volatility measures provides a more complete picture in identifying the conditions in the financial markets. A survey based measure supplements the picture by providing direct insight of respondents. In addition, selected proxies are assumed to reflect the conditions in three main markets that are bond market, foreign exchange market and equity market. Including the main markets would avoid catching distress only in a specific segment of the financial markets.

[26] These variables are plotted in Appendix A.

Table 3 Selected Variables for PCA

Variable	Definition	Source
BIST100	The main index for Borsa İstanbul Equity Market that includes 100 companies' stocks.	Bloomberg
Implied volatility of exchange rate	A measure of market expected future volatility of a currency exchange rate, TRY/USD	Bloomberg
Benchmark interest rate	The annual interest rate of Treasury bills, 2 year	Bloomberg
Cross currency swap rate	TRY/USD fixed vs floating swap, 1 year	Bloomberg
EMBI-Turkey	Turkey's sovereign spread	Bloomberg
Expected US dollar rate	Expected US dollar rate in the interbank foreign exchange market at the end of current month	Central Bank of Turkey - Survey of Expectations
Forward implied yield	Annualized interest rate derived from covered interest rate parity theorem, 3 month	Bloomberg
Interest rate swap	Turkish lira fixed vs floating swap	Bloomberg
Inflation expectations	Expected CPI over the next 12 months	Central Bank of Turkey - Survey of Expectations

Note: Volatilities of series are used in PCA.

Stock market volatility is one of the most frequently used proxies at capturing economy-wide uncertainty, therefore BIST100 index is used in the analysis.

Implied volatility of TL/USD exchange rate is forward looking in nature and considered as a barometer of expected volatility.

The Treasury market is the bridge between financial markets, monetary policy and the macroeconomy. Volatility from this market is therefore a good indicator of economic uncertainty (Creal & Wu, 2014). Hence, volatility of benchmark interest rate is covered in the data set.

A cross currency swap is an agreement to exchange interest payments and principals denominated in two different currencies with one leg in fixed and the other in floating rate.[27] A well-functioning cross currency swap market tends to support macroeconomic and financial stability through serving as a hedge against both interest rate risk and exchange rate risk. Heightened volatility in this market signals stress in financial markets, therefore volatility of TRY/USD swap rate is utilized in the PCA.

Emerging Market Bond Index (EMBI) spread, which is the difference between sovereign bond yields of emerging markets and industrialized economies with identical currency denomination and maturity, serves as an indicator of sovereign default risk (Özatay et al., 2007). Volatility of EMBI-Turkey is included in the data set to reveal the variation in the risk-premium.

Forward implied yield is the annualized interest rate for Turkish Lira that stems from the covered interest rate parity theorem. They are derived from the spot and forward rates for Turkish Lira versus the US dollar, along with the US interest rate for the same period. It is included in the data set since it is an indicator of market expectations of interest rate and exchange rate.

Interest rate swaps are highly liquid over-the-counter derivative instruments through which two parties exchange fixed and floating rate coupon payments. Such swaps are used for both hedging and speculating purposes. When the macroeconomic risk is higher, the usage of interest rate swaps increases. Accordingly, swap rate volatility is regarded as a good indicator of uncertainty. For example, findings of Azad et al (2011) suggest a strong relationship between uncertainties of macroeconomic fundamentals and the fluctuation in swap market volatility.

[27] The two parties exchange principals at the beginning, make floating-rate interest payments in the borrowed currency during the life of the contract and then re-exchange principals at the close of the contract at the initial exchange rate.

Dispersion of CPI expectations and dispersion of expected US dollar rate (interbank market) from the Survey of Expectations are included in the data set, given that the dispersion of forecasts across agents has been found in the literature to be a good proxy for uncertainty. The Survey of Expectations is conducted on a monthly basis and intends to monitor the expectations of experts and decision makers from financial and real sectors[28] related to various economic variables.

Prior to applying PCA to these series, it is important to determine whether PCA is in fact a meaningful procedure for the data set. A visual inspection of all the variables in Figure 6 reveals that while there is some variation among the different proxies of uncertainty for Turkey, they tend to move together, pointing to the existence of an uncertainty component common to all measures. This suggests that PCA is suitable to analyze the patterns in the data.

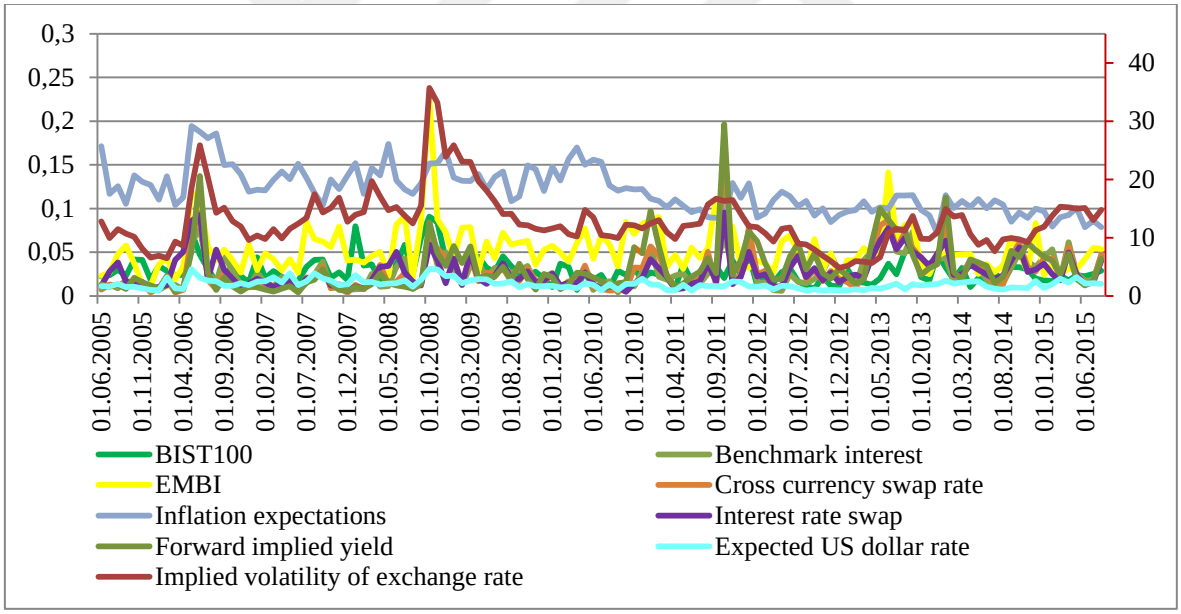


Figure 6 Volatility of Selected Indicators

[28] 113 participants, consisting of 81 experts from the financial sector, 17 experts from the real sector, 10 experts from foreign financial institutions and 5 professionals (see: http://www.tcmb.gov.tr/wps/wcm/connect/e2cbf720-94cb-4085-afe8-339fd9be74e1/SE-Report-Int.pdf?MOD=AJPERES&CACHEID=e2cbf720-94cb-4085-afe8-339fd9be74e1).

3.3.3 Construction of uncertainty measures for Turkey

Two uncertainty measures for Turkey will be constructed through PCA, which enables condensing the information contained in a number of uncertainty proxies into a smaller set of factors with a minimal loss of information.

In the following chapter, the constructed uncertainty measures will be employed in VAR analysis as to estimate the impact of uncertainty on Turkish economy. 8-variable measure will be used for the main analysis and 5-variable measure will be employed for the robustness check. Table 4 presents the variables chosen from Table 3 in order to form the uncertainty measures.

Table 4 Components of Uncertainty Measure for Turkey (PCA)

	Components
Uncertainty (8-variable)	BIST100, implied volatility of exchange rate, benchmark interest rate, cross currency swap rate, forward implied yield, interest rate swap, inflation expectations, EMBI-Turkey
Uncertainty (5-variable)	BIST100, implied volatility of exchange rate, benchmark interest rate, EMBI-Turkey, expected US dollar rate (interbank market)

Prior to performing PCA, it is useful to check the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to determine appropriateness of PCA. KMO is a statistic for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. If two variables share a common factor with other variables, their partial correlation will be small, indicating the unique variance they share. A KMO statistic is calculated for each variable, and their sum is the KMO overall statistic. KMO measure varies from 0 to 1.0. Small values of KMO suggest that the variables have too little in common to warrant a PCA. As noted by OECD (2008) a KMO overall should be 0.6 or higher to proceed with factor analysis.

Table 5 presents that KMO value for each variable is above 0.70 and overall KMO value is 0.78, indicating that data set is suitable to perform PCA.

Table 5 Kaiser-Meyer-Olkin Measure of Sampling Adequacy (8-variable)

BIST100	0.75
Implied volatility of exchange rate	0.75
Benchmark interest rate	0.85
EMBI-Turkey	0.82
Cross currency swap rate	0.70
Forward implied yield	0.73
Interest rate swap	0.89
Inflation expectations	0.67
Overall	0.78

After the identification of unobserved common factors and examining KMO measures, PCA is carried out using 8-variables from Table 4. Stata 12 program is utilized to perform PCA. In Stata 12 scores for a PCA of a correlation matrix are always based on the standardized variables.

Results of PCA show that 50% of the total variance of the underlying series is explained by the first principal component (Table 6). Thus, the derived factor explains a satisfactory amount of the common variation in underlying uncertainty of the sample. Since the eigenvalue of the first principal component is greater than 1.0, it explains more variance than a single variable, specifically 4.02 times as much.

Table 6 Results of Principal Component Analysis (8-variable)

	Eigenvalue	**Cumulative**
First principal component	4.02	0.50

Since PCs are linear functions of the data, it is useful to examine their correlations with the observed returns series to uncover their relevance. These correlations are also called factor loadings. Factor loadings present the extent of correspondence between the variable and

the factor, with higher loadings making the variable representative of the factor (Hair et al, 2010):

(i) Factor loadings that are in the range of ±0.3 to ±.40 meet the minimum level for interpretation.

(ii) Factor loadings that are ± 0.5 or greater are considered significant.

Table 7 lists correlation coefficients between the first PC and the corresponding observed series. The first PC is strongly positively correlated with five of the original variables, namely benchmark interest rate, EMBI-Turkey, cross currency swap rate, forward implied yield and interest rate swap (Table 7). These variables are the most important variables in forming the first PC. BIST100 and implied volatility of exchange rate also have coefficient correlations above 0.50. On the other hand, the first principal component is weakly correlated with inflation expectations implying the insignificance of the variable. However, KMO and communality values for inflation expectations are 0.67 and 0.56 respectively, validating its existence in the PCA. Therefore, the variable is kept in the analysis.

Table 7 Coefficient of Correlations between Variables and the First Principal Component (Factor Loadings)

BIST100	0.50
Implied volatility of exchange rate	0.53
Benchmark interest rate	0.86
EMBI-Turkey	0.67
Cross currency swap rate	0.91
Forward implied yield	0.85
Interest rate swap	0.86
Inflation expectations	0.05

Communality is the proportion of each variable's variance that can be explained by the common factors (principal components):

Communality = 1, All variance shared

Communality = 0, No variance shared

0 < Communality < 1, Some variance shared

If the communality of a variable is low, i.e. less than 0.50, the factors contain less than half of the variance in the original variable. Then, the variable could be a candidate for exclusion from the analysis.

Uniqueness is the variance that is 'unique' to the variable and not shared with other variables. It is equal to 1 –communality (the amount of variance that is shared with other variables). The lower the uniqueness the higher the relevance of the variable in the factor model.

Table 8 shows that all the unique variances are small (communalities are above 0.50). This suggests that all the variables are relevant in PCA.

Table 8 Unique Variances (8-variable)

BIST100	0.33
Implied volatility of exchange rate	0.26
Benchmark interest rate	0.22
EMBI-Turkey	0.39
Cross currency swap rate	0.07
Forward implied yield	0.15
Interest rate swap	0.20
Inflation expectations	0.44

As for the construction of 5-variable uncertainty measure, first KMO measure is checked. Table 9 shows all individual measures of sampling adequacy are greater than 0.70 and overall KMO value is 0.77, indicating a good fit for PCA.

Table 9 Kaiser-Meyer-Olkin Measure of Sampling Adequacy (5-variable)

BIST100	0.86
Implied volatility of exchange rate	0.75
Benchmark interest rate	0.73
EMBI-Turkey	0.78
Expected US dollar rate (interbank)	0.70
Overall	0.77

58 % of the total variance of the 5 uncertainty proxies is explained by the first principle component, which is reported in Table 10.

Table 10 Results of Principal Component Analysis (5-variable)

	Eigenvalue	**Cumulative**
First principal component	2.90	0.58

As presented in Table 11, the first PC is strongly positively correlated with all of the original variables, indicating that all the variables are associated with the direction of the maximum amount of variation in the dataset. High correlations suggest that all the variables load heavily on the first component. That is, all of the variables are influential in forming the first principal component. Implied volatility of exchange rate has the greatest influence on the first component.

Table 11 Coefficient of Correlations between Variables and the First Principal Component (Factor Loadings)

BIST100	0.81
Implied volatility of exchange rate	0.86
Benchmark interest rate	0.53
Expected US dollar rate	0.79
EMBI-Turkey	0.77

Table 12 illustrates that 27 % of the variance in implied volatility of exchange rate is not shared with other variables in the overall factor model. EMBI-Turkey and expected US dollar rate have also low unique variances, which are not accounted by the other variables (35% and 37%, respectively). Only benchmark interest rate has a high unique variance. However, its KMO value and factor loading is satisfactory, so it is kept in the PCA.

Table 12 Unique Variances (5-variable)

BIST100	0.35
Implied volatility of exchange rate	0.27
Benchmark interest rate	0.72
Expected US dollar rate	0.37
EMBI-Turkey	0.40

After confirming that PCA is suitable for both data sets in Table 4, uncertainty measures for Turkey are obtained by extracting the first PCs. Figure 7 and Figure 8 plot the first PCs, which is performed individually for 8-variables and 5-variables as shown in Table 4. The first PCs represent uncertainty measures for Turkey. Daily uncertainty measures are shown in the Appendix B.

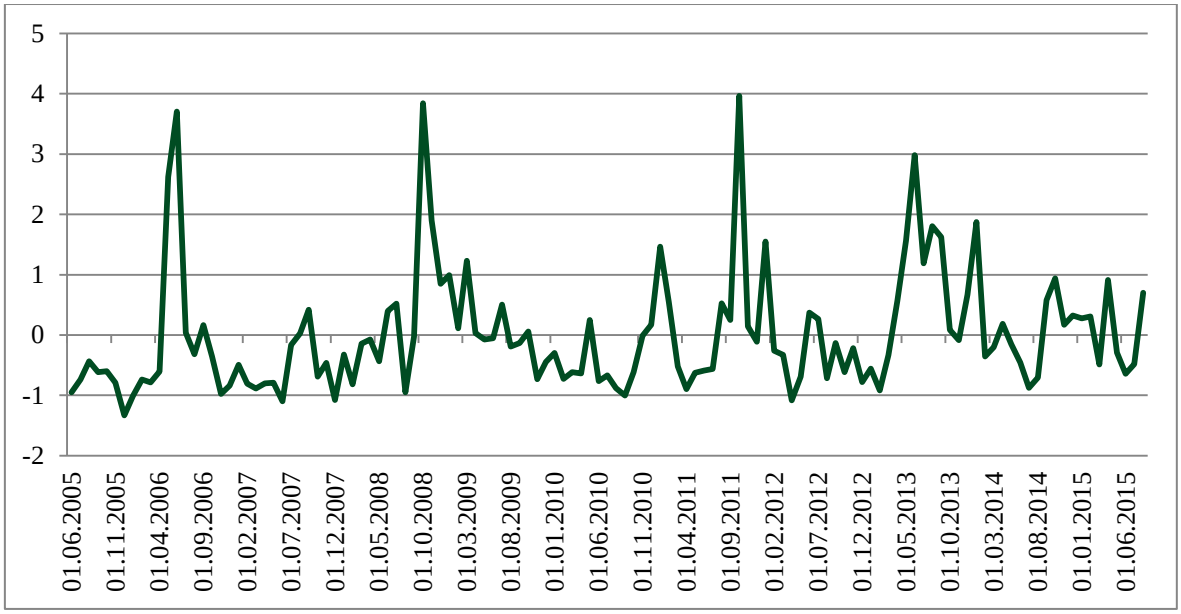


Figure 7 Uncertainty Measure for Turkey (Monthly, 8-variable)

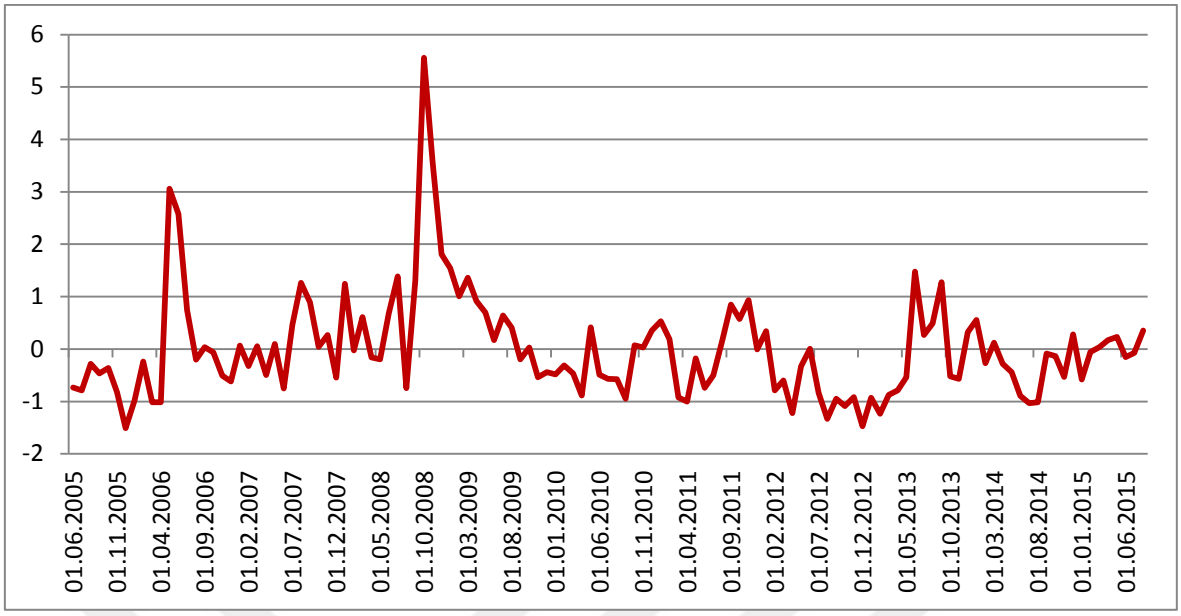


Figure 8 Uncertainty Measure for Turkey (Monthly, 5-variable)

8-variable and 5-variable uncertainty measures for Turkey reveal three and four large episodes of uncertainty in the last decade, respectively. Figure 7 and Figure 8 illustrate that uncertainty appears to spike in response to significant events such as domestic economic and political issues in May 2006, collapse of Lehman Brothers in October 2008, Europe crisis in 2011, and taper tantrum[29] coincided with Gezi events in the summer of 2013. This suggests that the sources of spikes in uncertainty seem widespread, and are both domestic and international.

Figure 7 and Figure 8 both identify a surge in uncertainty in Turkey in May 2006 and October 2008. The level of uncertainty in October 2008 was significantly higher than the size of uncertainty in May 2006 in Figure 8. The rise in May 2006 reflects concerns about the independence of key institutions, further progress in structural reforms and some emerging political tensions within Turkey (OECD, 2006). Accordingly, it is domestic originated.

Uncertainty measures for Turkey peaks in October 2008 due to the uncertainty surrounding the global economic and financial outlook with the collapse of Lehman Brothers in the US.

[29] Taper tantrum is the reaction of financial markets in the emerging countries, including Turkey, to the announcement of the FED's intention to finalize its quantitative easing program.

In this process, policy uncertainty index[30] in the US reached to historically high levels, contributing to the fragility of the outlook. The concurrent spread of the effects of failure of Lehman Brothers to the financial markets of a number of countries led to the widespread belief that there was a contagion effect. As Kazi and Wagan (2014) argues the presence of herding behavior among international investors and correlated trading across large institutional investors in the face of rising uncertainty resulted in contagion and exacerbated the conditions in emerging financial markets. Turkish financial markets faced sharp movements after the collapse of Lehman Brothers.

On the other hand, the rise in uncertainty measures for Turkey in the summer of 2013 originated from a combination of domestic and international sources. Following the statements of the FED Chairman Bernanke[31], the expectations increased that the FED would soon start lessening the amount of monetary stimulus it was providing to the economy through its unconventional monetary policies. However, timing and pace of tapering was uncertain. There was sharp movements in U.S. and global financial markets, including a large sell-off emerging assets by international investors, resulting in depreciations of currencies, rise in bond yields, EMBI spreads, and CDS spreads, as well as falls in equity markets (Shagil et al., 2015). Turkish financial markets were not immune from the global sell-off. Meanwhile, in Turkey Gezi events took place, contributing to uncertainty.

3.4 Summary

In an environment of uncertainty, little or nothing is known about the future course of the economy (Bloom et al., 2013). This means that households, firms, policy makers and other economic agents cannot figure out what is likely to happen in many different segments of the economy. In this situation, decision-makers are left with making judgements based on the available information or intuition. Measuring uncertainty is important since it plays an important role in shaping the economic and financial decisions.

[30] Developed by Baker, Bloom and Davis.
[31] In his testimony in front of the Congress on May 22, 2013, Bernanke stated that the FED is likely to start slowing, that is tapering, the pace of its bond purchases later in the year, conditional on continuing good economic news. At his press conference on June 19, 2013, Bernanke described economic conditions optimistically and again suggested that asset purchases might be reduced later in 2013.

The chapter starts with an explanation of increased attention to the Knightian uncertainty in the aftermath of the global financial crisis. With the advance of the originate-to-distribute model, pervasive uncertainty about the size and location of the risks rose to the surface, eventually resulting in freezing up of credit markets in 2008. After the collapse of Lehman Brothers in September 2008 severe turbulences occurred in the global financial markets. Heightened financial disruptions together with increased uncertainty are considered as the main drivers of the financial and economic meltdown. Uncertainty has also been suggested as one of the key factors that hinders ensuing recovery (IMF, 2012).

Following the global crisis several researchers have approached the question of how uncertainty is perceived and evaluated. Measurement of uncertainty in the recent literature is reviewed in the second part, taking into account the advantages and disadvantages of the methodologies employed. Third part covers methodology and data set. PCA is explained with a particular emphasis to its applications in finance. In addition, data set, which includes proxies representing realized volatility, implied volatility and dispersion of expectations, is described in detail. In the fourth part, two uncertainty measures (using 8-variables and 5-variables) for Turkey are constructed using PCA.

The first PCs of uncertainty proxies for Turkey show that different proxies have a common component that explains a significant part of the variations in individual proxies. Aggregating uncertainty derived from varying sources into one summary statistic, the constructed measures capture several important episodes of uncertainty for Turkey in the last decade. The findings suggest that the constructed measures could be useful as a benchmark in evaluating impact of uncertainty on the Turkish economy.

CHAPTER 4

IMPACT OF UNCERTAINTY ON TURKISH ECONOMY

In the aftermath of 2008/2009 global financial crisis there has been a growing recognition of the role played by uncertainty shocks in driving fluctuations in the economy. It is documented by the IMF (2012) that uncertainty surged at the onset of the Great Recession and remained high afterwards. Stock and Watson (2012) underline that "the main contributions to the decline in output and employment during the recession are estimated to come from financial and uncertainty shocks" (p. 119).

Uncertainty affects economy through several channels both from the demand side and supply side of the economy (Abigail et al., 2013). It can have an effect on the level of demand for goods and services in the economy through consumption and investment decisions. On the supply side, uncertainty can influence the economy via its impact on the productivity and credit provision. More recent studies highlight the importance of financial channel in transmission of uncertainty shocks. There also exist studies that examine international spillovers of uncertainty shocks.

The main aim of this chapter is to quantify the effects of uncertainty on Turkish economy. A deeper understanding of how uncertainty shocks affects the Turkish economy is likely to help policymakers to determine the appropriate policy response and assess how future shocks to uncertainty might affect demand and supply prospects. To this end, two uncertainty measures constructed via PCA in the third chapter are used in a VAR analysis.

The chapter starts with a review of the literature regarding the effects of uncertainty on the economy. Various channels of transmission are explored. The second part introduces the methodology and the data set employed in the analysis. Accordingly, VAR methodology

and data set, which includes macroeconomic variables, are explained in detail. In the third part, a VAR model with seven variables is constructed for Turkey. In the baseline model 8-variable uncertainty measure is used as the uncertainty proxy. This part also reports the empirical results of the VAR analysis and discusses the effects of uncertainty shocks on the Turkish economy. Robustness checks are made by changing the ordering of variables, using a 5-variable uncertainty measure, shortening the sample period and deleting the control variable from the model. Last part concludes.

4.1 Literature survey: The Effects of Uncertainty on the Economy

The view that uncertainty can negatively affect economic activity dates back to Keynes (1937), who claims that investment plays a crucial role in determining the performance of the economy as it is prone to fluctuations due to the uncertainty surrounding the views about the future. Keynes (1936) also argues that investment relies on expectations regarding the future yields of investments, which are uncertain because of the instability of information it is dependent on.

The literature on the effects of uncertainty shocks on investment is vast. Some studies suggest a positive relationship between uncertainty and investment, while others point to a negative relationship. In some early studies (Hartman, 1972; Abel, 1983), assumptions of risk-neutral competitive firms and constant returns to scale production function ensures convexity of the marginal profitability of capital in output price and input costs. Accordingly, heightened uncertainty about the price of output gives rise to higher investment and, in turn, enhances economic activity.

A larger body of literature provides explanation for the response of investment to the uncertainty by focusing on the real option feature of investment. The analyses rely on the three main characteristics of investment: First one is the irreversibility of investment (Bernanke, 1983; Dixit & Pindyck, 1994). It is not possible to completely retrieve the initial cost of investment, which have a sunk cost component. Modifying the investment would also be costly. Second, there is uncertainty over the future yields from the investment. At best, the probabilities of the alternative outcomes that can suggest greater or smaller profit (or loss) can be evaluated (Dixit & Pindyck, 1994). Third one is related to

the timing of the investment. The action can be postponed to obtain new information, which may lead to a better decision; however, complete certainty about the future is not possible.

In real options theory, a firm with an opportunity to invest is holding an option similar to a financial call option[32] (Dixit & Pindyck, 1994). Once an irreversible investment is made, the firm exercises its option to invest, forgoing the possibility of awaiting new information that might change the attractiveness or timing of the investment. If investment has an irreversible nature, there is an opportunity cost of investing immediately rather than waiting[33]. Bernanke (1983) theoretically validate the view that, when projects are irreversible and information is obtained through time, the uncertainty regarding future returns creates an option value of waiting, which dampens the current investment rate.

Bernanke (1983) noted two arguments for aggregate investment instability stemming from the interaction of irreversibility and uncertainty. Firstly, he underlined that macro-level factors, such as wars, the advent of new technologies with widespread applications, foreign policy shocks and changes in monetary, fiscal or regulatory policy, are important in determining the micro level decision of a firm to invest. This decision gains more importance for long-lived investment projects, which are costly to reverse. Secondly, Bernanke stated that aggregate uncertainty may be generated within the system by individual decision makers. If an individual firm or worker is uncertain about whether low aggregate demand is transitory or permanent, then the decision to make irreversible investment may be postponed in order to understand the true state of affairs. As new information comes, the chances of making a better decision increase, that is to say, there is an option value for waiting to invest.

Following the Bernanke's seminal paper, many studies further investigate the role of uncertainty in investment decisions. Providing a subsequent analysis, Dixit and Pindyck (1994) espouse the use of real option analysis to account for uncertainty in investment

[32] The firm has the right but not the obligation to purchase the asset at some future time.

[33] There are a few requirements for real option effect to arise (Bloom, 2014): 1) Investment decisions should be hard to reverse. Reversible actions do not generate the loss of an option, 2) Firms should have the ability to wait (for example: do not have to race for receiving a patent and presenting a new product etc.), 3) Firms should be selling into imperfectly competitive markets and/or working with a decreasing-returns-to-scale technology.

behavior when decisions are irreversible. Their key insight is that the amount of the option value that would lead to delaying investment will depend on the level of uncertainty. Heightened uncertainty is likely to increase the value of this "wait and see" option, thus reduce investment spending temporarily.

Guiso and Parigi (1999) investigate the effects of uncertainty on the investment decisions of Italian manufacturing firms, using data based on a survey among these firms. They measure uncertainty by probability distribution of future demand for firms' products and find a negative relation between uncertainty and investment. They show that there is heterogeneity in the impact of uncertainty on investment: it is higher for firms, which have higher degree of irreversibility and substantial market power.

Bloom et al. (2014), build a general equilibrium model with heterogeneous firms to measure the effect of uncertainty on the economy. In their model, firms are subject to idiosyncratic shocks and adjustment costs. The uncertainty and economic activity nexus operates through the adjustment costs preventing firms from acting in the presence of elevated uncertainty. They show that uncertainty shocks can account for contractions in GDP of around 3%, pointing to the importance of uncertainty in driving business cycles.

Kang et al. (2014) examine the influence of economic policy uncertainty on firm level investment for U.S. manufacturing firms during the period of 1985–2010. They provide evidence that economic policy uncertainty in interaction with firm-level uncertainty (stock price volatility) dampens firms' investment decisions. Firms that face higher firm-level uncertainty are more responsive to aggregate uncertainty. The policy shocks affect firm-level investment more during recessions. They also find that policy uncertainty do not influence the investment decisions of the largest firms.

The response of households to uncertainty is also examined in the literature. Applying Bernanke's (1983) analysis to the effects of income uncertainty on consumer spending in the U.S., Romer (1990) argues that consumers who become temporarily uncertain about their future income due to stock market crash of 1929 delay their spending on durable goods as they wait for more information about the likely course of economic activity. She finds a negative relation between stock market volatility and consumer spending on

durables in the late nineteenth and early twentieth centuries. She also underlines that this story is applicable to producers who may find it optimal to put off buying new plants and equipment until they get more information regarding the future soundness of the economy. Likewise, Carroll (1996) presents evidence that US households might decrease their consumption and engage in buffer-stock savings behaviour to utilize in periods of low income when they face uncertainty about their future stream of income.

Knotek II and Khan (2011) assesses the role of uncertainty on household purchases in the US through first a bivariate VAR model and then a multivariate VAR model that includes more relevant information. In the simple bivariate VAR model, the behaviors of households seem to be largely in line with the theoretical models would suggest. An uncertainty shock generates a quick drop and a subsequent rebound in spending. However, with the multivariate model they show that fall in household spending are modest and may only materialize after a considerable time. Besides, they suggest that changes in uncertainty explain a small portion of the total fluctuations in household spending.

The effects of uncertainty shocks on the economy are not limited to investment and consumption decisions. They are also felt through their influence on the labor market. Bloom (2009) introduces a theoretical model relating uncertainty shocks to output, and employment with firm level data. This model is utilized to stimulate an uncertainty shock where a rise in uncertainty affects real variables by delaying hiring and investment decisions. He argues that uncertainty can cause companies to hold back hiring and lay off decisions because adjustment to capital and labor inputs is costly and would need to be readjusted if future demand does not meet future capacities. When uncertainty diminishes, firms meet their pent-up demand for labor and capital, so activity picks up fast. There is also a fall in productivity growth following the shock because of the freeze in reallocation from low to high productivity firms due to reduced hiring and investment. He also estimates a series of VAR models to quantify the impact of uncertainty on economic outcomes in the US from June 1962 to June 2008. The complete set of variables are S&P500 stock market index (as control variable), a stock-market volatility indicator, Fed funds rate, hourly earnings, consumer price index, employment, and industrial production. According to his findings, there is a strong countercyclical relation between economic

activity and uncertainty[34]. Impulse responses show that an uncertainty shock initially depresses employment and output, and then leads to recovery and overshoot.

Exploiting Bloom's (2009) model, Mecikovsky and Meier (2015) decompose the employment change into layoffs, quits and hirings, which helps to identify the significance of employment adjustment costs. They show that a positive shock to uncertainty lowers hirings and quits, while it increases layoffs in the U.S. One of the suggestions of their model is that there should be more layoffs in more flexible labor markets in the face of uncertainty shocks. They present empirical evidence for France, Germany and the UK that is consistent with this hypothesis.

Caggiano et al. (2014) examine the effects of uncertainty shocks on unemployment dynamics during post-world war II U.S. recessions. They isolate the impact of uncertainty shocks during recessions by modeling data on uncertainty, unemployment, and other standard macroeconomic variables with a Smooth-Transition VAR framework. The findings show that uncertainty shocks have larger impacts on unemployment during recessions. The results also suggest that the impact of uncertainty shocks on unemployment during recessions is larger than the one estimated by a linear VAR model.

Similarly, Bonciani (2015) explores the asymmetric macroeconomic effects of uncertainty shocks depending on the state of the business cycle using a Smooth-Transition VAR model and uncertainty measure developed by Jurado et. al (2015). He presents evidence that uncertainty shocks behave like negative demand shocks in the U.S., depressing industrial production, increasing unemployment and lowering prices during recessions. On the contrary, uncertainty shocks make a positive effect on macroeconomic activity during expansions.

Baker et al. (2013) first examine the role of heightened policy uncertainty in driving business cycles using micro data exploiting variations in exposure of firms to government

[34] As summarized by Bloom (2014) the literature mentions four reasons why uncertainty increases during recessions: 1) In times of economic slowdown, firms do not trade actively, and in turn spread of information reduces, leading to increased uncertainty, 2) People are not accustomed to recessions so it becomes difficult to forecast during recessions. 3) Public policy may become overactive, experimental, and unclear, and 4) It is cheaper to experiment new ideas when business is slack. Heightened micro uncertainty may produce higher macro uncertainty.

contracts. Then they estimate VAR models to quantify the impact of policy uncertainty on economic outcomes. Their findings indicate that the increase in policy uncertainty in the US equal to the actual increase from 2006 to 2011 had significant negative effects on industrial production and on employment. Effects on industrial production and employment peak at about 10 and 18 months, respectively.

Alexopoulos and Cohen (2009) construct bi-variate and multi-variate VAR models with monthly data for the period of 1962-2008 in order to examine the impact of the two measures of uncertainty (their newspaper measure and Bloom's (2009) stock market volatility index on cyclical fluctuations in industrial production, employment, unemployment, labor productivity, consumption, and investment in the US. They present evidence that an unanticipated rise in uncertainty leads to sharp and short-lived recessions. Industrial production, employment, productivity, consumption and investment fall, while unemployment rises in response to uncertainty shocks.

Bachman et al. (2013) examine effects of survey based measures of uncertainty on economic activity in Germany and the U.S. through structural vector autoregressions. Their baseline VARs are bivariate, containing a measure of uncertainty and an indicator of economic activity. They provide evidence that a surprise movement in the uncertainty leads to a significant fall in production and employment in both Germany and the U.S. In Germany, production falls and recovers fast after a rise in uncertainty, broadly in line with the "wait and see" dynamics. The impact of uncertainty on the economic activity in the US is more prolonged and larger with no evidence of a significant rebound or overshooting. They argue that this suggests the importance of other channels (e.g. financial frictions) proposed in the literature.

Arslan et al. (2011) examine the relationship between uncertainty and economic activity in Turkey. Using aggregate uncertainty formed by survey based data, they show that a one standard deviation rise in uncertainty leads to a 0.5 percent decline in industrial production after five months. They also estimate an ordered probit model to examine the effect of uncertainty on firm's investment decisions. The findings show that elevated uncertainty (more expectation errors) increases the likelihood of postponing new investment decisions.

Stock and Watson (2012) investigated macroeconomic dynamics of 2007-2009 recession in the US and the weak recovery afterwards using a dynamic factor model. They take into account six shocks: to oil markets, productivity, liquidity, uncertainty, fiscal policy and financial risk. They find that the recession of 2007-2009 was the result of shocks originated mainly from financial upheaval and elevated uncertainty. Their results also show that slow recovery from the recession is attributable to these shocks to some extent, but most of the weak recovery in employment and almost all of that in output results from secular slowdown in trend labor force growth.

Quantifying the economic impact of uncertainty shocks in the UK through a VAR analysis for data that span the recent Great Recession period, Denis and Kannan (2013) find that uncertainty shocks have a significant impact on economic activity in the UK, depressing industrial production and GDP. Contrasting with the general view, their results also show that unemployment is unresponsive to uncertainty shocks. They think that this may be due to the relatively large employment in the public sector or the trend decline in the UK's unemployment rate over the sample period.

Jurado et al (2015) estimate an eleven-variable recursively ordered macro VAR. Their model contains industrial production, employment, consumption, PCE deflator, new orders, wage hours, federal funds rate, S&P 500 Index, M2 and uncertainty. Uncertainty shocks sharply depress production and employment, with prolonged effects of more than 60 months. There is no evidence of a strong recovery and overshooting, different from Bloom (2009), but consistent with Bachman et al. (2013). They point out that uncertainty shocks explain up to 29 percent of the forecast error variance in industrial production, subject to the VAR forecast horizon. Shocks to fed funds rate account (representing monetary policy shock) account for the same amount of forecast variance.

Rossi and Sekhposyan (2015) estimate a six-variable recursively ordered VAR in order to evaluate the effect of uncertainty on US economy. The model includes GDP, employment, Fed funds rate, stock prices, uncertainty index and a deterministic trend. Their overall uncertainty measure only slightly influences output. They also explore the effects of downside and upside uncertainty. They find that the effect of the downside uncertainty on

output is greater than the overall index. The upside uncertainty index also makes significant macroeconomic effects.

On the other hand, in the aftermath of the 2008/2009 global financial crisis, distortions in financial markets are also explored as a potential mechanism that generates the link between uncertainty and macroeconomic outcomes (Gilchrist et al., 2013). They point out that fluctuations in uncertainty can have a large effect on aggregate investment and this occurs largely through changes in credit spreads. An increase in uncertainty generates a widening of credit spreads, implying an increase in the cost of capital. This induces firms to reduce capital expenditures and delever at the same time. They show that movements in corporate bond credit spreads are a significant part of the uncertainty-investment relation.

Arellano et al. (2012) construct a general equilibrium model where increases in firm level uncertainty interact with financial frictions that produce a downturn in economic activity and a large increase in the dispersion of growth rates across firms. They find that the model can explain about 67% of the fall in output and 73% of the drop in employment observed during the Great Recession of 2007/2009.

Bonciani and Roye (2015) examine the effect of uncertainty shocks on macroeconomic aggregates with financial frictions in the banking sector by utilizing a Dynamic Stochastic General Equilibrium (DSGE) model. They show that macroeconomic aggregates in the euro area react more negatively to uncertainty shocks under these frictions and shocks become more persistent.

More recently, Popp and Zhang (2015) estimate the impact of uncertainty shocks and the role of the financial transmission channel using a smooth-transition factor-augmented vector-autoregression model in the US. Their findings suggest that a rise in uncertainty has negative effects on the real economy and financial markets, with larger effects during recessions. They also show the financial channel is significant in the transmission of uncertainty shocks, with a larger role in times of recessions and in the short run.

Gulen and Ion (2013) explore how corporate investment is influenced by the uncertainty related to future policy and regulatory outcomes, deploying the policy uncertainty index of

Baker et al. (2012)[35]. They find a negative relation between policy uncertainty and capital investments at both the firm and industry level. Their estimates suggest that rise in policy uncertainty that occurred during the 2007-2009 crisis may be accountable for up to two thirds of the 32% fall in capital investments registered in the same period. The two mechanisms through which uncertainty works are investment irreversibility and financial frictions.

Some studies investigate the impact of uncertainty on variables related to monetary policy and transmission of monetary policy. For example, Istrefi and Piloiu (2014) examine the effects of policy uncertainty, as quantified by Baker et al. (2012), on inflation expectations in the U.S. and the euro area. Using a Bayesian VAR model, they show that the effect of a shock in the EPU index differs depending on the horizon of the inflation expectations: while an uncertainty shock tends to reduce short-term inflation expectations, it leads to an increase in long-term expectations. Aastveit et al. (2013) examine how economic uncertainty alters the macroeconomic influence of monetary policy shocks in the U.S., Canada, the UK and Norway through interacted structural VAR model and find that monetary policy is less effective during periods of high uncertainty.

Leduc and Liu (2015) estimate two different Bayesian VARs, using VIX and a new survey-based measure[36] to examine the effects of uncertainty shocks. Their models include a measure of uncertainty, unemployment rate, CPI and three-month Treasury bills rate. They find similar results from both models. They present evidence that uncertainty shocks act like aggregate demand shocks, leading to a persistent increase in unemployment, and falls in inflation and the nominal interest rate. In contrast, Redl (2015) finds that uncertainty shocks are inflationary for South Africa. His findings also show that uncertainty shocks leads to drops in activity, altogether providing evidence against the view that uncertainty shocks behave like aggregate demand shocks.

International transmission of uncertainty shocks is also explored in some studies. Gauvin et al. (2014) investigate whether macroeconomic policy uncertainty in the U.S. or the European Union (EU) spilled over to emerging market economies via cross border capital

[35] Updated version is provided by Baker et al. (2013).
[36] As a measure of perceived uncertainty, they use responses of consumers to questions that have direct reference to uncertainty.

flows. They show that increases in US policy uncertainty decrease both bond and equity inflows into EMEs. On the other hand, increases in EU policy uncertainty decrease bond inflows, but increase equity inflows.

Mumtaz and Theodoridis (2012) examine the transmission of uncertainty associated with US GDP growth to the UK using a structural VAR model. They find that GDP growth declines by 0.1% and CPI inflation rises by 0.1% in the UK in response to a one standard deviation increase in volatility of US GDP growth. The responses of US GDP growth and inflation to the same shock seem similar. The transmission channel of this shock is investigated through a DSGE model. Simulations suggest that shocks that produce marginal cost uncertainty (e.g a wage mark-up and productivity shocks) in the foreign economy could give rise to VAR responses obtained.

Colombo (2013) investigates the effects of US economic policy uncertainty shocks on some euro area macroeconomic aggregates for the period of January 1999 and June 2008 via structural VAR. She concludes that US economic policy uncertainty shock leads to fall in European industrial production and prices. One of the possible reasons is that following an increase in uncertainty both households and firms delay their consumption and investment decisions due to precautionary savings-motive and a rise in the option-value of waiting, respectively.

Klossner and Sekkel (2014) investigate the spillovers of economic policy uncertainty for six developed countries, namely Canada, France, Germany, Italy, the U.S. and the UK. They particularly focus on how policy uncertainty in one country affects uncertainty in the others by a VAR analysis. Their findings indicate that shocks originating in other countries account for around 35% of the volatility of the policy uncertainty in other countries. This share increases in the financial crisis period. They also show that the UK and the U.S. are net exporters of policy uncertainty shocks since the financial crisis, while the other countries are receiving policy uncertainty shocks.

Carriere-Swallow and Cespedes (2013) examine the impact of uncertainty shocks in the US on investment and private consumption in forty countries using an open-economy VAR approach. Their findings suggest heterogeneity of responses across countries in the sense

that emerging countries experience greater falls in investment and consumption after uncertainty shocks, recover in a longer time compared to developed countries and do not have a following overshoot in activity. They show that the dynamics of investment and consumption are correlated with the depth of financial markets such that in emerging economies with less developed markets, the credit channel is key to understanding the increased fall in investment due to uncertainty shocks.

Fernandez-Villaverde et al. (2009) investigate effects of volatility in borrowing rates of four small open emerging economies (Argentina, Ecuador, Venezuela, and Brazil) on output, consumption, investment, and hours worked. They find that a rise in interest rate volatility generates a fall in output, consumption, investment, and hours worked, and a noteworthy change in the current account of the economy. They argue that following a domestic uncertainty shock households with precautionary behavior reduces holding of foreign debt since it becomes riskier.

4.2 Quantifying the Effects of Uncertainty on Turkish Economy

4.2.1. Methodology: VAR model

VAR is an econometric model initiated by Sims in 1980 to capture the linear interdependencies among multivariate time series. It consists of estimating a system of equations where every variable is expressed as a function of its own past values and the past values of each variable within the system and an error term. VAR model allows for examination of interdependencies between a set of variables, conditional on the other variables of the model.

A VAR model consists of three variables and of order one, denoted as VAR (1), and a constant would look like:

$$x_t = a_0 + a_1 x_{t-1} + a_2 y_{t-1} + a_2 z_{t-1} + u_1$$

$$y_t = b_0 + b_1 x_{t-1} + b_2 y_{t-1} + a_2 z_{t-1} + u_2$$

$z_t = c_0 + c_1x_{t-1} + b_2y_{t-1} + a_2z_{t-1} + u_3$

with U_{it} ~ i.i.d (0, $\sigma_{u_i}^2$) and Cov ($U_{i,}$ U_j)= 0 where i≠j

In the above model, each variable is a linear function of the lag 1 values for all variables in the set.

In VAR analysis the most important tools to assess how shocks to variables reverberate through a system are impulse responses and forecast error decompositions (variance decompositions). In a VAR model there is no need to set strong identification assumptions, however estimating impulse-response functions and variance decompositions requires identifying restrictions. A priori restriction is needed about the dynamic relationship between variables, for example, x affects y only with a lag.

Impulse responses indicate the response of current and future values of each of the variables in the model to a one unit rise in the current value of one of the VAR errors, with the assumption that this error reverts to zero in the following periods and that all other errors are equal to zero (Stock & Watson, 2001). For a total of n variables in the system, n^2 impulse responses is generated.

An impulse response function is useful in determining the evolution of dynamic effects of one-time shocks on variables in the model, and measuring the persistence of impacts to these shocks (Ajluni, 2005). Accordingly, an impulse response function graph illustrates whether a shock to one variable has a positive or negative impact on another variable (or both) and whether an impact strengthens or lessens over time.

Forecast error variance decompositions show to what extent the proportion of the movements in the dependent variables can be explained by their own shocks, versus shocks to the other variables. A shock to a variable will not only directly influence that variable, but also will convey to all of the other variables through the dynamic structure of the VAR system (Brooks, 2008). Therefore, the variance decomposition describes the relative importance of shocks through time in affecting the variables in the VAR. In practice, it is

usually observed that shocks to own series account for almost all of its forecast error variance at short horizons and smaller proportions at longer horizons (Enders, 2003).

4.2.2. VAR model for Turkey and data set

VAR approach could be particularly employed for generating an exogenous shock to the uncertainty measure and its effect on the macroeconomy, without entirely specifying the underlying structural model. For example, it is possible to introduce an exogenous shock to uncertainty equation and observe its effect on industrial production, conditional on other variables in the model. VAR method has been used to identify the effects of uncertainty on the US economy by Bloom (2009), Baker et. al. (2013), Alexopoulos and Cohen (2009), Knotek II and Khan (2011), Rossi and Sekhposyan (2015) and on the UK economy by Denis and Kannan (2013) and Haddow and Hare (2013).

In this study, a seven-variable VAR model is constructed to estimate the impact of uncertainty shocks on Turkish economy. Monthly data is used for the time span of June 2005-August 2015. Figure 9 plots the data and Table 13 describes the data set with their sources. Industrial production index, consumer price index and consumer confidence index are used in log levels. Credit interest rate and unemployment rate are included in percent. All variables are seasonally adjusted.

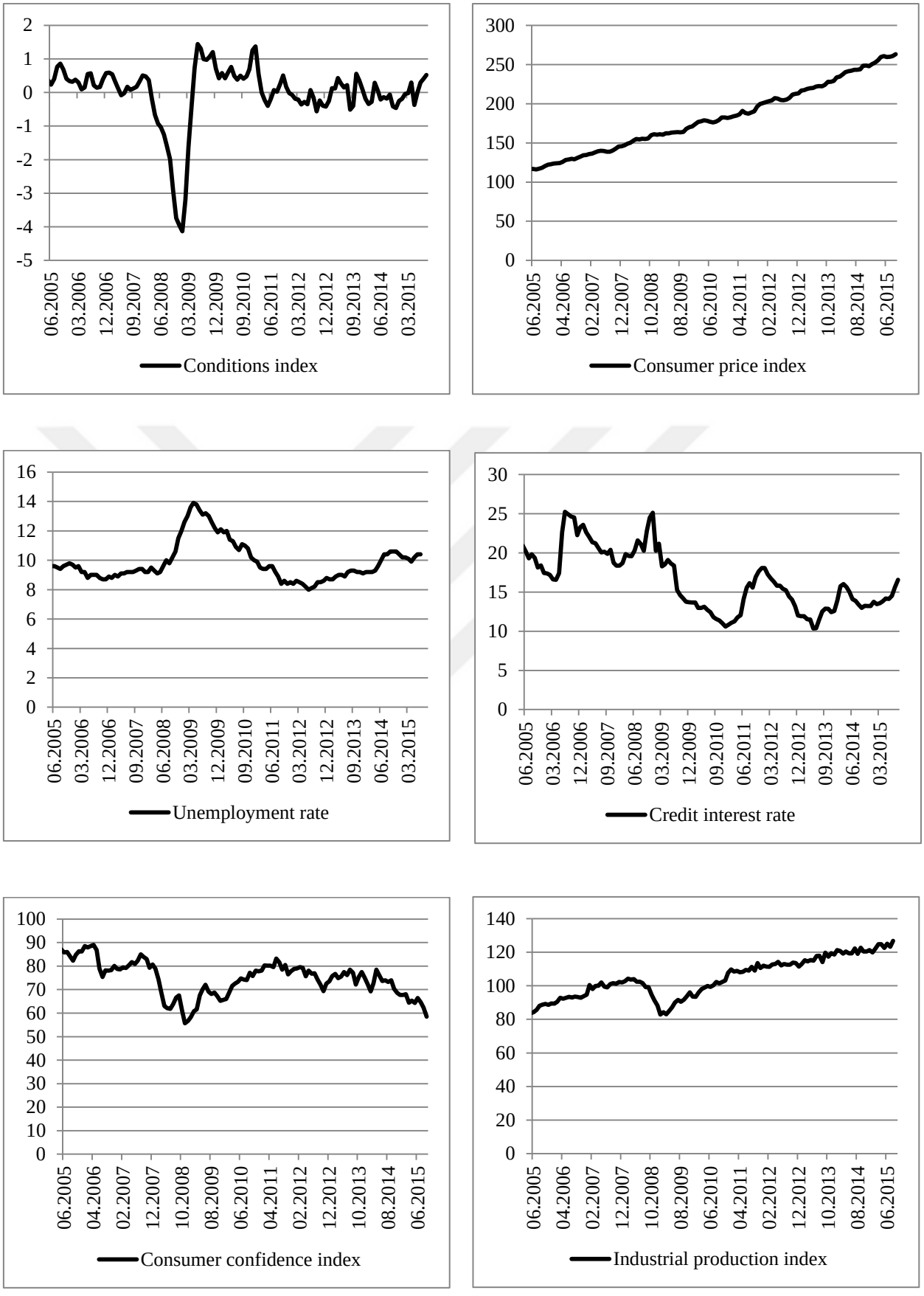


Figure 9 Macroeconomic Variables Used in VAR Model

Table 13 Data Set for VAR Model

Variable	Description	Source
Uncertainty measures	The first PCs from PCA	Own calculations in Chapter 2
Industrial production index	Includes manufacturing industry, mining and quarrying sector and electricity, gas, steam and air conditioning supply	TUIK
Unemployment rate	The ratio of unemployed people within the labor force.	TUIK
Consumer price index	Measures the changes in the retail prices of commodities purchased.	TUIK
Credit interest rate	Weighted average interest of housing, vehicle and personal loans.	Central Bank of Turkey - Electronic Data Delivery System
Consumer confidence index	Composed of four sub-items, namely financial situation expectation, general economic situation expectation, number of people unemployed expectation and the probability of saving over the next 12 months.	TUIK-CBRT
Economic conditions index (BOFA-Merrill Lynch)	Composite indicator of real economic activity	Bloomberg

Industrial production index and unemployment rate are included in the data set to estimate the impact of uncertainty on the real sector. Industrial production index is chosen to proxy economic activity since it is a cyclical indicator in the economy. Consumer price index is added to data set considering that examining the effects on economic activity and inflation together could help better comprehend the transmission mechanism of uncertainty shocks.

Consumer confidence index is used in the analysis as a leading indicator of future consumption, considering the evidence provided in the literature. A number of studies examine the predictive power of consumer confidence for private consumption. A common finding of these studies is that consumer confidence has explanatory power on future consumption expenditures[37].

Economic conditions index is included in the data set to control for the impact of general outlook. Periods of worsening outlook and increased uncertainty may take place simultaneously. Uncertainty increases when the future looks bleaker, so the results may reflect the impact of worsening in the outlook, rather than uncertainty shocks. Using a control variable would help to minimize the possibility that the uncertainty measure is simply grasping a deterioration of the outlook.

Before setting up the VAR model, all variables are HP detrended[38], except economic conditions index and uncertainty measure. Use of HP filter renders variables stationary[39]. Augmented Dickey Fuller (ADF), Dickey-Fuller-GLS (DF-GLS) and Phillips Perron (PP) tests are performed in order to confirm that the series have no unit roots. According to the results reported in Appendix C, all of the series are stationary in levels.

Eviews 8 program is utilized to perform VAR analysis. Following the recent literature, uncertainty is ordered first[40]. Subsequent ordering of the variables also complies with the common practices in the literature. It is based on the assumptions that prices can respond to these shocks immediately but quantities respond in a longer time, similar to Bloom (2009) and Alexopoulos and Cohen (2009).

[37] Karasoy and Yüncüler (2015) show that consumer confidence indices have explanatory power on the future growth of both total consumption and its subcomponents for Turkey. See also: Bram and Ludvigson (1998) for US, Dion (2006) for Euro Area, Acemoglu and Scott (1994) for the United Kingdom, Belessiotis (1996) for France and Kwan and Cotsomitis (2006) for Canada and Golinelli and Parigi (2004) for a cross country comparison.

[38] Bloom (2009), Alexopoulos and Cohen (2009), Knotek II and Khan (2011) and Denis and Kannan (2013) also use HP filter.

[39] The filter separates the trend from the cyclical component of a time series.

[40] For example: Baker et al. (2011; 2013; 2015), Abigail et al. (2013), Denis and Kannan (2013) and Alexopoulos and Cohen (2009), Jurado et al. (2015) and Bachman et al. (2013) ordered uncertainty measures first.

The following ordering of variables in this study suggest that that shocks quickly influence economic conditions and the consumer confidence, then prices (CPI and credit interest rates), and finally quantities (industrial production, unemployment):

1. Uncertainty measure (U)

2. Economic conditions index (ECI)

3. Consumer confidence index (CCI)

4. Consumer price index (CPI)

5. Credit interest rate (INT)

6. Industrial production index (IP)

7. Unemployment rate (UNP)

Shocks are identified with a Cholesky decomposition of the variance–covariance matrix of the residuals. The Cholesky decomposition involves recursive contemporaneous ordering among variables. This means that any variable does not depend contemporaneously on the variables ordered subsequently.

The Cholesky ordering in which uncertainty measure is ordered first implies that the impulse responses to uncertainty shocks have already been purged from the effects of other shocks. That is to say, uncertainty does not respond to macroeconomic shocks in the impact period, but economic conditions, consumer confidence, inflation, the credit interest rate, industrial production and unemployment are allowed to respond to an uncertainty shock.

The set of (seven) equations in the model are depicted below. The appropriate lag length is chosen 3[41]. The current values of each variable (at time *t*), on the left-hand side, depends on the first three lags of itself and all other variables (observed values at time *t*–1, *t*–2 and t-3), plus a contemporaneous shock, ε_t:

$$\begin{bmatrix} U_t \\ ECI_t \\ CCI_t \\ CPI_t \\ INTt_t \\ IP_t \\ UNP_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} U_{t-1} \\ ECI_{t-1} \\ CCI_{t-1} \\ CPI_{t-1} \\ INT_{t-1} \\ IP_{t-1} \\ UNP_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} U_{t-2} \\ ECI_{t-2} \\ CCI_{t-2} \\ CPI_{t-2} \\ INT_{t-2} \\ IP_{t-2} \\ UNP_{t-2} \end{bmatrix} + A_3 \begin{bmatrix} U_{t-3} \\ ECI_{t-3} \\ CCI_{t-3} \\ CPI_{t-3} \\ INT_{t-3} \\ IP_{t-3} \\ UNP_{t-3} \end{bmatrix} + \varepsilon_t$$

where A_0 is a (7×1) vector of constants, A_1, A_2 are (7×7) coefficient matrices and ε_t implies noise residuals.

4.2.3. Empirical results

Figure 10 plots impulse response functions of variables to a 1 standard deviation uncertainty shock along with error bands. Consistent with the literature, it is found that elevated uncertainty has a negative impact on output and unemployment in Turkey. The impulse responses suggest that firms postpone production and hiring new workers until they gain more certain expectations about future situation of the economy to avoid sunk costs from excess capacity or from labor input.

The maximum effect for industrial production takes place in 6 months after the shock, while the response becomes statistically negligible after about 18 months. The maximum impact on unemployment occurs 2 months later and the effect of the shock unwinds after 20 months. There is no overshooting in impulse responses of both series.

[41] Schwarz information criterion (SC) and final prediction error (FPE) suggest a model with one and two lags, while sequential modified LR test statistic and Akaike information criterion (AIC) select a model with seven and twelve lags, respectively. The proper lag length is chosen as 3 because it is the minimum lag sufficient to eliminate serial correlation and heteroscedasticity in the residuals. The results reported in Appendix D reveal that the residuals do not display any serial correlation, and are homoscedastic.

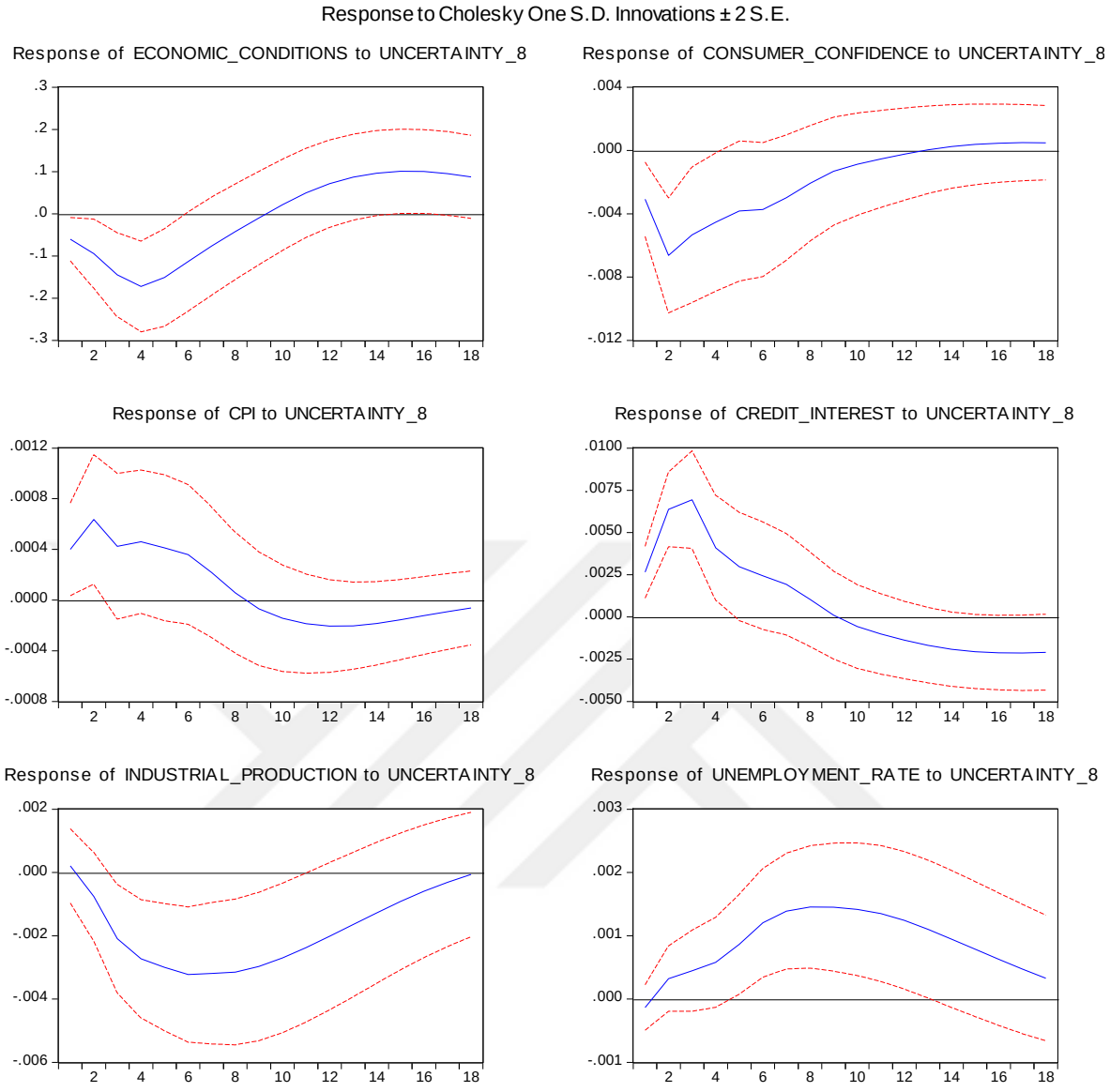


Figure 10 Impulse Responses to Uncertainty Shock (The Baseline VAR)

Responses of credit interest rate to uncertainty shocks in Figure 10 imply that that the financial channel is also important in the transmission of uncertainty shocks as the borrowing costs rise for households. Meanwhile, consumer confidence also deteriorates. Impulse responses in Figure 10 illustrate that credit interest rate and consumer confidence responds and returns to trend faster than industrial production and unemployment. The response of consumer confidence bottoms out in 2 months and fades away in 12-13 months. Uncertainty shocks put upward pressure on credit interest rate for 3 months, and the effect dies down in 9 months. After 9 months the impact moves to negative territory.

The results that consumer confidence is affected by uncertainty may unveil an extra transmission mechanism in times of distress, namely confidence channel, with the insight that households' consumption and saving decisions are sensitive to the uncertainty as it affects income prospects.

As depicted in Figure 10 an uncertainty shock leads to a slight increase in inflation in 2 months. The duration of the response to the uncertainty shock lasts for 8 months. If this analysis was done for an advanced country, one may expect a positive uncertainty shock to act like a negative aggregate demand shock that leads to increases in unemployment and declines in inflation. For example, Leduc and Lieu (2015) find that an uncertainty shock in the US leads to a rise in unemployment and a fall in inflation.

The rise in inflation in Turkey following an uncertainty shock may be due to worsening in inflation expectations because of the past history of high and chronic inflation in Turkey. On the other hand, amid heightened uncertainty, countries with large external financing needs, such as Turkey, experiences capital flight and currency depreciation. Therefore, another reason behind the increase in inflation in response to an uncertainty shocks may be capital reversal that may exert downward pressure on Turkish lira.

In the case of Turkey, the effects of uncertainty shocks seem to be similar to a fall in aggregate supply. It is known that a fall in aggregate supply reduces economic activity and puts upward pressure on inflation. Policymakers face a tradeoff between output and price stability when dealing with supply side shocks, unlike demand shocks, which affect output and inflation in the same direction, thereby simplify somewhat the policy response.
The forecast error variance decompositions of the industrial production index and unemployment rate provide further evidence about the uncertainty's role in explaining fluctuations in both series. Figure 11 plots the variance in forecast errors explained by uncertainty shocks for industrial production and unemployment over 36 months. Innovations in the uncertainty explain about 25 percent and 26 percent of the variance in the production and unemployment forecast errors, respectively.

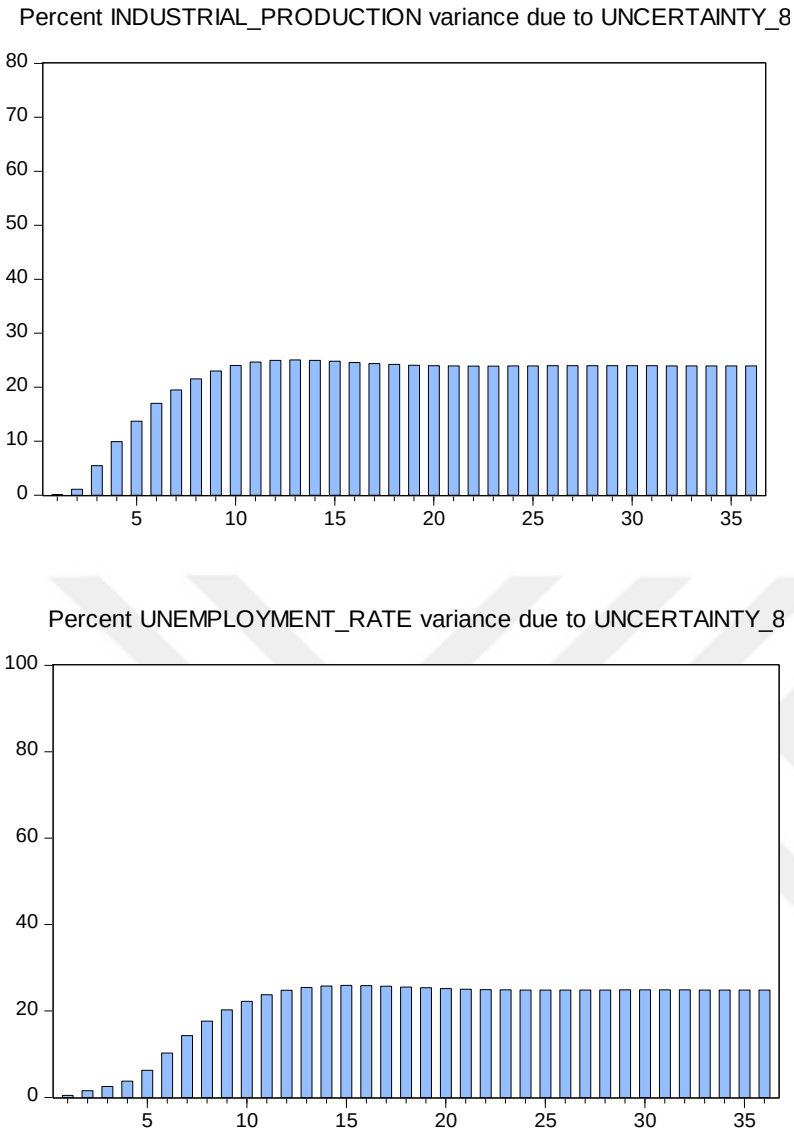


Figure 11 The Forecast Error Variance Decompositions (Industrial Production and Unemployment)

As depicted in Figure 12 changes in the uncertainty explain about 30 percent and 17 percent of the variance in the credit interest rate and consumer confidence forecast errors, respectively.

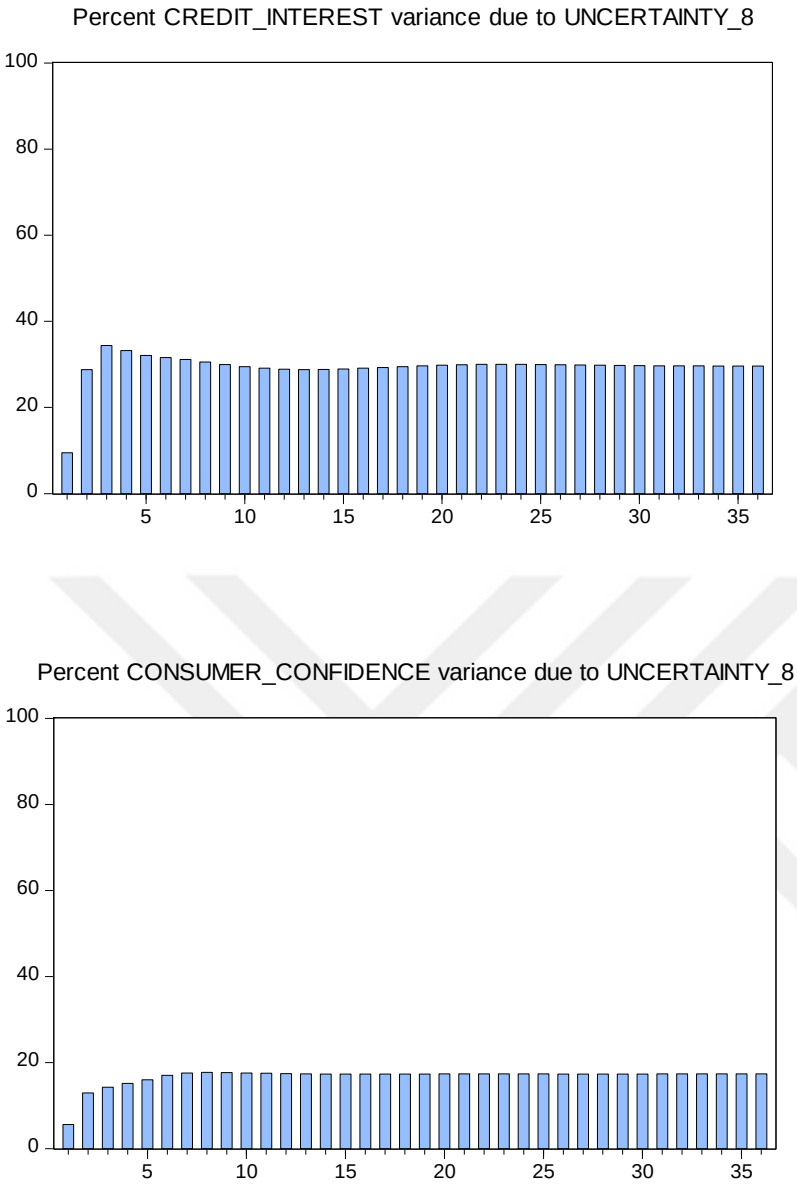


Figure 12 The Forecast Error Variance Decompositions (Credit Interest Rate and Consumer Confidence)

On the other hand, changes in the uncertainty explain 10 percent and 15-18 percent of the variance in the CPI (Figure 13) and economic conditions (Figure 14) forecast errors.

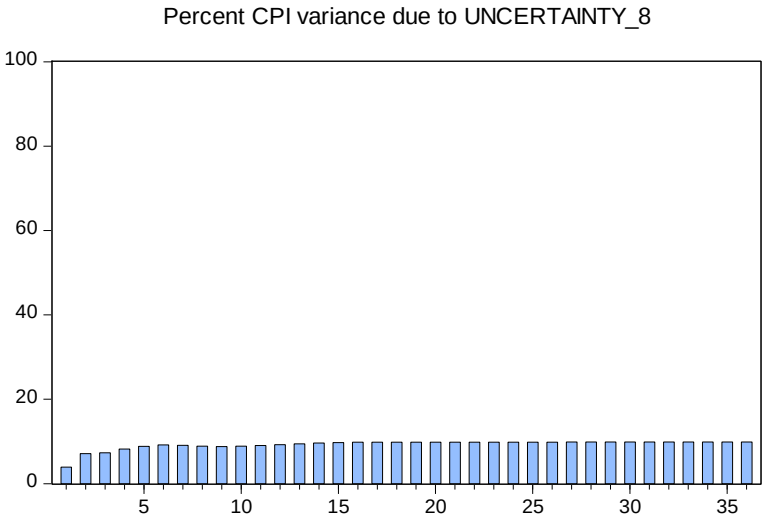


Figure 13 The Forecast Error Variance Decompositions (CPI)

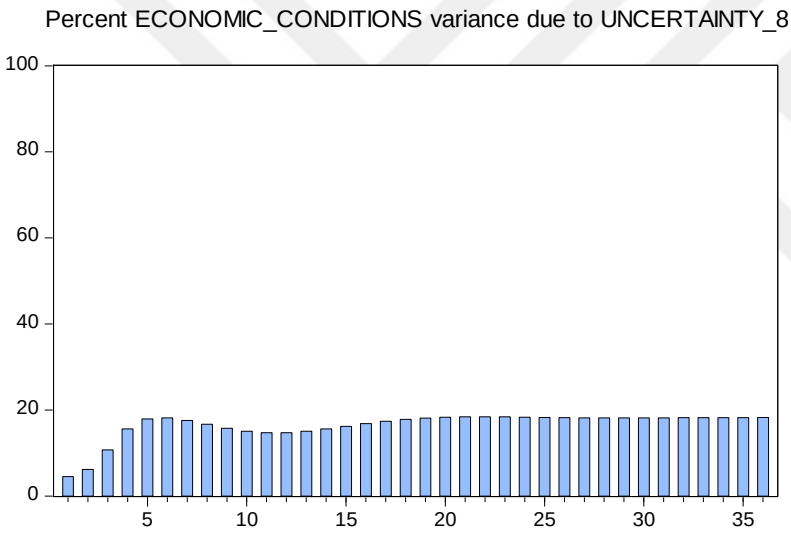


Figure 14 The Forecast Error Variance Decompositions (Economic Conditions)

Overall, forecast error decompositions suggest that uncertainty has an important role in describing the variations in credit interest rates, unemployment rate, industrial production, consumer confidence, economic conditions and inflation in order of significance. The results hold for a 36 month horizon.

4.2.4 Robustness Checks

Four robustness checks are performed through an alternative ordering of measures, using an alternative measure of uncertainty, deleting the control variable from the model and shortening the sample period to cover the aftermath of 2008/2009 global financial crisis.

First, the VAR model is estimated with uncertainty measure ordered last in order to examine the sensitivity of the results to the Cholesky ordering of variables. With this ordering, the measure of uncertainty is allowed to respond to all contemporaneous macroeconomic shocks. By placing uncertainty at the end of the Cholesky ordering, more conservative estimates for the effect of uncertainty shocks is obtained.

Figure 15 presents the impulse responses in the VAR model with uncertainty ordered last. The shapes of the responses of the six macroeconomic variables to an uncertainty shock ordered last look similar to those in the baseline VAR with uncertainty ordered first, while the estimated magnitude of the impact weakens slightly. However, the differences between the impulse responses of the baseline model and the model with alternative ordering are not large.

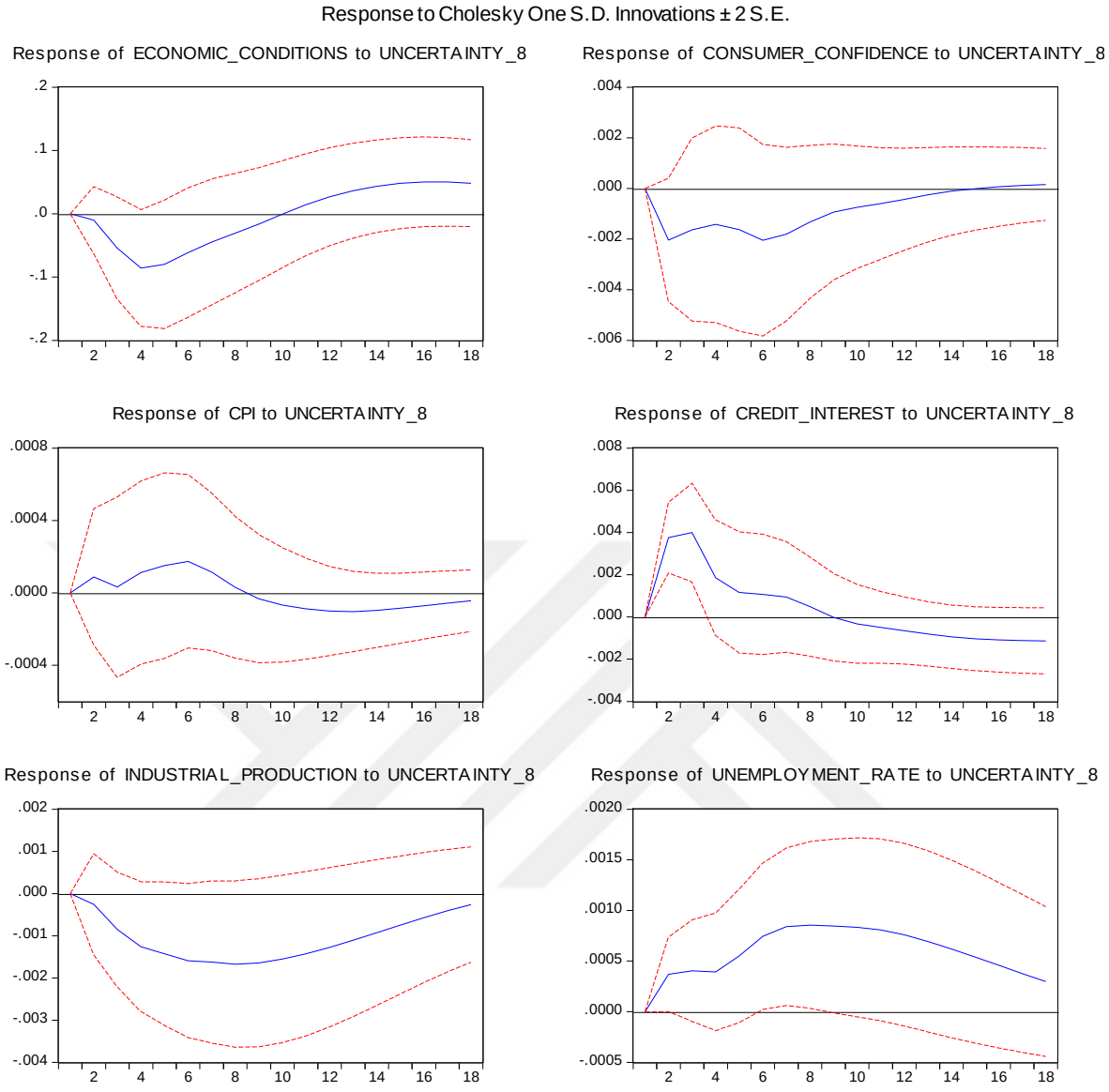


Figure 15 Impulse Responses (Uncertainty Ordered Last)

Second, VAR model is estimated with 5-variable uncertainty instead of 8-variable uncertainty. As Figure 16 depicts, the shapes of the responses are similar to that of the baseline VAR model in Figure 15.

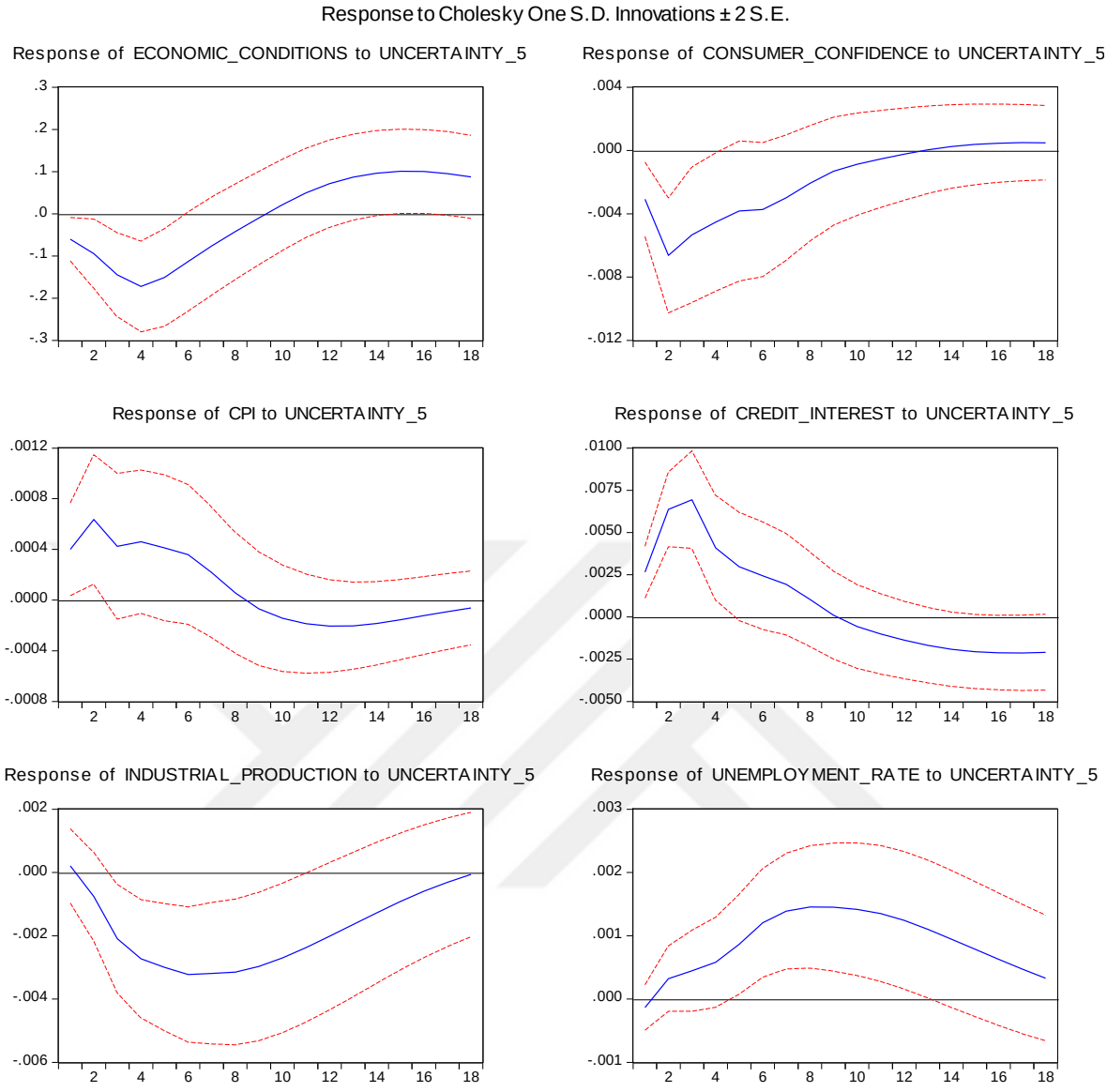


Figure 16 Impulse Responses (Alternative Uncertainty Measure)

Third, economic conditions index, which is included as a control variable in the baseline VAR model, is removed from analysis. Impulse responses of 6-variable VAR (Figure 17) are qualitatively similar to the baseline VAR, suggesting that the macroeconomic effects of uncertainty shocks do not seem to simply capture responses of variables to changes in economic outlook. This confirms outcome of the variance decomposition in the baseline VAR, which shows that the economic conditions explain only about 3-4 percent of the variance in the uncertainty forecast errors (Figure 18).

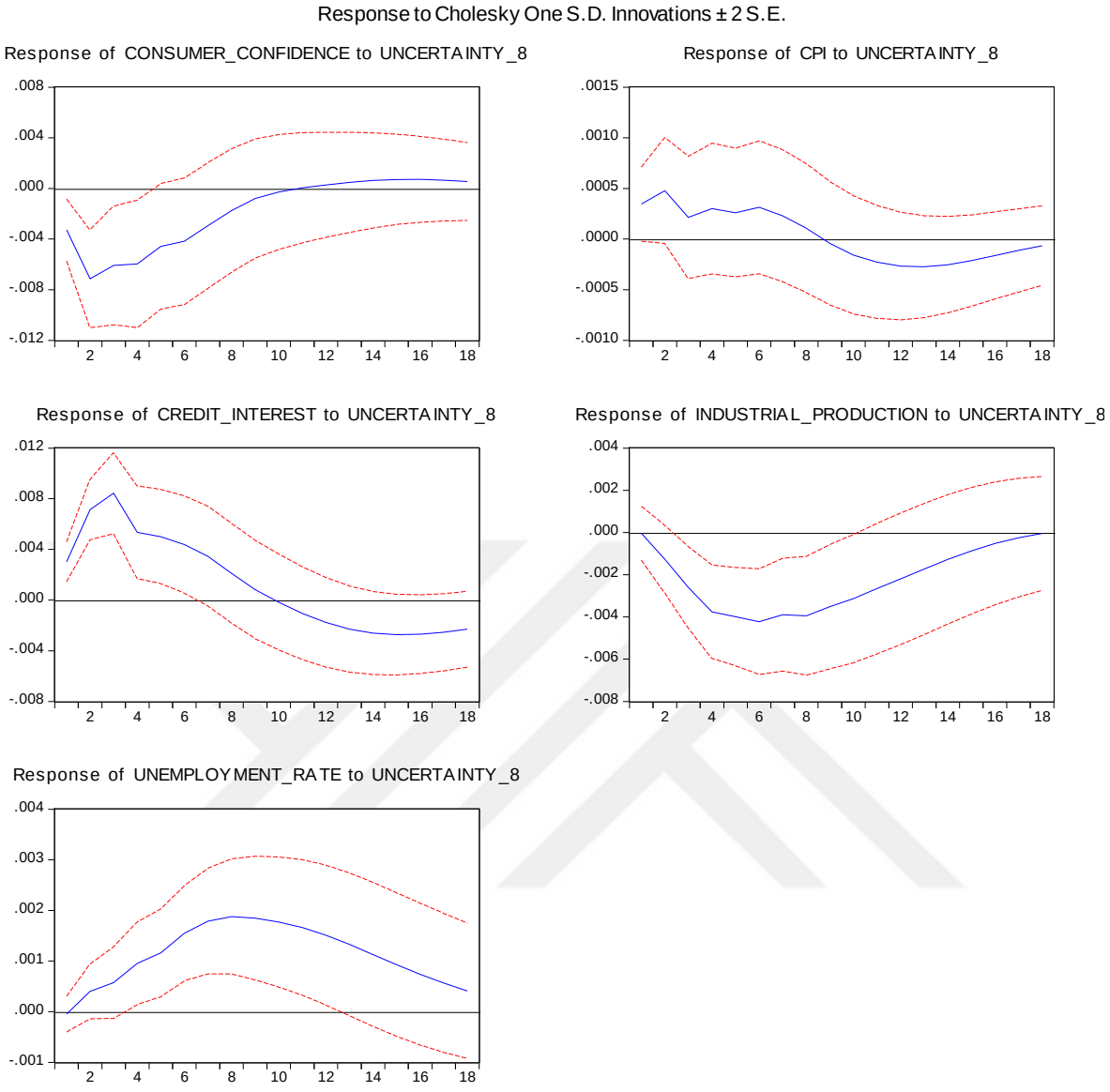


Figure 17 Impulse Responses (Without Control Variable)

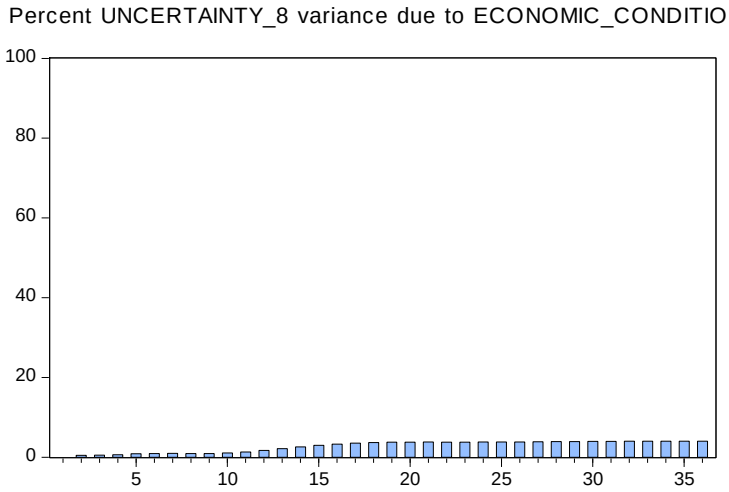


Figure 18 The Forecast Error Variance Decompositions (Uncertainty)

Fourth, the sample period is changed as January 2008- August 2015 to cover the global financial crisis. In doing so, it is aimed to capture the effects of uncertainty generated by the global crisis, which has a different nature than previous ones. The impulse responses (Figure 19) follow a similar path to the baseline VAR.

All in all, a series of checks with a different ordering of variables, an alternative uncertainty measure, a shorter variable set omitting the control variable and a shorter sample period that starts from January 2008 confirm the robustness of results.

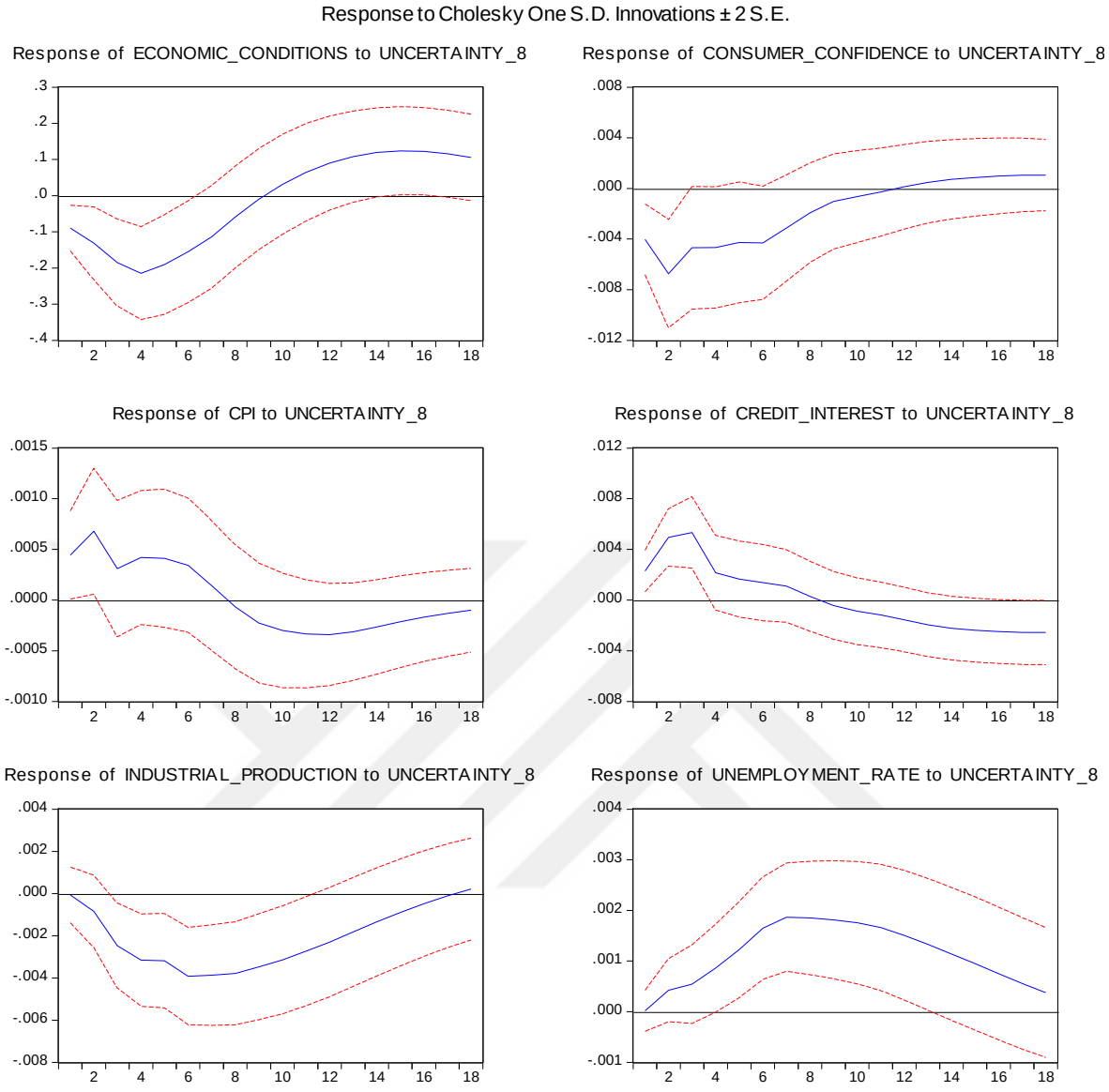


Figure 19 Impulse Responses (Shortened Sample Period)

4.3 Summary

The 2008/2009 global financial crisis has rekindled the discussion on the impact of uncertainty on the economy. There are several different channels through which higher uncertainty might affect the economy.

This chapter first reviewed the literature on impacts of uncertainty on the economy. The studies in the literature suggest that both in developed and emerging countries, the impacts of uncertainty on the economy are potentially widespread. In the second part, VAR system

is explained before constructing a VAR model for Turkey. In the third part, a VAR model for Turkey is specified including variables namely, uncertainty, economic conditions, unemployment industrial production, CPI, credit interest rate, and consumer confidence. Uncertainty is ordered first in the baseline model.

Results of the model show that an uncertainty shock leads to a rise in unemployment, fall in industrial production, and increases in inflation and credit interest rate together with worsening in consumer confidence in Turkey.

CHAPTER 5

CONCLUSION

Uncertainty is a broad concept, incorporating the uncertainty in the minds of market participants, managers, households and policymakers about possible futures. It is also a wide ranging concept from macro and micro phenomena to non-economic incidents (Bloom, 2014). As underlined by Knight (1921), in the presence of uncertainty it is impossible to assign probabilities to events because the relevant instances are so irregular, unique or intrinsically variable that prevents grouping and calculation of chances.

2008/2009 global financial crisis has highlighted that real world is permeated by complexity and uncertainty. New financial instruments and derivative structures behind the growth in credit markets were complex (Caballero, 2009). The complexity and lack of history fulfilled the preconditions for uncertainty, particularly Knightian in nature. Absence of full knowledge also underlined the epistemic characteristic of uncertainty. Following the defaults in subprime mortgages in the U.S. investors were concerned about the valuation of the other credit products that had been structured similarly as subprime mortgages. The result was rampant uncertainty, a freezing up across the whole credit market and subsequent defaults of financial institutions. While recovering from a prolonged and deep crisis, a number of challenges have arisen due to evolutions in the structure of the economy caused by the crisis, leading to increased uncertainty. In this process, policy makers and economists have repeatedly claimed that heightened uncertainty holds back the economic recovery (Kocherlakota, 2010). All in all, uncertainty has been highlighted as one of the drivers of global financial crisis and causes of slow recovery afterwards. This has reignited interest to measuring uncertainty and quantifying its effect on the macroeconomy.

Measuring uncertainty is a challenging exercise given its unobservable nature, therefore studies rely on the proxies, which could be divided into four categories: i) Measures based on volatility of indicators, ii) Measures based on surveys, iii) Measures based on frequency of keywords in newspapers and iv) Measures based on common variability of several indicators. Overall, these proxies present a few facts about uncertainty. First, uncertainty measures are not flawless as they reflect specific aspects or sources of uncertainty; however they provide a beneficial steer about the uncertainty in the economy. Second, uncertainty is countercyclical, which means that it increases in downturns and decreases in expansions. Third, uncertainty is higher in the emerging and developing economies than the advanced economies.

In the third chapter, PCA, which belongs to above-mentioned fourth category, is performed in order to form uncertainty measures for Turkey since it is useful in identifying patterns in data and compressing the data without much loss of information. It also enables to summarize underlying common information within several indicators that leads to a more succinct representation of uncertainty. Two uncertainty measures (with 8-variables and 5-variables) are constructed by using indicators reflecting realized volatility, implied volatility and dispersion of expectations from Expectations Survey. Indicators considered include BIST100, implied volatility of exchange rate, benchmark interest rate, cross currency swap rate, forward implied yield, interest rate swap, inflation expectations, expected US dollar rate and EMBI-Turkey. These indicators are presumed to reveal the conditions in the three main markets i.e. bond market, foreign exchange market and equity market. In addition, survey based data provides direct insight of respondents about future economic conditions.

In the PCA, if the first few PCs reproduce most of the variation in all of the original variables, then the PCs generate a simpler description of the data than the original variables (Jolliffe, 2002). The results of PCA for Turkey indicate that different uncertainty proxies have a common component that explains a large part of the variations in individual variables. The first principal components from PCA sufficiently capture the common variation of underlying series, and hence could be regarded as uncertainty measures for Turkey. This suggests that there is one (unobserved) shock of the economy that makes proxies co-move.

Uncertainty measures for Turkey highlights four important incidents of uncertainty in the last decade, originating from domestic and international sources or both. These episodes occurred in May 2006 (domestic economic and political issues), October 2008 (collapse of Lehman Brothers), 2011 (Europe crisis), the summer of 2013 (taper tantrum coincided with Gezi events).

In general, uncertainty plays a central role in decision-making in all parts of the economy. Uncertainty is likely to affect the economy through four main channels: i) Demand channel, ii) Supply channel, iii) Financial frictions channel and iv) International spillover channel. It is important to understand the impacts of uncertainty on the economy in order to determine the appropriate policy responses. Several studies have examined the macroeconomic impacts of uncertainty from an empirical perspective. VAR analyses in different forms are widely used in quantifying the impact of uncertainty on the economy.

Fourth chapter documents the dynamic links between uncertainty and macroeconomic variables for Turkey through a 7-variable VAR system for the period of June 2005-August 2015. The baseline VAR consists of uncertainty measure, unemployment rate, industrial production index, CPI, credit interest rate, consumer confidence index and economic conditions index (control variable). The periods of worsening outlook and increased uncertainty may take place simultaneously. Using a control variable would help to minimize the possibility that the uncertainty measure is simply grasping a deterioration of the outlook. Accordingly, economic conditions index is included as a control variable to purge the effects of worsening in the economic outlook on uncertainty shocks.

The VAR model for Turkey confirms most of the stylized facts in the literature concerning the macroeconomic implications of uncertainty shocks. Country specific results emerge from the model as well. The results are robust to a number of checks with respect to different ordering of variables, an alternative uncertainty measure, and a shorter variable set and sample period. The main findings are as follows:

The results seem to be partly consistent with a view that the impact of uncertainty on industrial production and unemployment occurs through a “wait and see” approach. The findings present evidence that when the bout of uncertainty subsides, firms cautiously

increase the pace of production and hiring to meet the recovering demand. Surges in uncertainty make fairly quick and persistent effects on production and employment, consistent with the findings in the literature. The peak impact on industrial production occurs 6 months after the shock and the effect unwinds after about 18 months. This path of the response is almost similar to that of the UK's as evidenced by Dennis and Kannan (2013). The maximum impact on unemployment in Turkey takes place 2 months later than industrial production and the effect the shock wanes after 20 months. One interesting result is that overshoot in the production is not observed. This suggests that on top of the "wait and see" mechanism, other channels of transmission may be at work in shaping the response of the economy to uncertainty shocks.

In the face of uncertainty, financial frictions channel may manifest itself through fall in the demand for or supply of credit, which may lead to a rise in the cost of borrowing. The worsening in the consumer confidence could also affect the real economy through a reduction in consumption expenditures in line with the evidence provided in the literature (Karasoy & Yüncüler, 2015; Bram & Ludvigson, 1998; Ludvigson, 2004; Dion, 2006; Acemoglu & Scott, 1994).

This study finds some support for the financial and confidence channels in the transmission of uncertainty shocks. In response to uncertainty shocks, the cost of credit to households rises and consumer confidence deteriorates. The results suggest that uncertainty pushes up borrowing costs for consumers as banks ask for more compensation against future risks. The effects of uncertainty shocks on the consumer confidence and the credit interest rate have a relatively sharp and short nature compared to their impact on industrial production and unemployment. In response to an uncertainty shock consumer confidence bottoms out in 2 months and the effect of the shock dissipates in 12-13 months. Credit interest rate reaches its peak in 3 months and the effect of the shock fades in 9 months. Future research could explore in detail transmission mechanisms of uncertainty shocks to the economy. A better understanding of these mechanisms would be useful in identifying the appropriate policy response against heightened uncertainty.

On the other hand, CPI slightly increases in response to an uncertainty shock. This is in line with the findings of Redl (2015) who shows that an uncertainty shock leads to a drop

in output and a rise in inflation in South Africa. The path of the CPI's response to uncertainty shock in Turkey is akin to that of the South Africa's, though the former responds earlier. However, some studies, particularly for advanced economies, point out that following an uncertainty shock CPI falls due to a fall in aggregate demand. For example, Leduc and Lieu (2015) present evidence that an uncertainty shock in the US leads to a decrease in inflation. The opposite movement of inflation in Turkey may be due to two reasons: First, long history of high and persistent inflation in Turkey may lead to a rapid deterioration in inflation expectations. Second, in the presence of uncertainty countries with large external financing needs, such as Turkey, face the challenge of capital reversals and currency depreciation. Capital flight and an associated downward pressure on Turkish lira due to uncertainty may be behind the rise in inflation. This suggests that in times of uncertainty exchange rate pass through becomes more effective on inflation rather than a fall in demand in Turkey.

The results present evidence against the argument that uncertainty shocks are prototypical aggregate demand shocks. The impulse responses of production and CPI jointly imply that uncertainty shocks operate via aggregate supply channel in Turkey, tending to depress economic activity, while increasing inflation. A tradeoff between reviving economic activity and achieving price stability arises when handling supply side shocks, unlike demand shocks, which affect output and inflation in the same direction.

Overall, a 7-variable VAR model constructed with a novel measure of uncertainty obtained from PCA documents robust evidence that an uncertainty shock leads to a rise in unemployment, fall in industrial production, increases in inflation and credit interest rate together with worsening in consumer confidence in Turkey. The results points out that measure of uncertainty captures features associated with firms, consumers and financial institutions' cautious behaviors in times of uncertainty.

Forecast error decompositions indicate that uncertainty shocks have an important role explaining the variations in credit interest rates, unemployment rate, industrial production, consumer confidence, economic conditions and inflation in order of significance over a 36 month horizon.

More generally, the results of the analysis suggests that policymakers should be vigilant to an increase in uncertainty even if they believe it does not reflect a deterioration in the macroeconomic fundamentals. In times of stress, delays in action, absence of transparency and overactive steps that elevate the level of uncertainty in the economy could be damaging. A prompt and carefully calibrated response to emerging challenges together with clear communication would help to reduce the effects of uncertainty.

In the case of emerging economies, such as Turkey, where uncertainty can be much higher than in advanced economies, ignoring uncertainty may increase probability of making policy errors significantly. As underlined by Bernanke (2007) policy decisions under uncertainty must take into consideration various possible scenarios about the state or structure of the economy, and those policy decisions may seem quite different from those that would be optimal under certainty. Therefore, incorporating uncertainty into the policy formulation process would be useful to develop the appropriate policy response.

Policymakers should also keep in mind that uncertainty may reduce the response of the economy to stimulative policies because economic agents become more cautious in the presence of uncertainty. This may necessitate more aggressive policy than otherwise in order to stabilize economic activity. Policy stimulus may need to be larger to offset the cautious behavior of economic agents. Measuring uncertainty is important in this regard.

REFERENCES

Aastveit, K. A., Natvik G. J., & Sola, S. (June 2013). Economic uncertainty and the effectiveness of monetary policy. *Norges Bank Research Working Paper,* 17.

Abel, A. B. (1983). Optimal Investment Under Uncertainty. *American Economic Review,* 73, 228-33.

Abel, J., Rich, R., Song J., & Tracy, J. (January 2015). The Measurement and Behavior of Uncertainty: Evidence from the ECB Survey of Professional Forecasters. *Journal of Applied Econometrics.* Retrieved June 1, 2015, from http://onlinelibrary.wiley.com/doi/10.1002/jae.2430/epdf

Acemoglu, D. and A. Scott. 1994. Consumer Confidence and Rational Expectations: Are Agents' Beliefs Consistent with the Theory. *Economic Journal,* 104(422), 1-19.

Ahrend, R., & Schwellnus, C. (2013). Do investors disproportionately shed assets of distant countries during global financial crises?: The role of increased uncertainty. *OECD Journal: Economic Studies,* Vol. 2012/1.

Ajluni J. (June 2005). Notes in Macroeconometrics –Introduction. Retrieved June 11, 2015, from http://www.geocities.ws/j_ajluni/pdf/var.pdf

Alexopoulos, M. & Cohen, J. (2009). Uncertain times, uncertain measures. *University of Toronto Working Paper,* 352. Retrieved May 28, 2015, from http://www.economics.utoronto.ca/public/workingPapers/tecipa-352.pdf

Alexopoulos, M. & Cohen, J. (2015). The Power of Print: Uncertainty shocks, markets, and the economy. *International Review of Economics and Finance.*

Arellano, C., Bai, Y., & Kehoe, P. (March 2012). Financial Markets and Fluctuations in Uncertainty. *Federal Reserve Bank of Minneapolis Research Department Staff Report.* Retrieved June 01, 2015, from http://www.albany.edu/economics/research/seminar/files/Yan%20Bai.pdf

Arrow, K. J. (1951). Alternative approaches to the theory of choice in risk-taking situations. *Econometrica,* 19 (4), 404–437.

Arslan, Y., Atabek, A., Hulagu, T., & Sahinoz, S. (September 2011). Expectation Errors, Uncertainty and Economic Activity. *CBRT Working Paper,* No. 11/17.

Asteriou, D., & Price, S. (2005). Uncertainty, investment and economic growth: evidence from a dynamic panel. *Review of Development Economics,* 9(2), 277–288.

Azad, A.S.M. S., Fang V., & Hung, C. (2012). Linking the interest rate swap markets to the macroeconomic risk: The UK and US evidence. *International Review of Financial Analysis,* 22, 38–47.

Bachmann, R., Elstner, S., & Sims, E. R. (2013). Uncertainty and Economic Activity: Evidence from Business Survey Data. *American Economic Journal: Macroeconomics,* 5(2), 217–249.

Baker, S. R., Bloom, N., & Davis, S. J. (2011, October 10). Measuring Economic Policy Uncertainty. Retrieved February 1, 2015, from http://web.stanford.edu/~nbloom/PolicyUncertainty.pdf

Baker, S. R., Bloom, N., & Davis, S. J. (2013, May 19) Measuring Economic Policy Uncertainty. Retrieved February 21, 2015, from http://www.policyuncertainty.com/media/BakerBloomDavis.pdf

Baker, S. R., Bloom, N., & Davis, S. J. (2015). Measuring Economic Policy Uncertainty. *NBER Working Paper,* 21633.

Bank for International Settlements (BIS). (2008). 78th Annual Report, Basel, Switzerland. Retrieved September 7, 2015, from http://www.bis.org/publ/arpdf/ar2008e.pdf

Basu, S., & Bundick, B. (September 2012). Uncertainty Shocks in a Model of Effective Demand. *NBER Working Paper,* 18420.

Belessiotis, T. (1996). Consumer Confidence and Consumer Spending in France. *European Commission Economics Papers,* 116.

Bernanke, B. S. (1983). Irreversibility, Uncertainty, and Cyclical Investment. *The Quarterly Journal of Economics,* 98(1), 85-106.

Bernanke, B. S. (2008, January 10). Financial Markets, the Economic Outlook, and Monetary Policy. Speech at the Women in Housing and Finance and Exchequer Club Joint Luncheon, Washington, D.C. Retrieved September 9, 2015, from http://www.federalreserve.gov/newsevents/speech/bernanke20080110a.htm

Bernanke, B. S. (2010, September 2). Causes of the Recent Financial and Economic Crisis. Testimony before the Financial Crisis Inquiry Commission, Washington, D.C. Retrieved December 9, 2015, from http://www.federalreserve.gov/newsevents/testimony/bernanke20100902a.htm

Bernanke, Ben S. (2007, October 19). Monetary Policy under Uncertainty. Speech at the 32nd Annual Economic Policy Conference, Federal Reserve Bank of St. Louis. Retrieved September 17, 2015, from http://www.federalreserve.gov/newsevents/speech/bernanke20071019a.htm

Berument, H., Ceylan, N. B. & Olgun, H. (2007). Inflation uncertainty and interest rates: is the Fisher relation universal?. *Applied Economics,* 39, 53–68.

Bloom, N. (May 2009). The Impact of Uncertainty Shocks. *Econometrica*, 77(3), 623–685.

Bloom, N. (Spring 2014). Fluctuations in Uncertainty. *Journal of Economic Perspectives*, 28(2), 153–176.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten I., & Terry, S. J. (December 2014). Really Uncertain Business Cycles. Retrieved August 07, 2015, http://web.stanford.edu/~nbloom/RUBC.pdf

Bloom, N., Kose, M. A., & Terrones, M. E. (March 2013). Held back by uncertainty. *IMF Finance & Development*, 38-41.

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, 31, 307-327.

Bonciani, D. (August 2015). Estimating the effects of uncertainty over the business cycle. *MPRA Paper*, 65921. Retrieved November 05, 2015, from http://mpra.ub.uni-muenchen.de/65921/

Bonciani, D., Van Roye, B. (July 2015). Uncertainty shocks, banking frictions and economic activity. *ECB Working Paper Series*, 1825.

Bram, J. & Ludvigson, S. C. (June 1998). Does Consumer Confidence Forecast Household Expenditure?: A Sentiment Index Horse Race. *FRBNY Economic Policy Review*, 59-78. Retrieved October 30, 2015, from https://www.newyorkfed.org/medialibrary/media/research/epr/98v04n2/9806bram.pdf

Bronk, R. (2011). Epistemological difficulties with neoclassical economics. Conference Paper presented at Southern Economic Association. LSE Research Online.

Brooke, G. T. F. (June 2010). Uncertainty, Profit and Entrepreneurial Action: Frank Knight's Contribution Reconsidered. *Journal of the History of Economic Thought*, 32(02), 221–235.

Brooks, C. (2008). *Introductory Econometrics for Finance*. Cambridge, United Kingdom: Cambridge University Press.

Caballero, R. J. (2009, November 5-6). Sudden Financial Arrest. Paper presented at the 10th Jacques Polak Annual Research Conference Hosted by the International Monetary Fund.

Caballero, R. J., & Krishnamurthy, A. (February 2008). Musical chairs: a comment on the credit crisis. *Banque de France, Financial Stability Review, Special Issue Liquidity, No. 11*.

Caggiano, G., Castelnuovo, E., & Groshenny, N. (2014). Uncertainty shocks and unemployment dynamics in U.S. recessions. *Journal of Monetary Economics*, 67, 78-92.

Camerer, C., & Weber, M. (1992) Recent Developments in Modeling Preferences: Uncertainty and Ambiguity. *Journal of Risk and Uncertainty*, 5, 325-370.

Carney, M. (2012, October 15). Uncertainty and the Global Recovery. Remarks at Vancouver Island Economic Alliance Nanaimo, British Columbia. Retrieved June 1, 2015, from http://www.bankofcanada.ca/wp-content/uploads/2012/10/remarks-151012.pdf

Carriere-Swallow, Y., & Cespedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. *Journal of International Economics*, 90, 316-325.

Carroll, C. D. (October 1996). Buffer Stock Savings and the Life Cycle/Permanent Income Hypothesis. *NBER Working Paper*, 5788.

Cesa-Bianchi, A. M., Pesaran, H., & Rebucci A. (2014). Uncertainty and Economic Activity: A Global Perspective. Center for Applied Financial Economics (CAFE).

Cevik, E. I. & Dibooglu, S., & Kenc, T. (2013). Measuring financial stress in Turkey. *Journal of Policy Modeling*, 35, 370–383.

Chang, B. Y. & Feunou, B. (Spring 2014). Measuring Uncertainty in Monetary Policy Using Realized and Implied Volatility. *Bank of Canada Review 37*.

Chicago Board Options Exchange (CBOE). S&P 100 Volatility Index-VXO. Retrieved July 25, 2015, from http://www.cboe.com/micro/vix-and-volatility.aspx.http://www.cboe.com/micro/vxo/.

Chicago Board Options Exchange (CBOE). VIX Index & Volatility. Retrieved July 25, 2015, from http://www.cboe.com/micro/vix-and-volatility.aspx.

Colombo, V. (2013). Economic policy uncertainty in the US: Does it matter for the Euro area?. *Economics Letters*, 121 39–42.

Conflitti, C. (2011). Measuring Uncertainty and Disagreement in the European Survey of Professional Forecasters. *OECD Journal: Journal of Business Cycle Measurement and Analysis*, 2.

Creal, D. D., & Wu J. C. (2014).Term Structure of Interest Rate Volatility and Macroeconomic Uncertainty. Unpublished. Retrieved February 11, 2015, from http://faculty.chicagobooth.edu/drew.creal/research/papers/crealWu2013_sv.pdf

Crocco, M. (2002). The concept of degrees of uncertainty in Keynes, Shackle, and Davidson. *Nova Economia, Economics Department, Universidade Federal de Minas Gerais (Brazil)*, 12(2), 11-28.

Davidson, P. (Summer, 1996). Reality and Economic Theory. *Journal of Post Keynesian Economics*, 18(4), 479-508.

Davis, J. (Spring 2010). Uncertainty and Identity: A Post Keynesian Approach. *Erasmus Journal for Philosophy and Economics*, 3(1), 33-49.

Denis, S., & Kannan, P. (2013). The Impact of Uncertainty Shocks on the UK Economy. IMF Working Paper, *13/66*.

Dequech, D. (2003). Uncertainty and Economic Sociology - A Preliminary Discussion. *American Journal of Economics and Sociology, Inc.*, 509-532.

Dequech, D. (2006). The new institutional economics and the theory of behaviour under uncertainty. *Journal of Economic Behavior & Organization*, 59, 109–131.

Dequech, D. (2008). Varieties of uncertainty: a survey of the economic literature.

Dequech, D. (September 1997). Uncertainty in a Strong Sense: Meaning and Sources. *Economic Issues*, 2(2), 21-43.

Dequech, D. (September 2011). Uncertainty: A Typology and Refinements of Existing Concepts. *Journal of Economic Issues*, XLV(3), 621-640.

Der Kiureghian, A., & Ditlevsen, O. (2007, March 26-27). Aleatory or epistemic? Does it matter?. Special Workshop on Risk Acceptance and Risk Communication Stanford University. Retrieved August 2, 2015, from http://www.ripid.ethz.ch/Paper/DerKiureghian_paper.pdf

Dion, D. P. (2006). Does Consumer Confidence Forecast Household Spending? The Euro Area Case. *MPRA Paper*, 911. Retrieved October 13, 2015, from https://mpra.ub.uni-muenchen.de/911/1/MPRA_paper_911.pdf

Dixit, A, & Pindyck, R. (1994). *Investment Under Uncertainty*. Princeton, New Jersey: Princeton University Press.

Dosi, G., & Egidi, M. (1991). Substantive and Procedural Uncertainty – an Exploration of Economic Behaviour in Changing Environments. *Journal of Evolutionary Economics*, 1, 145-168.

Dzielinski, M.. (2012). Measuring economic uncertainty and its impact on the stock market. *Finance Research Letters*, 9, 167–175.

Emmett, R. B. (2002). William B. Greer, Ethics and Uncertainty: The Economics of John M. Keynes and Frank H. Knight. *Journal of the History of Economic Thought*, 24, 374-376.

Emmett, R. B. (2008). Annotated Bibliography of Frank Knight. Liberty Fund, Inc. Retrieved July 09, 2015, from http://www.econlib.org/cgi-bin/printarticle2.pl?file=Knight/KnightBib.html

Enders, W. (2003). *Applied Econometric Time Series.* New York: John Wiley and Sons Inc.

Engle, R. F. (1982). Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4), 987-1007.

European Commission. (2009). Economic Crisis in Europe: Causes, Consequences and Responses. *The European Economy Series 7*. Retrieved August 1, 2015, from http://ec.europa.eu/economy_finance/publications/publication15887_en.pdf

Federal Reserve System (FED). (2008, October 28-29). Minutes of the Federal Open Market Committee Meeting. Retrieved June 23, 2015, from http://www.federalreserve.gov/monetarypolicy/files/fomcminutes20081029.pdf

Feduzi, A. (2007). On the relationship between Keynes's conception of evidential weight and the Ellsberg paradox. *Journal of Economic Psychology*, 28, 545–565.

Feeney, G. J. & Hester D. D. (1964). Stock market indices: a principal components analysis. *Cowles Foundation for Research in Economics Discussion Paper,* 175. Retrieved June 23, 2015, from http://econpapers.repec.org/paper/cwlcwldpp/175.htm

Fernandez-Villaverde J., Guerrón-Quintana, P. A., Rubio-Ramírez J., & Uribe, M. (April 2009). Risk Matters: The Real Effects of Volatility Shocks. *NBER Working Paper*, 14875.

Foerster, A. (2014Q3). The Asymmetric Effects of Uncertainty. Economic Review, Federal Reserve Bank of Kansas City. Retrieved June 2, 2015, from https://www.kansascityfed.org/publicat/econrev/pdf/14q3Foerster.pdf

Gauvin, L., McLoughlin, C., & Reinhardt, D. (September 2014). Policy uncertainty spillovers to emerging markets— evidence from capital flows. *Bank of England Working Paper*, 512.

Ghosal, V., & Ye, Y. (January 2015).Uncertainty and the Employment Dynamics of Small and Large Businesses. *IMF Working Paper*, 15/4.

Gilchrist, S., Sim, J. W., & Zakrajsek E. (2013, April 21). Uncertainty, Financial Frictions, and Irreversible Investment

Gillies, D. (2003). Probability and Uncertainty in Keynes's The General Theory. In Runde, J. and Mizuhara, S. (eds.) The Philosophy of Keynes's Economics. Probability, Uncertainty, and Convention, Routledge, 111-129.

Golinelli, R. & Parigi, G. (2004). Consumer Sentiment and Economic Activity: A Cross-Country Comparison. *Journal of Business Cycle Measurement and Analysis*, 1(2), 147-170.

González-Páramo, José Manuel (6 February 2009). Financial market failures and public policies: A central banker's perspective on the global financial crisis. Closing remarks at XVI Meeting of Public Economics Granada. Retrieved November 13, 2015, from https://www.ecb.europa.eu/press/key/date/2009/html/sp090206.en.html

Guiso L., & Parigi, G. (February 1999). Investment and Demand Uncertainty. *The Quarterly Journal of Economics*, 185-227. Retrieved October 28, 2015, from http://qje.oxfordjournals.org/content/114/1/185.full.pdf

Gulen, H., & Ion, M. (April 4, 2013). Policy Uncertainty and Corporate Investment. Retrieved November 1, 2015 from http://web.stanford.edu/group/SITE/SITE_2013/2013_segment_2/2013_segment_2_papers/gulen.pdf

Haddow, A., & Hare, C. (2013). Macroeconomic uncertainty: what is it, how can we measure it and why does it matter?. *Bank of England Quarterly Bulletin,* Q2, 100-109.

Hair J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate analysis principle factors. Upper Saddle River: Pearson Prentice Hall.

Hartman, R. (October 1972). The Effects of Price and Cost Uncertainty on Investment. *Journal of Economic Theory,* 5, 258-66

Hassett, K. A., & Sullivan, J. (2015, April 7-8). Policy Uncertainty and the Economy: A Review of the Literature. Prepared for Exploring the Price of Policy Uncertainty Conference co-sponsored by the Becker-Friedman Institute and the Urban Institute Center for Global Development, Washington, DC.

Hébert, R. F. & Link, A. N. (2009). *A History of Entrepreneurship*. New York: Routledge.

Hébert, R. F., & Link, A. N. (2006) Historical Perspectives on the Entrepreneur. *Foundations and Trends in Entrepreneurship,* 2(4), 261–40.

Hermansson, Cecilia. (December 21, 2012). Uncertainty continues to frustrate forecasters. Discussion on the economy. Swedbank. Retrieved June 15, 2015 from https://www.swedbank.se/idc/groups/public/@i/@sc/@all/@gs/@corpaff/@pubaff/documents/publication/cid_734331.pdf

Herve´ A., & Williams, L. J. (July/August 2010). Principal component analysis. Volume 2, John Wiley & Sons, Inc., Wiley Online Library, Retrieved April 15, 2015 from http://onlinelibrary.wiley.com/doi/10.1002/wics.101/pdf

Hodgson, G. M. (1997). The ubiquity of habits and rules. *Cambridge Journal of Economics*, 21, 663-684.

Hodgson, G. M. (2001). *Economics and Utopia- Why the learning economy is not the end of history.* Taylor & Francis e-Library.

Hodgson, G. M. (2011a). The Eclipse of the Uncertainty Concept in Mainstream Economics. *Journal of Economic Issues,* XLV(1), No. 1.

Hodgson, G. M. (2011b). Reforming Economics after the Financial Crisis. *Global Policy Volume 2, Issue 2.*

International Monetary Fund (IMF). (April 2013). Hopes, Realities, Risks. *World Economic Outlook.*

International Monetary Fund (IMF). (October 2012). Coping with High Debt and Sluggish Growth. *World Economic Outlook.*

Issing, O. (2002). Monetary Policy in a World of Uncertainty. *Economie international*, 92, 165-180.

Istrefri, K. & Piloiu, A. (2014). Economic Policy Uncertainty and Inflation Expectations. *Banque de France Working Papers 511*. Retrieved September 06, 2015, from https://www.banque-france.fr/uploads/tx_bdfdocumentstravail/DT-511.pdf

Jacome, L. I. & Nier, E. W. (2012). Macroprudential Policy: Protecting the Whole. Finance and Development, IMF.

Janeway, W. (2006, June 07). Risk versus Uncertainty: Frank Knight's "Brute" Facts of Economic Life. Retrieved August 06, 2015, from http://privatizationofrisk.ssrc.org/Janeway/

Jolliffe, I.T. (2002). *Principal Component Analysis, Second Edition*. New York. Springer-Verlag.

Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring Uncertainty. *American Economic Review*, 105(3), 1177–1216.

Kang, W., Lee, K., & Ratti, R. A. (2014). Economic policy uncertainty and firm-level investment. Journal of Macroeconomics, 39, 42-53.

Karasoy, H. G., & Yüncüler, Ç. (2015). The Explanatory Power and the Forecast Performance of Consumer Confidence Indices for Private Consumption Growth in Turkey. *Central Bank of the Republic of Turkey Working Paper,* 15/19.

Karni, Edi. (2014). Axiomatic Foundations of Expected Utility and Subjective Probability. In Machina, M. J. & Viscusi, W. K. (eds), Handbook of the Economics of Risk and Uncertainty. Vol 1, Oxford: North Holland.

Kazi, I. A., & Wagan, H. (2014). Are emerging markets exposed to contagion from U.S.: Evidence from stock and sovereign bond markets. *IPAG Business School Working Paper*, 058. Retrieved September 10, 2015, from https://www.ipag.fr/wp-content/uploads/recherche/WP/IPAG_WP_2014_058.pdf

Keho, Y. (2012). The Basics of Linear Principal Components Analysis. In Sanguansat P. (Ed.), Principal Component Analysis (p 181-206). InTech. Retrieved June 23, 2015, from http://www.intechopen.com/books/principal-component-analysis/the-basics-of-principal-component-analysis

Keynes, J. M. (1921). A Treatise on Probability. London: Macmillan and Co., Limited.

Keynes, J. M. (1937). *The General Theory of Employment. The Quarterly Journal of Economics*, 51(2), 209-223.

Keynes, J.M. (1936). The General Theory of Employment, Interest and Money. The University of Adelaide Library South Australia: The University of Adelaide Library Electronic Texts Collection.

Kliesen, K. L. (2013). Uncertainty and the Economy. Retrieved May 1, 2015, from https://www.stlouisfed.org/~/media/Files/PDFs/publications/pub_assets/pdf/re/2013/b/uncertainty.pdf

Klößner, S., & Sekkel, R. (2014). International spillovers of policy uncertainty. *Economics Letters,* 124, 508–512.

Knight, Frank H. Risk, Uncertainty, and Profit (Boston MA: Hart, Schaffner and Marx; Houghton Mifflin, 1921). Online Library of Liberty A collection of scholarly works about individual liberty and free markets. Retrieved May 25, 2015, from http://oll.libertyfund.org/titles/306

Knight, M. D. (2008, April 21). Some reflections on the future of the originate-to-distribute model in the context of the current financial turmoil. Speech at the Euro 50 Group Roundtable on "The future of the originate and distribute model", London. Retrieved September 9, 2015, from http://www.bis.org/speeches/sp080423.htm

Knotek II, E. S. & Khan, S. (2011). How Do Households Respond to Uncertainty Shocks?. *Economic Review, Federal Reserve Bank of Kansas City,* Second Quarter. Retrieved September 16, 2015, from https://www.kansascityfed.org/publicat/econrev/pdf/11q2knotek-khan.pdf

Kocherlakota, N. (2010, November 22). Monetary Policy, Labor Markets, and Uncertainty. Speech at Sioux Falls Rotary. Retrieved December 17, 2015, from https://www.minneapolisfed.org/~/media/files/news_events/pres/kocherlakota_speech_11222010.pdf

Kose, A. M, & Terrones M. E. (2012, 18 October) Uncertainty weighing on the global recovery. Retrieved Sep 10, 2015, from http://www.voxeu.org/article/uncertainty-weighing-global-recovery

Krol, R. (2014). Economic Policy Uncertainty and Exchange Rate Volatility. *International Finance*, 17(2), 241–255.

Kwan, A. C. C. & J. A. Cotsomitis. (2006). The Usefulness of Consumer Confidence in Forecasting Household Spending in Canada: A National and Regional Analysis. *Economic Inquiry,* 44(1), 185-197.

Lagarde, C. (2012, September 24). Promises to Keep: The Policy Actions Needed to Secure Global Recovery Speech at the Peterson Institute for International Economics, Washington DC. Retrieved September 16, 2015, from https://www.imf.org/external/np/speeches/2012/092412.htm

Lawson , T. (1987). The Relative/Absolute Nature of Knowledge and Economic Analysis. *The Economic Journal,* 97(388), 951-970

Lawson, T. (Autumn, 1988). Probability and Uncertainty in Economic Analysis. *Journal of Post Keynesian Economics*, 11(1), 38-65.

Leahy, J. V., & Whited, T. M. (February 1996). The Effect of Uncertainty on Investment: Some Stylized Facts. *Journal of Money, Credit, and Banking*, 28(1), 64-83

Leduc, S., & Liu, Z. (May 2015). Uncertainty Shocks are Aggregate Demand Shocks. *Federal Reserve Bank of San Francisco Working Paper*, 2012 (10).

Leduc, S., & Liu, Z. (September 2012) Uncertainty, Unemployment, and Inflation. *FRBSF Economic Letter*. Retrieved May 19, 2015, from http://www.frbsf.org/economic-research/publications/economic-letter/2012/september/uncertainty-unemployment-inflation/el2012-28.pdf

Litterman, R., & Scheinkman, J. (1991). Common factors affecting bond returns. *Journal of Fixed Income 1,* 54-61 Retrieved June 3, 2015, from https://www.math.nyu.edu/faculty/avellane/Litterman1991.pdf

Lucas Jr., Robert E., 1977. Understanding business cycles. *Carnegie-Rochester Conference Series on Public Policy*, 5, p 7-29.

MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics*, 11, 601–618.

McGuire P., & Schrijvers, M. A. (December 2003). Common factors in emerging market spreads. *BIS Quarterly Review*.

Mecikovsky, A. M., & Meier, M. (February 15, 2015). Do plants freeze upon uncertainty shocks?. Retrieved November 4, 2015, from https://site.stanford.edu/sites/default/files/plants_freeze.pdf

Mishkin F. S. (2008, March 4). Outlook and Risks for the U.S. Economy. Speech At the National Association for Business Economics Washington Policy Conference, Washington, D.C. Retrieved June 22, 2015, from http://www.federalreserve.gov/newsevents/speech/mishkin20080304a.htm

Mizen P. (September/October 2008). The Credit Crunch of 2007-2008: A Discussion of the Background, Market Reactions, and Policy Responses. *Federal Reserve Bank of St. Louis Review*. Retrieved August 21, 2015, from https://research.stlouisfed.org/publications/review/08/09/Mizen.pdf

Morandé F., & Tejada, M. (October 2008). Sources of Uncertainty for Conducting Monetary Policy in Chile. *Banco Central de Chile Working Paper,* No. 492.

Morris, S., & Shin, H. S. (July 31, 2002). Measuring Strategic Uncertainty. Retrieved November 12, 2015, from http://www.nuff.ox.ac.uk/users/shin/pdf/barcelona.pdf

Mumtaz, H., & Theodoridis, K. (October 2012). *Bank of England Working Paper*, 463

O'Donnell, R. (July 2015). The Origins of the Risk-Uncertainty Distinction and the Light it Throws on Contemporary Economics. Australian Conference of Economists. Retrieved August 11, 2015, from http://editorialexpress.com/conference/ACE2015/program/ACE2015.html

O'Mahony, D. (Fall 1985). Richard Cantillon-A Man of His Time: A Comment on Tarascio. *The Journal of Libertarian Studies,* VII(2), 259-267.

Organization for Economic Cooperation and Development (OECD), Joint Research Centre (JRC), & European Commission (EC). (2008). Handbook on Constructing Composite Indicators, 2008. Retrieved April 03, 2015, from http://www.oecd.org/std/42495745.pdf

Organization for Economic Cooperation and Development (OECD). (October 2006). Economic Survey of Turkey, 2006. Policy Brief. Retrieved May 13, 2015, from http://www.egm.org.tr/makaleler//OECD%20Policy%20Brief-Economic%20Survey%20of%20Turkey,%20October%202006.pdf

Orlik, A., & Veldkamp, L. (2014). Understanding Uncertainty Shocks and the Role of Black Swans. *NBER Working Paper,* 20445. Retrieved September 19, 2015, from http://www.nber.org/papers/w20445.pdf

Özatay, F., Özmen, E., & Şahinbeyoğlu, G. (December 2007). Emerging Market Sovereign Spreads, Global Financial Conditions and U.S. Macroeconomic News. *ERC Working Papers in Economics,* 07(07). Retrieved June 13, 2015, from http://www.erc.metu.edu.tr/menu/series07/0707.pdf

Pol, E. (2009). Understanding the Global Financial Crisis. 9th Global Conference on Business & Economics, Cambridge, UK: Cambridge University, 1-43.

Poloz, S. S. (October 2014). Integrating Uncertainty and Monetary Policy-Making: A Practitioner's Perspective. *Bank of Canada Discussion Paper,* 6. Retrieved November 15, 2015, from http://www.bankofcanada.ca/wp-content/uploads/2014/10/dp2014-6.pdf

Popp, A., & Zhang, F. (2015, August 16). The Macroeconomic Effects of Uncertainty Shocks: The Role of the Financial Channel. Retrieved October 21, 2015, from http://mihaylofaculty.fullerton.edu/sites/fazhang/Macro%20effect%20of%20U%20shock_Credit.pdf

Redl, C. (2015). Macroeconomic Uncertainty in South Africa. *ERSA Working Paper 509.* Retrieved November 30, 2015, from http://www.econrsa.org/system/files/publications/working_papers/working_paper_509.pdf

Romer, C. D. (1990, August). The Great Crash and the Onset of the Great Depression. *The Quarterly Journal of Economics,* 105(3), 597-624

Rosser, J. B. Jr. (1999). Between Cambridge and Vienna: The Risky Business of New Austrian Business Cycle Theory. *Critical Review,* 13 (3-4), 373-389.

Rosser, J. B. Jr. (Summer, 2001). Alternative Keynesian and Post Keynesian Perspectives on Uncertainty and Expectations. *Journal of Post Keynesian Economics,* 23(4), 545-566.

Rossi, B. & Sekhposyan, T. (2015). Macroeconomic Uncertainty Indices Based on Nowcast and Forecast Error Distributions. *American Economic Review: Papers & Proceedings,* 105(5), 650–655.

Rothbard M. N. (2006). *Economic Thought Before Adam Smith - An Austrian Perspective on the History of Economic Thought Volume I.* Auburn, Alabama: Edward Elgar Publishing, Ltd.

Sauter, O. (2012). Assessing uncertainty in Europe and the US – Is there a common factor?. *FZID Discussion Papers,* 47. Retrieved October 19, 2015, from https://fzid.uni-hohenheim.de/fileadmin/einrichtungen/fzid/fzid_dp_2012_47_Spahn.pdf

Sauter, O. (2014). *Monetary Policy under Uncertainty - Historical Origins, Theoretical Foundations, and Empirical Evidence*. Wiesbaden: Springer Gabler.

Schwert G. W. (April 1989). Tests for Unit Roots: A Monte Carlo Investigation. *Journal of Business & Economic Statistics,* 7(2), 147-159.

Shaghil, A., Coulibaly, B., & Zlate, A. (April 2015). International Financial Spillovers to Emerging Market Economies: How Important Are Economic Fundamentals?. *Board of Governors of the Federal Reserve System International Finance Discussion Papers,* 1135. Retrieved November 30, 2015, from http://www.federalreserve.gov/econresdata/ifdp/2015/files/ifdp1135.pdf

Simon, G., & Quiggin, J. (2005). Increasing uncertainty: a definition. *Mathematical Social Sciences,* 49, 117-141.

Smith, L. I. (2002, February 26). A tutorial on Principal Components Analysis. Retrieved May 10, 2015, from http://www.cs.otago.ac.nz/cosc453/student_tutorials/principal_components.pdf

Stein, J. C. (2010). Securitization, Shadow Banking, and Financial Fragility. Daedalus, 139 (4): 41-51. Retrieved October 30, 2015, from http://scholar.harvard.edu/files/stein/files/daedalus-sept-2010-final.pdf?m=1360040289

Stigler, G. J. (1985). Frank Hyneman Knight. *The University of Chicago Center for the Study of the Economy and the State, Working Papers Series,* 37.

Stock, J. H. & Watson, M. W. (Fall 2001).Vector Autoregressions. *Journal of Economic Perspectives,*15(4), 101–115.

Stock, J. H. & Watson, M. W. (Spring 2012). Disentangling the Channels of the 2007–09 Recession. *Brookings Papers on Economic Activity, The Brookings Institution,* 81-156.

Svetlova, E., & Fiedler, M. (2011). Understanding Crisis: On the Meaning of Uncertainty and Probability. In Dejuan, O., Febrero, E. & Marcuzzo, M. C (eds.), The First Great Recession of the 21st Century: Competing Explanations. Cheltenham: Edward Elgar.

Taylor, J. B. (2000, February 29). How the Rational Expectations Revolution Has Changed Macroeconomic Policy Research. Stanford University. Retrieved July 13, 2015, from http://web.stanford.edu/~johntayl/Papers/IEALecture.pdf

Terzi, A. (Summer 2010). Keynes's Uncertainty Is Not about White or Black Swans. *Journal of Post Keynesian Economics,* 32(4), 559-65.

The European Central Bank (ECB). (August 2009). Uncertainty and the economic prospects for the euro area. *Monthly Bulletin,* 58-62. Retrieved April 1, 2015, from https://www.ecb.europa.eu/pub/pdf/mobu/mb200908en.pdf

The European Central Bank (ECB). (October 2013). How has macroeconomic uncertainty in the euro area evolved recently?. *Monthly Bulletin*, 44-48. Retrieved June 6, 2015, from https://www.ecb.europa.eu/pub/pdf/mobu/mb201310en.pdf

Van den Hauwe, Ludwig. (2011). John Maynard Keynes and Ludwig von Mises on Probability. *Journal of Libertarian Studies,* 22 (1), 471–507. Retrieved October 25, 2015, from https://mises.org/library/john-maynard-keynes-and-ludwig-von-mises-probability.

Van Praag, C. M. (1999). Some Classic Views on Entrepreneurship. *De Economist*, 147(3), 311-335. Retrieved July 30, 2015, from http://home.fau.edu/kjakee/web/Entrep/Readings/VanPragg-ClassicViewsOnEntrep-DeEconst-99.pdf

Verick, S., & Islam, I. (May 2010). The Great Recession of 2008-2009: Causes, Consequences and Policy Responses. IZA Discussion Paper, 4934.

APPENDICES

A. FIGURES (PCA VARIABLES)

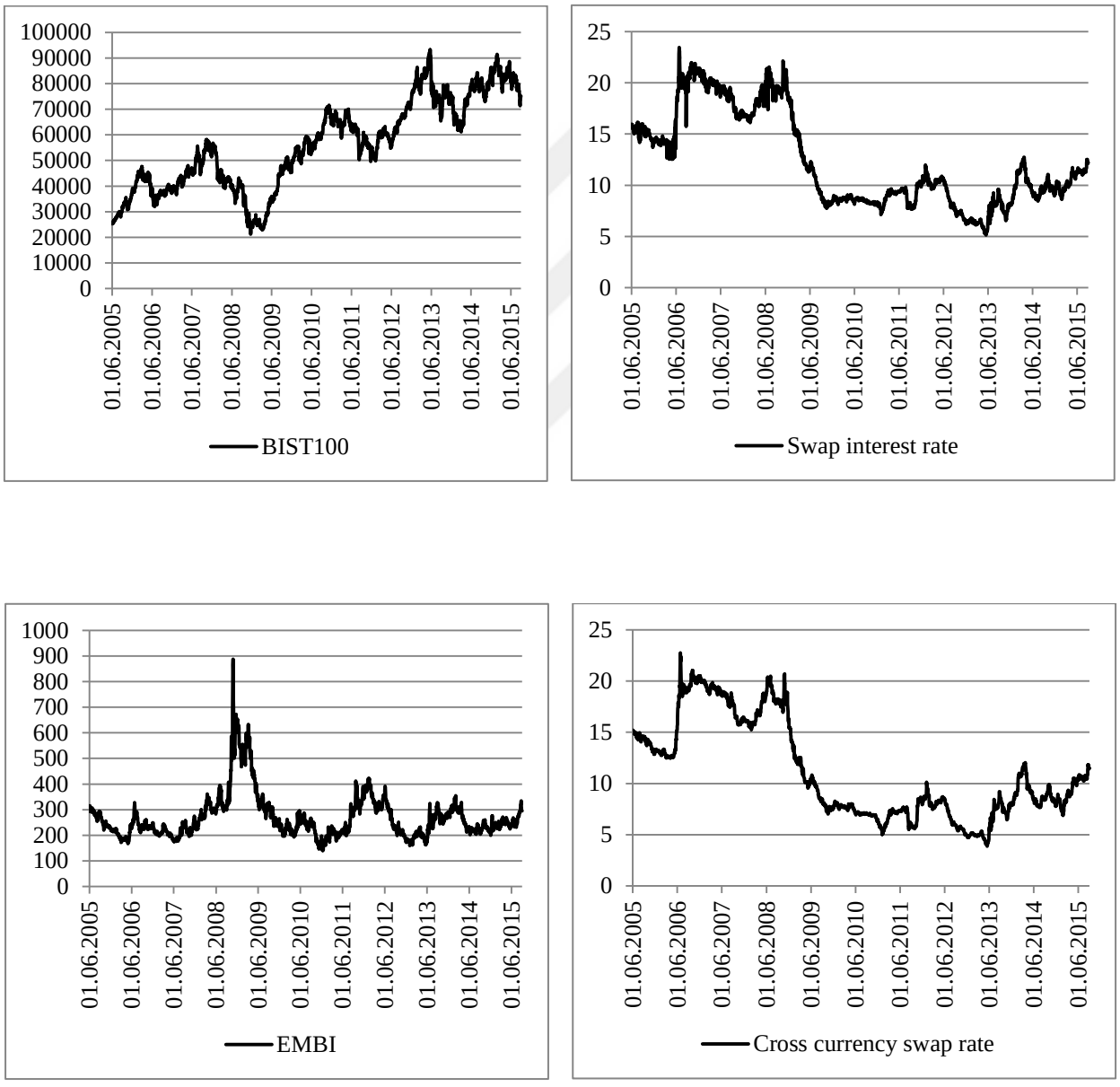
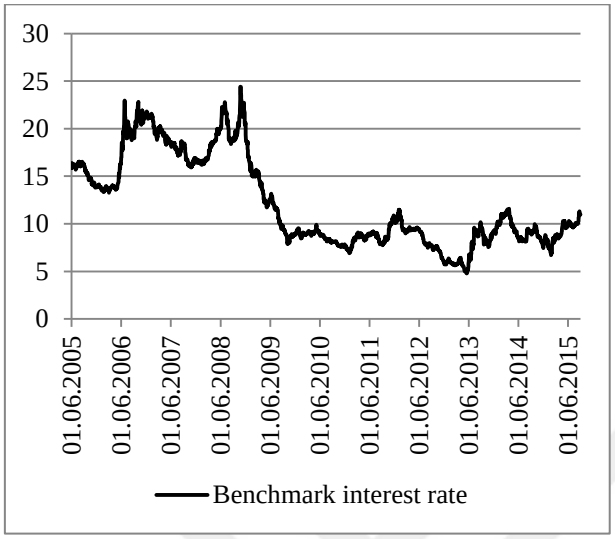
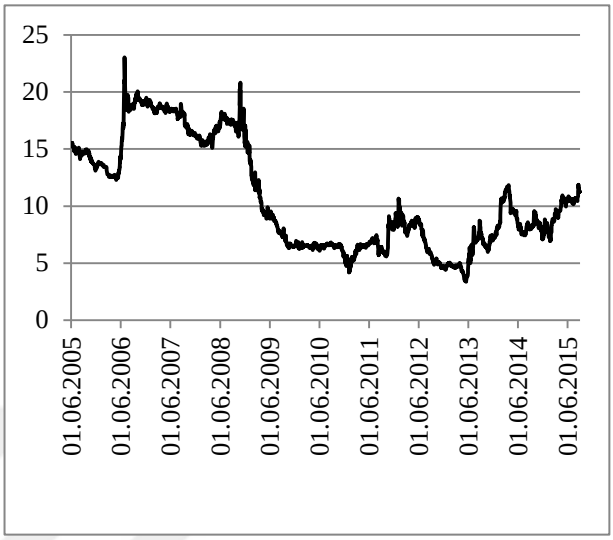


Figure A1 Selected Variables (Daily)





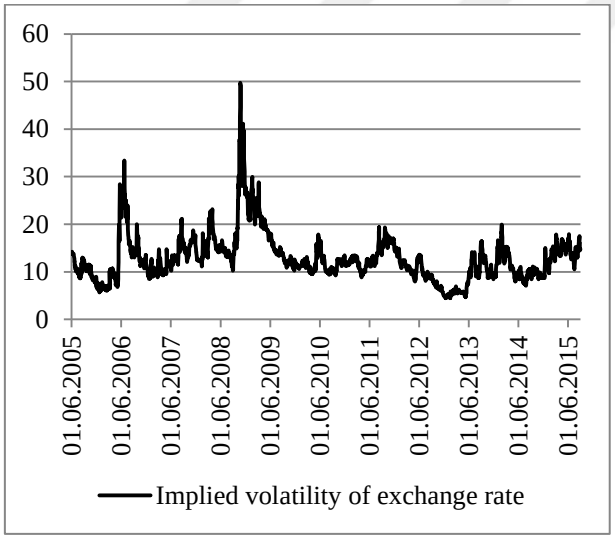
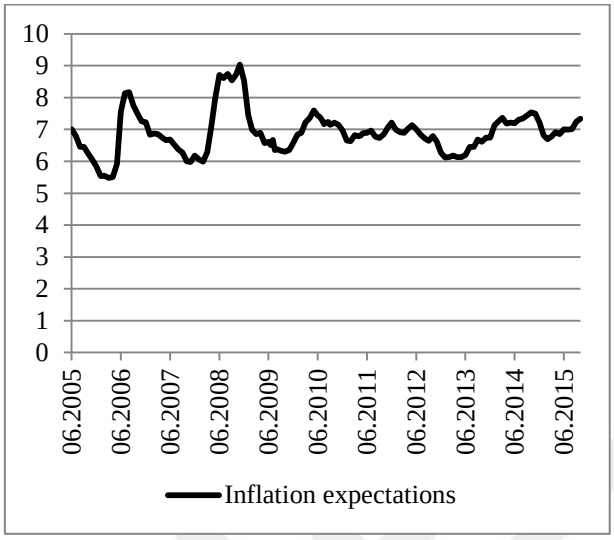


Figure A1 (continued)



FigureA2 Inflation Expectations (Next 12 Months, Monthly)

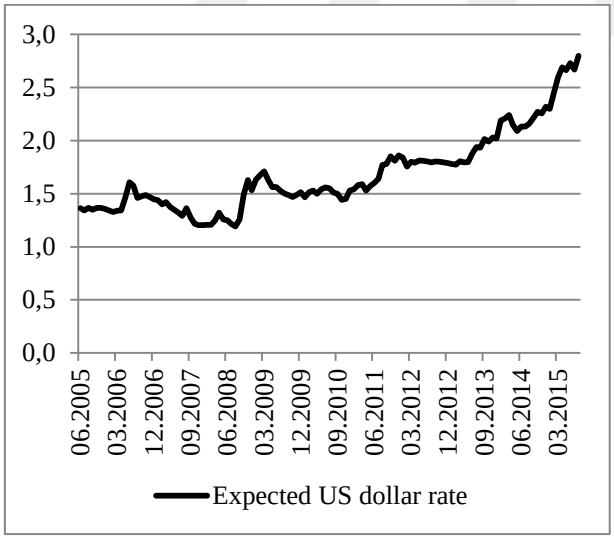


Figure A3 Expected US Dollar Rate (At the End of Current Month)

B. FIGURES (DAILY UNCERTAINTY MEASURES FOR TURKEY)

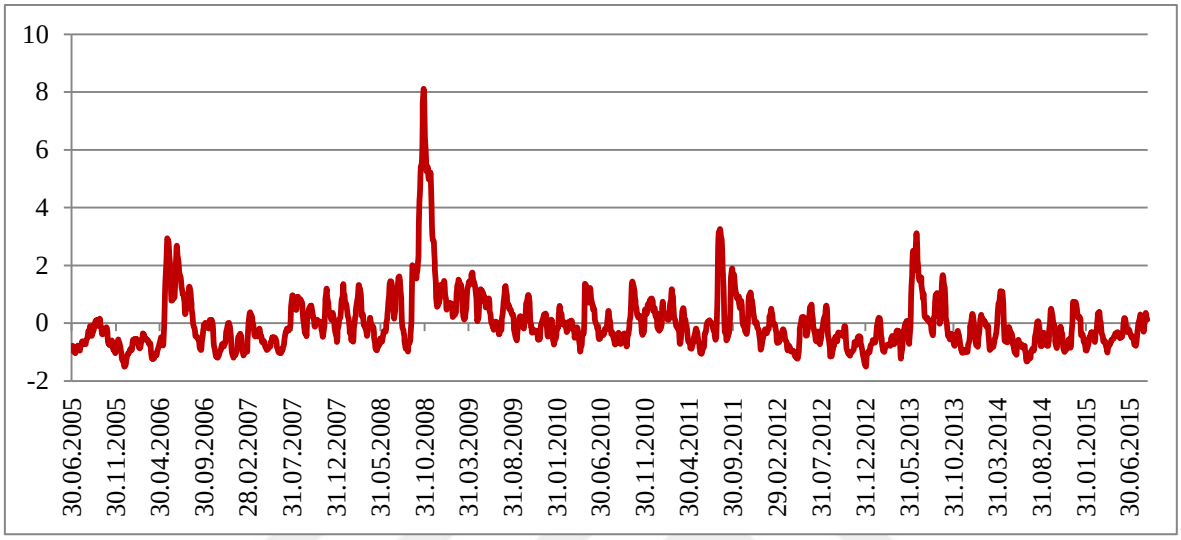


Figure B1 Measure of Uncertainty for Turkey (Daily, 4-variable*)

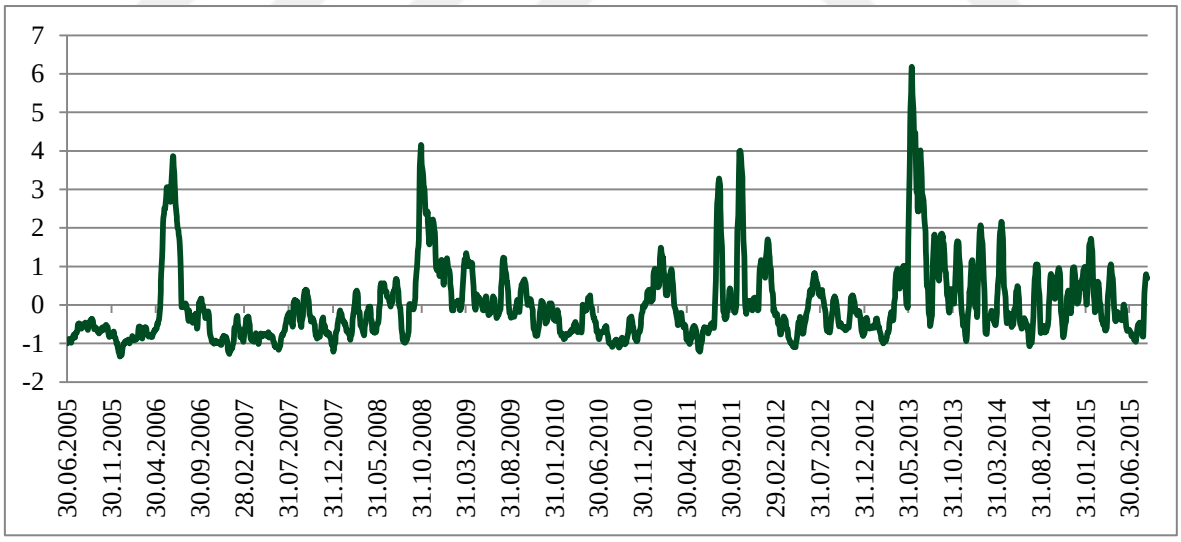


Figure B2 Measure of Uncertainty for Turkey (Daily, 7-variable*)

*: There is no daily data for inflation expectations and expected US dollar rate; therefore PCA is run with 7-variables and 4-variables.

C. UNIT ROOT TESTS

Tests		Level
Uncertainty	**ADF**	--5.608 (0)***
	DF-GLS	--3.166 (2) ***
	PP	-5.608 (0)***
Industrial production	**ADF**	-2.778 (2)*
	DF-GLS	-1.997 (2)**
	PP	-3.135 (2)**
Unemployment	**ADF**	2.645 (6)*
	DF-GLS	-2.197771 (6) **
	PP	-3.336 (6)**
Consumer price index	**ADF**	-5.417 (8)***
	DF-GLS	-5.241 (8)***
	PP	-3.742 (8)***
Credit interest rate	**ADF**	-4.644 (7)***
	DF-GLS	-4.573 (7)***
	PP	-23.921 (7)***
Consumer confidence index	**ADF**	-3.923 (1)***
	DF-GLS	-3.691891 (1)***
	PP	-4.041 (1)***
Economic conditions index	**ADF**	-3.921 (1)***
	DF-GLS	-3.840289 (1)***
	PP	-3.947 (1)***

Notes:

1. *, **, and *** denote stationary at 10%, 5% and 1%, respectively. Critical values are taken from MacKinnon (1996).
2. Max lag level is 12, which is calculated using formula [12 *(number of observations /100) ¼] proposed by Schwert (1989, p.151).
3. Optimal lag is determined by Akaike information criterion and shown in parenthesis.

D. AUTOCORRELATION AND HETEROSCEDASTICITY TESTS

D1 VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Lags	LM-Stat	Prob
1	37.42101	0.8865
2	31.42501	0.9760
3	37.91941	0.8745
4	41.98851	0.7508
5	45.44615	0.6180
6	46.53822	0.5735

Probs from chi-square with 49 df.

D2 Heteroscedasticity Test

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Joint test:		
Chi-sq	df	Prob.
1232.377	1176	0.1234

E. CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Gürgün, Gözde
Nationality: Turkish (TC)
Date of Birth: 15 August 1975
Place of Birth: Ankara Phone: +90 5324259688
email: ggurgun@hotmail.gov.tr

EDUCATION

Degree	Institution	Year of Graduation
MA	University of Leeds Economics and Finance	2001
BS	METU Economics	1997

PROFESSIONAL EXPERIENCE

Year	Place	Enrollment
1997-2003	Central Bank of the Republic of Turkey	Assistant Specialist
2003-2014	Central Bank of the Republic of Turkey	Specialist
2014-Present	Central Bank of the Republic of Turkey	Senior Specialist

FOREIGN LANGUAGES

Advanced English

PUBLICATIONS

Gürgün, Gözde. "Exchange Rate Policies: The Case of Turkey". Master's Thesis, University of Leeds, 2001.

Gürgün, Gözde. “1990’lı Yıllarda Sermaye Akımları ve Krizler”, Uzmanlık Yeterlilik Tezi, TCMB, 2003.

Gürgün, G. & Ünalmış, İ. “Is Gold a Safe Haven Against Equity Market Investment in Emerging and Developing Countries?”, Finance Research Letters, 2014.

Gurgun, G. & Bakin, B. “Portfolio Investments and Asset Prices Relationship in Turkey”, IISES Vienna 10th International Academic Conference, 03-06 June 2014, Vienna/Austria.

Gurgun, G. & Bakin, B. “The Impact of Exchange Rate Volatility on Domestic Investment: Evidence from Emerging and Developing Europe”, Lupcon Economics and Finance Conference, 05-08 August 2015, Frankfurt/Germany.

F. TURKISH SUMMARY

Belirsizlik kavramı Cantillon'un 1730'larda da yazdığı "Essai sur la Nature du Commerce en Général[42]" adlı çalışmasındaki girişimcilik analiziyle iktisadi içerik kazanmıştır. Cantillon iktisadi aktörleri 1) toprak sahipleri 3) işçiler ve 2) girişimciler olmak üzere 3 grupta sınıflandırmıştır. Toprak sahipleri finansal olarak bağımsızdırlar ve ekonomideki esas tüketicilerdir. İşçiler kontrata bağlı çalışarak sabit bir geliri garantilerler. Üretim, dağıtım ve mal değişiminden sorumlu olan girişimcilerin motivasyonu ise arbitraj yaparak kar elde etme umududur (Hebert ve Link, 2006). Piyasa, mükemmel bilgi ve kesinlikten ziyade belirsizlikle çevrelenmiştir (Rothbard, 2006).

Cantillon detaylı bir belirsizlik analizi yapmak yerine girişimcinin fonksiyonunu belirsizlikle ilişkilendirmiştir. Cantillon'a göre girişimcinin fonksiyonu yatırım yaparak ve maliyetleri karşılayarak kar beklentisinde olmak ve böylelikle rekabetçi piyasanın doğasında bulunan belirsizliğe katlanmaktır. Belirli bir fiyattan aldıkları ürünü, pazarda belirsiz fiyattan tekrar satan girişimciler, bunun sonunda kar ya da zarar elde ederler (Rothabard, 2006). Girişimcinin karşı karşıya olduğu belirsizlik sigortalanamaz.

Knight 1921'de yazdığı "Risk, Uncertainty and Profit" adlı çalışmasında risk ile belirsizlik arasındaki farkları ortaya koymuştur. Riski ölçülebilir ve sigorta edilebilir belirsizlik olarak niteleyen Knight'a göre belirsizlik ölçülemez niteliktedir. Knight, risk ve belirsizlik arasındaki farkları, apriori, istatistiksel ve tahmin olmak üzere üç gruba ayırdığı olasılık değerlendirmesine dayandırmıştır. Apriori olasılık, geçmiş deneylere dayanır ve matematiksel olarak hesaplanabilir. Bir zar atıldığında belirli bir sayının gelme olasılığı apriori olasılığın en bilinen örneklerinden biridir. İstatistiksel olasılık, olayların gruplanmasına dayanır ve sonuçlar homojen değildir. Knight, bir sigorta şirketinin belirli bir binada yangın çıkma olasılığını istatistiksel araştırmayla değerlendirebileceği örneğini vermiştir. A priori olasılık ile istatistiksel olasılık arasındaki en temel fark dağılımları

[42] Essay on the Nature of Trade in General

oluştururken ilkinde matematiksel prensiplerin, ikincisinde yargının kullanılmasıdır. Knight'ın yaklaşımına göre apriori ve istatistiksel olasılık çeşitleri risktir.

Olaylar heterojense ve gruplama yapılamıyorsa, sadece tahminde bulunulabilir. Bu durumda "gerçek belirsizlik" ile karşı karşıya kalınır ve tahmin oluşturabilmek için yargıda bulunulur. İş alemi ve karın yapısını araştıran Knight, tahmin tipi olasılığa ilgi duymuştur. Knight, gerçek belirsizlikle karşı karşıya olan iş adamlarının kararlarını sübjektif yargılara dayandırmak durumunda olduklarını ve başarının girişimcinin beklediği sonuçla gerçekleşen sonuç arasındaki farka bağlı olduğu görüşündedir (Svetlova ve Fiedler, 2011). İş alemi kararları, hesaplanabilir olasılık değerlendirmelerine dayanmamaktadır.

Knight ve Keynes'in belirsizlik anlayışlarının benzer yanları olmakla birlikte ayrıştığı noktalar da bulunmaktadır. İkisi de belirsizliğin ölçülemez niteliğinin altını çizmiş, ancak bu yaklaşımı farklı dayanaklarla açıklamıştır. Knight ve Keynes'in belirsizlik anlayışları arasındaki fark olasılık yaklaşımları ve gerçek dünyayla ilgili bakış açılarından kaynaklanmaktadır.

Knight belirsizlik kavramına ekonomik bakış açısıyla yaklaşmış ve kar teorisini açıklamaya odaklanmıştır. Knight'ın önemli bir katkısı belirsizliğin kar etme fırsatı yarattığı, risk durumunda ise kar elde edilemeyeceğini ortaya koymasıdır. 1921 yılında "Treatise on Probability" adlı çalışmasıyla belirsizlik konusuna katkıda bulunan Keynes ise felsefi bir bakış açısı getirmiş ve olasılığın mantık yoluyla düşünülmesi gerektiğini savunmuştur. Keynes'in olasılık yaklaşımı genel olarak öznelciliğe ağırlık vermektedir. Keynes, 1936 ve 1937 tarihli "The General Theory of Employment, Interest and Money" ve "The General Theory of Employment" adlı çalışmalarında ise belirsizliğin karar alma mekanizmasındaki rolüne değinmiştir.

Öte yandan, öznelciliği benimseyenler, kişisel olasılık görüşünü (öznel olasılık) desteklerler. Bu görüş nihai olarak belirsizlik altında tercihler teorisine Savage'ın yaklaşımına, yani belirsizliğin tamamen öznel olduğu ve olasılık değerlendirmesini kişinin tercihlerinin belirlediği, yol açar. Örneğin, iki kumar oyununun sonucu aynı ise, ancak biri diğerine tercih ediliyorsa, karar alıcı favori alternatif için daha yüksek kazanma olasılığı belirler (Feduzi, 2007). Öznelciler, herhangi bir olay için olasılık belirlenebileceğini

varsayarlar. Güçlü öznelciler ise tüm olasılık tahminlerinin öznel olduğunu düşünürler. Bu yaklaşıma göre, karar alıcı olaylara sayısal olasılık belirlemiş gibi davranabileceği ve dolayısıyla belirsizlik riske indirgenebileceği için, Knight'ın risk ve belirsizlik ayırımı anlamsızdır.

İlk defa John Muth tarafından öne sürülen ve daha sonra Robert Lucas tarafından makroekonomiye dahil edilen rasyonel bekleyişler hipoteziyle birlikte Knight ve Keynes'in belirsizlik kavramı, neoklasiklerin öncülüğünde ölçülebilir riske dönüşmüştür. Rasyonel bekleyişler görüşünü savunanlara göre belirsizlik sayısal olarak belirli olan olasılık bilgisidir.

Sonuç olarak, belirsizlik kavramı ve olasılık anlayışlarına göre, Keynes ölçülemez-öznel, Knight ölçülemez-nesnel, Savage ölçülebilir-öznel, Muth ve Lucas ölçülebilir-nesnel olarak gruplanmaktadır (Lawson, 1988).

Knight ve Keynes'in belirsizlik anlayışına yönelik ilgi, matematiksel modellerin iktisat biliminde yoğun olarak kullanılmaya başlanmasıyla birlikte 1950'lerden itibaren azalmıştır. Bu süreçte, ölçülemez bir kavram olan belirsizlik ya göz ardı edilmiş ya da ölçülebilir şekilde yorumlanmıştır. 2008/2009 küresel finansal kriziyle birlikte belirsizlik kavramı tekrar popülarite kazanmış ve belirsizliğin ölçülmesi ile ekonomiye etkilerinin tahmin edilmesine yönelik akademik ilgi artmıştır.

Belirsizlik, küresel krizin ve sonrasında kaydedilen yavaş toparlanmanın en önemli nedenlerinden biri olarak ortaya konmuştur. (IMF, 2012). Küresel kriz öncesinde finansal piyasaların deregülasyonuna finansal inovasyondaki artış eşlik etmiş ve kredi aç-dağıt (originate-to-distribute) modeli doğmuştur. Finansal kuruluşlar topladıkları fonları krediye dönüştürdükten sonra menkul kıymetleştirme yöntemiyle dilimlere ayırıp paketlemiş ve menkul kıymet olarak tekrar yatırımcılara satarak yeni varlıklar oluşturmuştur. Kredi derecelendirme kuruluşlarından yüksek notlar alan söz konusu menkul kıymetler oldukça cazip risk-getiri profili sağlıyor gibi görünmüşlerdir. Kredilerin paket haline getirilip diğer yatırımcılara satılmasından dolayı riskler ekonominin geneline dağıtılmıştır, ancak söz konusu modelin Modelin başlıca zayıflıkları, şeffaf olmaması, yeni varlıkların karmaşık yapısı ve kredi derecelendirme kuruluşlarının verdiği notlara fazla güvenilmesidir. Kredi

aç-dağıt modeli riskin belirsizliğe dönüşmesine yol açarak, finansal sistemde risklerin yeri ve miktarına ilişkin bir kara kutu yaratmıştır. Finansal sistemin riskinin tam olarak değerlendirilememesi belirsizliğe (Knight'ın tanımladığı şekilde) yol açmıştır.

ABD'de eşik altı ipotek kredilerinde geri ödeme sorununun ortaya çıkmasıyla patlak veren kriz, konut fiyatlarındaki gerilemenin ardından yatırımcıların ellerindeki varlıkların değerine ilişkin endişe duymalarıyla finansal sisteme ve reel ekonomiye yayılmış, küresel nitelik kazanmıştır. Risk algılamasındaki bozulma yatırımcıların varlıklarını likidite etmesine sebep olmuştur. Varlık fiyatları hızla gerilemiş, finansal kuruluşların bilançolarında büyük zararlar kaydedilmiş ve birçok finansal kuruluş iflas etmiş veya kamu desteği sayesinde ayakta kalabilmiştir. Merkez bankalarının agresif politika uygulamalarına rağmen birçok finansal piyasa uzun bir süre işlemez hale gelmiştir. Stock ve Watson (2012) ABD'de 2007/2009 resesyonuna yol açan şokların artan belirsizlik ve finansal çalkantılarla ilişkili olduğunu bulmuştur. Bu süreçte, finansal problemlerin ne derecede ciddi olduğunun ve etkilerinin bilinmediğini ve uygun politika adımlarının belirlenemediğini vurgulamıştır.

Krizin çözümlenmesine yönelik politikaların belirsizliğinin yanı sıra krizin etkisiyle ekonominin yapısında meydana gelen değişimlerin belirsizliği artırarak ekonomik toparlanmayı sınırladığı sıklıkla dile getirilmiştir. Lagarde (2012) küresel ekonomi üzerinde aşağı yönlü baskı yapan en önemli faktörün gelişmiş ülkelerde politika yapıcıların verdikleri sözleri tutup tutamayacağına dair belirsizlik olduğunu ifade etmiştir. Köse ve Terrones (2012) 2006 ve 2011 yılları arasında politika belirsizliğindeki artışın beş standart sapma büyüklüğünde olduğunu ve bunun gelişmiş ekonomilerde büyümeyi 2,5 yüzde puan sınırladığını öne sürmüştür.

Özet olarak, küresel kriz esnasında belirsizlik çeşitli açıları ortaya çıkmıştır. Bunlar i) Risklerin miktarı ve yerine ilişkin kesin bilgi olmaması, ii) varlıkların değerinin tam olarak değerlendirilmesine ilişkin yetersizlik, iii) ekonominin mevcut durumuna ilişkin bilgi eksikliği ve iv) politika adımlarının, özellikle geleneksel olmayanların ekonomiyi nasıl etkileyeceğine dair kesin bilginin bulunmaması. Bu sebeple, küresel kriz sonrasında belirsizliğin ölçülmesi ve etkilerine ilişkin çalışmalar hızla artış kaydetmiştir.

Belirsizliğin ölçülemez nitelikte olması, birçok vekilin kullanılmasına neden olmuştur. Belirsizlik ölçütleri dört temel grupta toparlanabilir. En yaygın yaklaşımlardan biri, vekil olarak ekonomik ve finansal göstergelerin oynaklığının kullanılmasıdır. Söz konusu oynaklıkların tercih edilmesi üç temel nedenle açıklanabilir. Birincisi, Asya krizi, Lehman Brothers'ın batışı gibi yüksek oynaklık görülen dönemlerin "bilinmeyen bilinmeyenler" içermesi nedeniyle genel olarak belirsiz olarak nitelendirilmesidir. İkincisi, belirsizlik dönemlerinde haberlere ve yeni bilgilere daha fazla ilgi gösterilmesi ve bu durumun finansal piyasalarda işlem hacminin yükselmesini ve oynaklığın artmasını tetiklemesidir. Üçüncüsü, finansal piyasalardan elde edilen belirsizlik ölçütleri yüksek frekanslı olmakta ve kolay erişilebilmektedir. Böylelikle belirsizlik şokları hemen yakalanabilmekte ve hızlı politika tepkisi verebilmeyi mümkün kılmaktadır. Ancak, söz konusu vekillerin ekonominin genelindeki değil sadece belirli kısımlarındaki şartları yansıtacağı eleştirisi de getirilmektedir. Ekonomik ve finansal göstergelerin oynaklığını belirsizlik vekili olarak kullananlar arasında Leahy and Whited (1996), Bloom (2009), Basu and Bundick (2012), Bloom vd. (2013), Caggiano vd. (2014), Leduc and Liu (2015), Popp and Zhang (2015) ile Knotek II ve Khan (2011) bulunmaktadır. Ayrıca, varyans serilerinin elde edilmesinde GARCH modelleri de kullanılmıştır (Asteriou ve Price, 2005; Berument et. al, 2007; Bloom vd., 2014).

Bir diğer popüler yaklaşım, ekonomik aktörlerin algıladığı belirsizliğini gösteren ankete dayalı ölçütlerdir. Bu grupta belirsizlik, beklenti uyuşmazlığı (Baker vd. 2013; Bloom vd. 2014; ve Bachman vd. 2013), beklenti hataları (Bachmann vd., 2013; Arslan vd., 2011; Scotti, 2013 ve Rossi and Sekhposyan, 2015) ve belirsizliğe doğrudan atıfta bulunan anket soruları aracılığıyla ölçülmektedir (Leduc ve Liu, 2015). Beklenti uyuşmazlığı tahminlerin dağılımını ifade etmekte, tahminlerin dağılımı ne kadar fazlaysa, ankete cevap verenler arasındaki uyuşmazlığın o kadar yüksek olduğunu göstermektedir. Ekonomik aktörlerin tahminlerindeki farklılaşmanın ekonominin geleceğine ilişkin belirsizliği yansıttığı öne sürülmektedir. Beklenti hataları ise tahminler oluşturulurken değil, veriler açıklandıktan sonra belirlenebilmektedir (Orlik ve Veldkamp, 2014). Tahminlerin kesinliği ne kadar düşük ise belirsizliğin de o kadar yüksek olduğu varsayılmaktadır (Abel vd., 2015). Ankete dayalı ölçütler ekonometrik model içermeme avantajına sahiptirler ve karar alıcılarının belirsizliğe ilişkin düşüncelerini doğrudan yansıtmalarından dolayı iş alemindeki belirsizliği göstermeleri açısından oldukça faydalıdırlar. Ancak, söz konusu ölçütlerin bazı

eksiklikleri de bulunmaktadır. Bazı anketler seyrek olarak yapılır, dolayısıyla belirsizliği hemen yakalamak mümkün olmayabilmektedir. Anket verileri kısıtlı sayıda seri için bulunabilmektedir ve ülkelerde anketlerin aynı olmamasından dolayı karşılaştırmalı ülke analizi yapmak mümkün olmayabilmektedir. Ankete tüm cevap verenlerin benzer tahminlerde bulunmaları halinde, her biri geleceğin oldukça belirsiz olduğu görüşünde olsa bile tahmin uyuşmazlığı belirsizliği yansıtmayabilir. Şirketlerin aktiviteye ilişkin konjonktürel özellikleri farklılaşabilir, bu nedenle tahmin uyuşmazlığı belirsizlikle ilgi olmayabilir. Ankete cevap verenler, itibarlarını korumak amacıyla konsensüs tahminden fazla sapmak istemeyebilirler, bu durumda geleceğe ilişkin görüşlerini tam olarak yansıtmayabilirler (Dzielinski, 2012)

Ekonomik politika belirsizliği endeksleri de özellikle küresel kriz sonrasında sıklıkla kullanılan belirsizlik ölçütleri arasında yer almıştır. Söz konusu endeksler, politika adımlarına ve bu adımların etkilerine dair belirsizlikleri yansıttıkları düşüncesiyle oluşturulmuştur (Baker vd., 2013; Alexopolous and Cohen, 2009). Baker vd. (2013) tarafından ortaya konulan ekonomik politika belirsizliği endeksi 3 ana bileşenden oluşmaktadır: 1) Gazete makalelerinde ekonomik politika belirsizliğine vurgu yapan anahtar kelimelerin kullanılma sıklığı, 2) süresi dolacak olan vergi düzenlemelerinin sayısı, 3) enflasyon ile federal hükümet ve yerel yönetim harcamalarına ilişkin beklentilerdeki uyuşmazlığı kullanarak elde etmektedir. Genel endeksteki bileşenlerin ağırlıkları sırasıyla 1/2, 1/6 ve 1/3 olarak belirlenmiştir. Baker vd. (2013) tarafından oluşturulan ekonomik politika belirsizliği endeksi birçok çalışmada kullanılmıştır (Gulen ve Ion, 2013; Istrefi ve Piloiu, 2014; Klößner ve Sekkel, 2014; Krol, 2014). Ayrıca, Baker vd. (2013) tarafından ortaya konulan yöntemi kullanarak ekonomik politika belirsizliği endeksi oluşturan çalışmalar da bulunmaktadır. Örneğin, Ermişoğlu and Kanık (2013) Türkiye için, Redl (2015) ise Güney Afrika için ekonomik politika belirsizliği endeksi oluşturmuşlardır.

Ekonomik politika belirsizliğini gösteren endeksler belirsizliğin potansiyel kaynaklarına ilişkin geniş bir kapsam sunarak farklı potansiyel etkilerin daha iyi değerlendirilmesine katkıda bulunurlar, ancak bazı dezavantajlara da sahiptirler. İlk olarak, söz konusu ölçütlerin haber kaynaklı bileşeni dolaylı bir ölçüttür ve kısıtlı sayıda anahtar kelimeye dayalı olması nedeniyle sonuçların seçilen kelimelere hassasiyeti konusunda sorular doğurmaktadır (Alexopoulos ve Cohen, 2015). Seçilen kelimelerin ekonominin gelecekteki

durumuna ilişkin beklentileri tam olarak yansıtıp yansıtmadığı açık değildir. Dzielinski (2012), söz konusu ölçütlerin en iyimser ihtimalle bireysel ve daha az sofistike yatırımcıların görüşünü yansıttığını belirtmektedir. İkinci olarak, birçok vergi düzenlemesi düzenli olarak yenilenmekte ve dolaysıyla belirsizlik kaynağı oluşturmamaktadır (IMF, 2013). Üçüncü olarak, tahmin uyuşmazlığı bileşeni, sadece politika belirsizliği nedeniyle değil, diğer faktörlerin etkisiyle de artış kaydedebilir. Son olarak, bileşenler için belirlenen ağırlıkların zaman içerinde sabit tutulması yerine değiştirilmesi politika belirsizliğinin daha iyi tespit edilmesini sağlayabilir.

Belirsizlik ölçütünün oluşturulmasında sıklıkla kullanılan tekniklerden bir diğeri temel bileşen analizi (TBA) yöntemiyle bir dizi göstergenin ortak değişkenliğin ölçülmesidir. İstatistiksel bir teknik olan temel bileşen analizi çalışmaları Pearson tarafından 1901 yılında başlatılmış, Hotelling tarafından 1933 yılında geliştirmiştir. TBA veri setindeki örüntüleri tespit etmenin, verileri benzerlikleri ve farklılıkları vurgulayacak şekilde göstermenin bir yoludur (Smith, 2002). TBA birbiri ile ilişkili değişkenler içeren veri setinin boyutlarını, veri içerisindeki mevcut değişimleri mümkün olduğunca koruyarak ve saklı yapıları açığa çıkararak indirgemeyi sağlayan bir doğrusal dönüşüm tekniğidir. Dönüşümden sonra elde edilen değişkenler orijinal değişkenlerin temel bileşenleri olarak nitelendirilir. İlk temel bileşen en büyük varyans değerine sahiptir ve daha sonraki temel bileşenler varyans değerleri azalacak şekilde sıralanır. Abdi ve Williams (2010) TBA'nın amaçlarını şöyle özetlemiştir:

1. Önemli bilgilerin korunarak veri setinin boyutunun indirgenmesi

2. Veri setinden en önemli bilginin elde edilmesi

3. Veri setinin daha basit betimlenmesi

4. Değişkenlerin yapısının analiz edilmesi

Orijinal değişkenler arasında korelasyon bulunmuyorsa TBA uygulamanın bir anlamı yoktur. Orijinal değişkenler arasındaki korelasyon yüksek (artı veya eksi), anlamlı bir boyut indirgemesi sağlanabilir.

ECB (2013), Hadow ve Hare (2013), IMF (2012), Creal and Wu (2014) ve Jurado vd. (201) belirsizlik ölçütlerini TBA ile oluşturmuştur. ECB (2013) TBA'yı üç grupta toparlanan göstergelere uygulamıştır. Bunlar: 1) ankete dayalı belirsizlik göstergeleri, 2) risk algılamasını işaret eden finansal piyasalardan elde edilen göstergeler ve 3) ekonomik politika belirsizliği göstergeleri. Benzer şekilde, Hadow ve Hare (2013) İngiltere için 7 belirsizlik göstergesini kullanarak özet bir belirsizlik ölçütü elde etmiştir. Bu göstergeler: hisse senedi örtük oynaklığı, döviz kuru örtük oynaklığı, şirketlerin kazançlarına ilişkin tahmin uyuşmazlığı, büyüme tahminlerinin uyuşmazlığı, Gfk işsizlik oranı beklentileri, yatırımları sınırlayan CBI talep belirsizliği, makalelerde ekonomik belirsizliğe atıfta bulunulma sayısıdır. IMF (2012) ise makroekonomik belirsizliğe odaklanarak Fransa, İtalya, Almanya, Japonya, İngiltere ve Amerika'nın hisse senedi serilerinin standart sapmasının dinamik ortak faktörü aracılığıyla küresel belirsizliği tahmin etmiştir.

Genel olarak, yukarıdaki 4 yöntemle oluşturulan belirsizlik ölçütleri belirsizliğe ilişkin bazı gerçekleri ortaya koymaktadır. İlk olarak, belirsizlik ölçütleri kusursuz değildir. Ancak, ekonomide belirsizliğe ilişkin yön göstermeleri açısından oldukça faydalıdırlar. İkinci olarak, belirsizlik konjonktüre karşı hareket eder; ekonominin gerilediği dönemlerde artar, genişlediği dönemlerde ise azalış kaydeder. Üçüncü olarak, belirsizlik gelişmiş ekonomilere göre gelişmekte olan ve yükselen piyasa ekonomilerinde daha yüksektir. Bu durumun başlıca nedenleri, söz konusu ekonomilerin daha az çeşitlenmiş olmaları, emtialar gibi fiyatı oynak olan mallar bağlı olmaları ve istikrar politikaların daha az etkin olması ve politik şoklara, doğal felaketler gibi olaylara daha fazla maruz kalmaları olarak belirtilmektedir (Bloom 2014).

İktisadi yazında, artan belirsizliğin ekonomik dalgalanmalara yol açabileceği ortaya konmuştur. Belirsizlik ekonomiyi dört ana kanal üzerinden etkileyebilmektedir: Bunlar: i) Talep kanalı, ii) Arz kanalı, iii) Finansal friksiyonlar kanalı, ve iv) Uluslararası yayılma kanalıdır.

Belirsizliğin ekonomik aktiviteyi olumsuz etkileyebileceği görüşü Keynes'e (1937) kadar gitmektedir. Keynes (1937) geleceğin belirsizlikle çevrelenmesinden dolayı yatırımların çalkantıya maruz olduğunu ve bu durumun ekonominin performansında önemli bir rol oynadığını öne sürmüştür.

İktisadi yazında belirsizlik şoklarının yatırımlara etkileri yatırımların 3 temel karakteristiğine dayanarak analiz edilmiştir. Bunlar: 1) yatırımların tersine döndürülememesi (Bernake, 1983; Dixit ve Pindyck, 1994), 2) yatırımların gelecekteki getirisine ilişkin belirsizlik bulunması ve 3) yatırımların daha fazla bilgi elde etmek amacıyla ertelenebilmesidir. İktisadi yazının önemli bir kısmı yüksek belirsizliğin yatırım kararları üzerinde "bekle gör" mekanizması aracılığıyla etkili olduğunu vurgulamaktadır (Bernake, 1983; Dixit ve Pindyck, 1994). Yatırım fırsatıyla hisse senedi opsiyonu arasında paralellik kuran Dixit ve Pindyck (1994) yatırımın tersine döndürülemediği durumlarda belirsizliğin nakit biriktirme ve belirsizliği azaltacak yeni gelişmeleri beklemenin değerini artıracağını savunmuştur.

Hane halkının belirsizliğe yaklaşımı şirketlerinkiyle benzerlik göstermektedir. Hane halkı daha fazla kesinliğe ulaşmak amacıyla yeni bilgileri beklerken ihtiyati tasarruflarını artırmakta (Romer, 1990; Carroll, 1996), dolayısıyla tüketim harcamalarını azaltmakta (Knotek II ve Khan, 2011) veya gelirlerini artırmaktadırlar. Zaman içerisinde belirsizlik dağıldığında ve hane halkı gelecek dönemdeki refahına ilişkin daha fazla bilgi edindiğinde, harcamalarda geçici bir artış görülebilmektedir. ABD'deki tüketicilerin gelirlerine ilişkin belirsizliğin tüketim harcamalarını nasıl etkilediğini araştırmak amacıyla Bernanke'nin (1983) analizini uygulayan Romer (1990), tüketicilerin ekonomik aktiviteye dair daha fazla bilgi edinmeyi beklediklerini ve dayanıklı mallara yönelik harcamalarını erteleddiklerini göstermiştir.

İşgücü piyasası da belirsizlikten olumsuz etkilenebilmektedir. Belirsizlikle karşı karşıya kalan şirketler maliyetli olmasından dolayı işe alım ve işten çıkarım planlarını erteleyebilmektedir. Ek olarak, belirsizlik işgücün yer değişimini yavaşlatarak verimlilik artışını da zayıflatabilmekte ve dolayışla büyümeyi aşağı çekebilmektedir. Bu çerçevede Bloom (2009) şirket seviyesinde teorik bir model oluşturarak belirsizlik şoklarını büyüme ve istihdamla ilişkilendirmiştir. Belirsizliğin ABD ekonomisine Haziran 1962-Haziran 2008 döneminde yaptığı etkileri tahmin edebilmek için bir dizi vektör otoregresif model de kuran Bloom (2009) ekonomik aktivite ve belirsizlik arasında güçlü bir konjonktür karşıtı ilişki bulmuştur. Etki-tepki fonksiyonları, belirsizlik şoklarının önce istihdam ve büyümede azalışa yol açtığını, daha sonra ise toparlanma kaydedildiğini ve başlangıç seviyesinin aşıldığını göstermiştir.

Son dönemde iktisadi yazında belirsizliğin makroekonomik performansı etkileyebileceği ek kanallar da öne sürülmüştür. Bunlar arasında finansal friksiyon teorileri belirsizliğin finansal piyasalarda risk primini yükseltebileceği, bu durumda sermayenin maliyetinin artabileceği ve büyümenin olumsuz etkilenebileceğini savunmaktadır (Arellano vd., 2012; Gilchrist vd., 2013; Popp ve Zhang, 2015; Bonciani ve Roye, 2015). Arellano vd. (2012) bir genel denge modeli kurarak şirket seviyesindeki belirsizlik artışının finansal friksiyonlarla etkileşimle birlikte ekonomik aktivitede gerilemeye yol açtığını göstermiştir. Söz konusu modelin, 2007/2009 tarihlerinde yaşanan büyük resesyon (great recession) esnasında büyümede ve istihdamda kaydedilen gerilemenin sırasıyla % 67'sini ve % 73'ünü açıkladığını bulmuşlardır. Popp ve Zhang (2015) belirsizlik şokların ekonomiye ve finansal piyasalara olumsuz etki yaptığını, söz konusu etkinin resesyon dönemlerinde daha fazla olduğunu bulmuştur. Finansal kanalın rolünü de araştıran Popp ve Zhang (2015) belirsizlik şoklarının yayılmasında finansal kanalın önem arz ettiğini, bu kanalın özellikle resesyon dönemlerinde daha fazla rol üstlendiğini göstermiştir.

Belirsizlik şoklarının uluslararası yayılması da bazı çalışmalarda incelenmiştir. Söz konusu çalışmalar yayılmanın derecesini, ihracatçı/ithalatçılarını ve dinamiklerini araştırmıştır. Yayılmanın, gelişmiş ekonomiler arasında (Colombo, 2013; Klossner ve Sekkel, 2014; Mumtaz ve Theodoridis, 2012) ve gelişmiş ekonomilerden (veya küresel şoklar) yükselen piyasa ekonomilerine doğru (Gauvin vd., 2014; Carriere-Swallow ve Cespedes, 2013) nasıl olduğu incelenmiştir. Örneğin, Colombo (2013) ABD'de yaşanan ekonomik politika belirsizliklerinin Avrupa'nın makroekonomik değişkenleri üzerindeki etkisini yapısal vektör otoregresif model aracılığıyla irdelemiştir. Colombo (2013) ABD politika belirsizliğinin Avrupa'da sanayi üretimi ve fiyatlarda gerilemeye yol açtığı sonucuna varmıştır. Carriere-Swallow ve Cespedes (2013) ABD'de yaşanan belirsizlik şoklarının 40 ülkenin yatırım ve tüketim harcamalarını nasıl etkilediğini incelemiştir. Carriere-Swallow ve Cespedes'in (2013) bulguları etkinin heterojen olduğunu, belirsizlik şokları karşısında yükselen piyasa ekonomilerinde yatırım ve tüketim harcamalarının gelişmiş ülkelere göre daha fazla düşüş kaydettiğini göstermiştir. Carriere-Swallow ve Cespedes (2013) bu durumu yükselen piyasa ekonomilerinde finansal piyasaların derinliğinin daha az olmasıyla açıklamış, söz konusu düşüşte kredi kanalının etkili olduğunu belirtmiştir.

Belirsizliğin ekonomi üzerindeki etkisini anlamak uygun politika tepkisinin belirlenebilmesi açısından önemlidir. Birçok ampirik çalışma belirsizliğin etkilerini çeşitli vektör otoregresif modelleri kullanarak tahmin etmiştir (Baker vd., 2013, Jurado vd., 2013, Bachmann vd., 2012; Aastveit vd., 2013; Istrefi and Piloiu, 2014; Leduc and Liu, 2015; Rossi and Sekhposyan, 2015).

Sims tarafından 1980 yılında geliştirilmiş olan VAR yaklaşımı, birbirleriyle ilişkili olduğu düşünülen değişkenleri birlikte ele alarak nasıl hareket ettiklerini gösteren bir denklem sistemidir. Söz konusu sisteminde, tüm içsel değişkenler kendi gecikmeleri ve diğer değişkenlerin gecikmeli değerleri ile açıklanmaktadır. Modelin oluşumuna etki eden katı bir iktisadi teorinin varlığı kabul edilmez. VAR modelleri değişkenler arasındaki ilişkilerin incelenmesinde ve rassal şokların değişkenler sistemine olan dinamik etkisinin analizinde kullanılmaktadır.

Değişkenler arasındaki ilişkiler, etki tepki fonksiyonları ve varyans ayrıştırması yoluyla analiz edilebilmektedir. Etki-tepki fonksiyonları, modeldeki hata terimine verilen bir standart sapmalık şokun, diğer değişkenlerin şu anki ve gelecekteki değerlerini ne yönde ve ne kadar etkilediğini gösterir. Bir makroekonomik büyüklüğün üzerinde en etkili değişkenin hangisi olduğu ise varyans ayrıştırması yoluyla ile tespit edilir. VAR sisteminin dinamik yapısı içerisinde bir değişkene verilen şok sadece o değişkeni değil, diğer değişkenleri de etkilemektedir (Brooks, 2008). Varyans ayrıştırması şokların değişkenleri etkilemede zaman içerisindeki göreli önemini gösterir.

Bu tez, iktisadi yazının üç farklı kısmıyla ilişkilidir. İlk olarak, belirsizliğin tanımı ve kaynaklarıyla ilgilidir. İkinci olarak, belirsizliğin ölçülmesine ilişkin son dönem çalışmalarla alakalıdır. Üçüncü olarak, belirsizliğin makroekonomik değişkenler üzerindeki etkileriyle ilinti kurmaktadır. İktisadi yazının söz konusu üç kısmı, Türkiye için bir belirsizlik ölçütü oluşturarak ve belirsizliğin Türk ekonomisine etkilerini tahmin ederek bütüncül hale getirilmiştir.

Çalışmada belirsizlik ile ne kastedildiğinin iki ana yönü bulunmaktadır. Birincisi belirsizliğin doğası ile ilgili, ölçülemez ve gözlemlenemez nitelikte olmasıdır. Bu anlamda, Knightian veya Keynesyen belirsizliğe atıfta bulunmaktadır. İkincisi ise belirsizliğin

içeriğini kapsamaktadır. Belirsizlik çeşitli kaynaklardan doğabilmekte ve dolayısıyla farklı bileşenleri içerebilmektedir. Bu özelliğini yansıtabilmek için, belirsizlik ölçütü üç ana finansal piyasadan ve Beklenti Anketi'nden çeşitli değişkenler kullanılarak TBA aracılığıyla oluşturulmuştur.

Tablo 1 TBA için seçilmiş değişkenleri tanımları ve kaynaklarıyla birlikte sergilemektedir. Söz konusu değişkenler tarihsel oynaklığı, örtük oynaklığı ve tahminlerin uyuşmazlığını (ankete dayalı) yansıtmaktadır. Tarihsel oynaklık gerçekleşmiş oynaklığı, örtük oynaklık ise önceden tahmin edilen gelecek dönem oynaklığını göstermektedir (Chang and Feunou, 2014). Değişkenlerin seçiminde iki tür oynaklığa da yer verilmesi finansal piyasalardaki şartların daha iyi anlaşılmasına yardımcı olmaktadır. Ankete dayalı değişken de ekonomik aktörlerin görüşlerini doğrudan yansıtarak resmi tamamlamaktadır. Ayrıca, değişkenler başlıca 3 piyasadaki (tahvil piyasası, hisse senedi piyasası ve döviz kuru piyasası) şartları yansıtmakta ve böylelikle belirsizlik ölçütünün finansal piyasaların sadece belirli bir kısmındaki stresi yansıtmasının önüne geçilmesine yardımcı olmaktadır.

Tablo 1'de yer alan değişkenlerin önce 8 tanesi (BIST100, döviz kurunun örtük oynaklığı, gösterge faiz oranı, EMBI-Türkiye, çapraz para swap oranı, enflasyon beklentileri, örtük forward getiri ve faiz swap oranı) daha sonra ise 5 tanesi (BIST100, döviz kurunun örtük oynaklığı, gösterge faiz oranı, EMBI-Türkiye ve döviz kuru beklentisi) kullanılarak iki belirsizlik ölçütü oluşturulmuştur.

TBA uygulamadan önce Tablo 1'deki serilerin aylık oynaklığını elde edebilmek için 20 işgünü kayan ortalamalarının varyasyon katsayısı hesaplanmış, daha sonra serilerin ay sonu değerleri seçilmiştir. 8-değişkenli ve 5-değişkenli belirsizlik ölçütlerinin ilki, belirsizliğin Türkiye ekonomisine etkilerini tahmin etmek amacıyla oluşturulan vektör otoregresif analizinde temel belirsizlik ölçütü olarak, ikincisi ise sağlamlık testinde alternatif ölçüt olarak kullanılmıştır.

Tablo 1 Temel bileşen analizinde kullanılan değişkenler

Değişken	**Tanımı**	**Kaynak**
BIST100	Borsa İstanbul Pay Piyasası'nda ana endeks olarak kullanılmakta, 100 şirketin payını kapsamaktadır.	Bloomberg
Döviz kurunun örtük oynaklığı	Döviz kurunun tahmin edilen gelecek dönem oynaklığı, Türk Lirası/ABD doları	Bloomberg
Gösterge faiz oranı	Gösterge hazine bonosu faiz oranı, 2 yıl	Bloomberg
Çapraz para swap oranı	Türk Lirası/ABD doları sabit-değişken swap oranı, 1 yıl	Bloomberg
EMBI-Türkiye	Türkiye'nin tahvilleri ile ABD tahvilleri arasındaki getiri farkı	Bloomberg
Döviz kuru beklentisi	Bankalararası döviz piyasası gelecek 12 ay sonundaki döviz kuru beklentisi	Merkez Bankası Beklenti Anketi
Örtük forward getiri	Karşılanan faiz haddi paritesi teoremi ile hesaplanan yıllık faiz oranı, 3 ay	Bloomberg
Faiz oranı swapı	Türk Lirası cinsinden sabit-değişken faiz swapı	Bloomberg
Enflasyon beklentileri	Gelecek 12 ayda beklenen TÜFE	Merkez Bankası Beklenti Anketi

Not: Serilerin oynaklıkları kullanılmıştır.

Oynaklık serilerinin TBA için uygun olup olmadığını tespit edebilmek amacıyla ilk olarak oynaklıklar görsel olarak analiz edilmiştir. Söz konusu analiz, verilerin oynaklığında birlikte bir hareket eğilimi olduğunu ve dolayısıyla TBAnın uygulanabileceğini göstermiştir. İkinci olarak, serilerin TBAya uygunluğunu belirlemek amacıyla Kaiser-Meyer-Olkin örneklem uygunluk ölçüsü ile incelenmiştir. KMO değeri her bir değişken için hesaplanmakta ve toplam bir değer de bulunmaktadır. KMO değeri 0 ile 1 arasında değişebilmektedir. KMO değerinin küçük olması değişkenlerin TBA uygulayabilmek için

fazla ortak noktası olmadığını göstermekte; yüksek olması ise her bir değişkenin, diğer değişkenler tarafından mükemmel bir şekilde tahmin edilebileceği anlamına gelmektedir. KMO'nun 0.6'dan yüksek çıkması TBA'nın uygunluğuna işaret etmektedir (OECD, 2008). KMO değerinin 0.5'den düşük olması halinde faktör analizine devam edilemeyeceği belirtilmektedir. Tablo 2'de yer alan KMO değerleri, tüm değişkenlerin KMO değerinin 0.67'nin üzerinde olduğunu, 5 ve 8 değişken için bulunan toplam KMO değerlerinin sırasıyla 0.72 ve 0.78 olduğunu, dolayısıyla TBAnın uygulanabileceğini göstermektedir.

Tablo 2 KMO değerleri

	5 değişken	**8 değişken**
BIST100	0.86	0.75
Döviz kurunun örtük oynaklığı	0.75	0.75
Gösterge faiz oranı	0.73	0.85
EMBI getiri farkı	0.78	0.82
Döviz kuru beklentisi	0.70	-
Çapraz swap oranı	-	0.70
Örtük forward getiri	-	0.73
Faiz oranı swapı	-	0.89
Enflasyon beklentileri	-	0.67
Toplam	0.77	0.78

Stata 12 programı kullanılarak 5 değişken ve 8 değişkenle yapılan iki ayrı TBA sonucunda elde edilen ilk temel bileşenler toplam değişkenliğin sırasıyla % 56'sını ve %50'sini açıklamakta ve Türkiye için belirsizlik ölçütlerini temsil etmektedir. Çeşitli kaynaklardan türeyen ve gözlemeyen belirsizliği özet bir istatistik içerisinde toplayan söz konusu ölçütler, Türkiye için son on yılda dört önemli belirsizlik olayını yakalamaktadır. Yerel ve uluslararası gelişmelerin etkisini bireysel veya beraber olarak yansıtan bu olaylar, Mayıs 2006 (yerel ekonomik ve siyasi konular), Ekim 2008 (Lehman Brothers'ın batışı), 2011 (Avrupa krizi) ve 2013 yılı yaz aylarında (FED'in varlık alımlarını azaltacağı açıklamasının Gezi olayları ile çakışması) gerçekleşmiştir.

Belirsizlik şoklarının Türkiye ekonomisine etkilerini tahmin etmek amacıyla Eviews 8 programı kullanılarak Haziran 2005-Ağustos 2015 dönemi için 7 değişkenli bir vektör

otoregresif modeli oluşturulmuştur. Modelde yer verilen değişkenler belirsizlik ölçütü, ekonomik şartlar endeksi, işsizlik oranı, sanayi üretim endeksi, tüketici fiyat endeksi (TÜFE), kredi faiz oranı ve tüketici güven endeksidir. Veriler mevsimsellikten arındırılmıştır. Tablo 3'de verilerin tanımları ve kaynakları sunulmaktadır.

Tablo 3 VAR analizinde kullanılan değişkenler

Değişken	**Tanım**	**Kaynağı**
Belirsizlik ölçütü	TBA yoluyla elde edilen ilk temel bileşen	Bu tezde yapılan hesaplamalar
Sanayi üretim endeksi	İmalat sanayi, madencilik ve taş ocakçılığı ile elektrik, gaz, buhar iklimlendirme üretimi ve dağıtımını içermektedir.	TUIK
İşsizlik oranı	İşsiz nüfusun işgücü içindeki oranı.	TUIK
Tüketici fiyat endeksi	Hane halklarının tükettiği mal ve hizmet fiyatlarını göstermektedir.	TUIK
Kredi faiz oranı	Konut, taşıt ve bireysel kredilerin ağırlıklı ortalaması	Merkez Bankası Elektronik Veri Dağıtım Sistemi
Tüketici güven endeksi	Dört alt-bileşenden oluşmaktadır: Finansal durum beklentisi, genel ekonomik durum beklentisi, işsiz sayısı beklentisi ve gelecek 12 ayda tasarruf yapma ihtimali.	TUIK-TCMB
Ekonomik şartlar endeksi (BOFA-Merrill Lynch)	Reel ekonomik aktiviteyi gösteren bileşik gösterge	Bloomberg

Sanayi üretimi ekonomik büyümeyi temsil etmesi nedeniyle veri setine dahil edilmiştir. Sanayi üretimi ve işsizlik oranı reel ekonominin görünümü göstermektedir. Tüketici güven endeksi ise tüketim harcamalarının öncü göstergesi olabileceği ve dolayısıyla reel ekonominin durumuna ilişkin bilgi verebileceği göz önünde bulundurularak veri setine eklenmiştir. Kredi faiz oranına ise finansal piyasa kanalına ilişkin bilgi sağlayabileceği

düşüncesiyle modelde yer verilmiştir. Öte yandan, bozulan ekonomik görünüm ve artan belirsizlik dönemleri aynı anda gerçekleşebilmektedir. Kontrol değişkeninin kullanılmasının, belirsizlik ölçütünün sadece görünümdeki bozulmayı yakalama ihtimalini en aza indirgemeye yardımcı olacağı düşünülmektedir. Bu nedenle, ekonomik şartlar endeksi belirsizliğin etkilerinin ekonomik görünümdeki bozulmanın etkilerinden ayrıştırmak için kontrol değişkeni olarak kullanılmıştır.

VAR modeli kurulmadan önce, belirsizlik ölçütü ve ekonomik şartlar endeksi hariç tüm veriler Hodrick-Prescott filtresinden geçirilmiş, verilerin durağanlığı sağlanmıştır. Ayrıca, Augmented Dickey Fuller ve Phillips Perron birim kök testleri uygulanmıştır. Model kurulurken, değişkenlerin sıralaması iktisadi yazında genel kabul görmüş sıralamaya göre yapılmıştır. Belirsizlik ölçütü ilk sıraya konulmuş, daha sonra fiyat değişkenlerinin daha erken, miktar değişkenlerinin ise daha geç tepki vereceği varsayımıyla değişkenler aşağıdaki gibi sıralanmıştır:

1. Belirsizlik ölçütü

2. Ekonomik şartlar endeksi

3. Tüketici güven endeksi

4. Tüketici fiyat endeksi

5. Kredi faiz oranı

6. Sanayi üretim endeksi

7. İşsizlik oranı

Modelin gecikme uzunluğu, otokorelasyon ve değişen varyans problemlerini ortadan kaldıracak minimum değer olan 3 olarak belirlenmiştir Etki tepki analizi Cholesky ayrıştırmasına göre yapılmıştır. Cholesky ayrıştırmasında değişken sıralaması önemlidir, herhangi bir değişken eş zamanlı olarak kendinden sonra sıralanan değişkene bağlı

değildir. Modelde yapılan sıralamaya göre belirsizlik ölçütü diğer şoklara tepki vermezken, ekonomik koşullar endeksi, tüketici güven endeksi, enflasyon, kredi faiz oranı, sanayi üretimi endeksi ve işsizlik oranı belirsizlik şoklarına tepki vermektedir.

Türkiye için kurulan VAR modeli, belirsizlik şoklarının makroekonomik etkilerine dair iktisat yazınındaki bulguların çoğuyla paralellik arz etmektedir. Buna ek olarak, ülkeye özgü sonuçlar da elde edilmiştir. Sonuçlar, değişkenleri farklı sıralayarak, alternatif bir belirsizlik ölçütü kullanılarak, değişken setinin sayısı azaltılarak ve daha kısa örneklem dönemi kullanılarak yapılan bir dizi test karşısında sağlamlık göstermiştir. Modelin sonuçları, belirsizlik ölçütü üzerindeki beklenmedik şokların sanayi üretiminde düşüş, işsizlik oranında, enflasyonda ve kredi faiz oranında yükselişle birlikte tüketici güveninde bozulmayla ilişkili olduğuna dair delil sunmaktadır.

Sonuçlar, belirsizliğin sanayi üretimi ve işsizlik üzerindeki etkilerinin bekle-gör mekanizmasıyla ortaya çıkacağı görüşüyle kısmen tutarlılık göstermektedir. Belirsizlikteki artış, üretim ve istihdam üzerinde hızlı ve kalıcı etki yapmaktadır. Sanayi üretimi üzerindeki en yüksek etkiye 6. ayda ulaşılmakta ve etki 18. ayda sona ermektedir. Sanayi üretiminin tepkisinin şekli Dennis ve Kannan'ın (2013) Birleşik Krallık için elde ettiği bulgularıyla çok benzerdir. İşsizlik oranı üzerindeki maksimum etkiye ise 2 ay daha geç ulaşılmakta ve şokun etkisi 20 ay sonra geçmektedir. Şokun etkisinin geçmesinin ardından üretimde hızlı bir artış gözlenmemesi ilginç bulgulardan birisidir. Bu durum, belirsizlik şoklarının etkisini "bekle gör" mekanizmasına ek olarak, iktisat yazınında öne sürülen diğer kanalların da şekillendiriyor olabileceğine işaret etmektedir. Bu kanallardan ikisi finansal friksiyon ve güven kanalıdır. Belirsizlik karşısında, ülkeye özgü koşullar nedeniyle finansal piyasalarda kredi kısıtları ortaya çıkabilmektedir. Ayrıca, belirsizliğin artmasıyla birlikte tüketici güveninin bozulması da tüketim harcamalarını aşağı çekerek reel ekonomiyi olumsuz etkileyebilmektedir (Karasoy ve Yüncüler, 2015; Bram ve Ludvigson, 1998; Ludvigson, 2004; Dion, 2006; Acemoglu ve Scott, 1994).

Çalışmanın sonuçları, belirsizlik şoklarının ekonomiyi finansal friksiyon (kısıt) ve güven kanalları yoluyla etkileyebildiğine ilişkin görüşlere destekte bulunmaktadır. Türkiye'de belirsizlik şoklarının ardından hane halkının kredi kullanma maliyetleri artmakta, tüketici güveni ise bozulmaktadır. Belirsizliğin, tüketici güveni ve kredi faiz oranı üzerindeki etkisi

sanayi üretimi ve işsizlik oranına kıyasla daha keskin ve hızlı olmaktadır. Belirsizlik şokunun ardından tüketici güveni 2. ayda dibe inmekte, 11-12 ay içerisinde da şokun etkisi ortadan kalkmaktadır. Kredi faiz oranındaki yükseliş de 3 ayda tepe noktasına ulaşmakta, şokun etkisi 9. ayda sona ermektedir.

Öte yandan, belirsizlik şokları karşısında TÜFE hafif artış kaydetmektedir. Bu sonuç, Redl (2015) tarafından Güney Afrika için yapılan çalışmanın bulgularıyla tutarlılık göstermektedir. Türkiye ve Güney Afrika'da enflasyonun belirsizlik şoklarına karşı etki-tepki fonksiyonları benzer görünmektedir (Türkiye daha erken tepki vermektedir). Ancak gelişmiş ülkeler için yapılan bazı çalışmalar, belirsizlik karşında enflasyonun, talepteki daralma nedeniyle, düşüş kaydettiğini bulmuştur. Örneğin, Leduc ve Lieu (2015) belirsizlik şoklarının ABD'de enflasyonu aşağı çektiğine dair delil sunmaktadır. Türkiye'de enflasyonun aksi yönde tepki vermesi 2 nedene bağlanabilir. Birincisi, Türkiye'nin yüksek ve kronik enflasyon geçmişi enflasyon beklentilerinde hızlı bir bozulmaya yol açabilir. İkincisi, Türkiye gibi dış açığı yüksek olan ülkeler, sermaye akımlarının tersine dönmesi ve para biriminin değer kaybetmesine maruz kalabilmektedir. Belirsizliğin arttığı durumlarda sermaye çıkışı olması ve Türk lirasının değer kaybetmesi, enflasyondaki yükselişin ardındaki nedenlerden biri olarak düşünülebilir. Bu durum belirsizlik zamanlarında döviz kurundan enflasyona geçisin, talepteki daralmaya baskın olduğuna işaret etmektedir.

Sonuçlar, belirsizlik şoklarının prototip talep şokları gibi etki yaptığı görüşüne karşı delil sunmaktadır. Sanayi üretimi ve enflasyonun etki-tepki fonksiyonları birlikte değerlendirildiğinde, belirsizlik şoklarının Türkiye'de arz kanalıyla hareket ettiğini ima etmektedir. Söz konusu şoklar ekonomik aktiviteyi aşağı çekmekte, enflasyonu ise yukarı itmektedir. Bu durumda, politika yapıcılar için ekonomiyi canlandırmak ve fiyat istikrarını sağlamak arasında bir değiş-tokuş ortaya çıkmaktadır. Talep şoklarında ise ekonomik aktivite ve enflasyon aynı yönde etkilenmekte, politika tepkisi göreli olarak daha kolay olabilmektedir.

Toplu olarak, TBA ile elde edilen belirsizlik ölçütü kullanılarak kurulan 7-değişkenli VAR modeli, Türkiye'de belirsizlik şoklarının işsizlikte artışa, sanayi üretiminde düşüşe, enflasyonda ve kredi faiz oranlarında yükselişe, tüketici güveninde ise bozulmaya yol

açtığını ortaya koymaktadır. Sonuçlar, belirsizlik ölçütünün şirketlerin, tüketicilerin ve finansal kuruluşların belirsizlik zamanlarındaki temkinli davranışlarını yansıttığını göstermektedir.

Varyans ayrıştırması sonuçları incelendiğinde, belirsizlik şoklarının 36 aylık dönemde sırasıyla, kredi faiz oranı, işsizlik oranı, sanayi üretimi, tüketici güveni, ekonomik şartlar ve enflasyon üzerinde etkilerinin önemli olduğu görülmüştür. Belirsizlik şokları, sanayi üretimi ve işsizlik oranındaki tahmin hata varyanslarının % 25 ve % 26'sını açıklamaktadır. Kredi faiz oranı ve tüketici güven endeksinin varyans ayrıştırması sonuçları, belirsizlik şoklarının 36 ay sonunda tahmin hata varyanslarının % 30 ve % 17'sini açıkladığını göstermektedir. Belirsizlik şokları, ekonomik şartlar endeksi ve enflasyondaki tahmin hata varyanslarının yaklaşık % 15-18 ve %10'unu açıklamaktadır.

Daha genel olarak sonuçlar, politika yapıcıların belirsizlik artışına karşı, söz konusu artışın makroekonomik temellerde bozulmadan kaynaklandığına inanmasalar bile, tetikte olması gerektiğine işaret etmektedir. Stres zamanlarında politika adımlarının ertelenmesi, şeffaflık eksikliği ve belirsizliği artıracak şekilde aşırı aktif adımlar atılması ekonomiye zarar verebilir. Hızlı ve büyüklüğü dikkatli ayarlanmış politika tepkisi verilmesi ve söz konusu tepkinin iletişiminin açık bir şekilde yapılması belirsizliğin etkilerinin hafifletilmesine yardımcı olacaktır.

Türkiye gibi belirsizliğin daha yüksek olabileceği yükselen piyasa ekonomilerinde, belirsizliğin göz ardı edilmesi politika hataları yapma ihtimalini artırabilir. Bernanke'nin (2007) altını çizdiği gibi belirsizlik altında politika kararları ekonominin durumuna ve yapısına ilişkin çeşitli politika senaryolarını dikkate almalıdır. Bu politika kararları belirsizliğin olmadığı durumlardaki optimal kararlardan oldukça farklı görünebilir. Belirsizliğin politika oluşturma sürecine dahil edilmesi uygun politika tepkisinin geliştirilebilmesi için gereklidir.