December 2019

Economic Policy Uncertainty and Macroeconomic Activity: An Asymmetric Approach

Majid Makinayeri
University of Wisconsin-Milwaukee

ECONOMIC POLICY UNCERTAINTY AND MACROECONOMIC ACTIVITY: AN ASYMMETRIC APPROACH

by

Majid Makinayeri

A Dissertation Submitted in
Partial Fulfilment of the
Requirements for the Degree of

Doctor of Philosophy
in Economics

at
The University of Wisconsin-Milwaukee
December 2019

ABSTRACT

ECONOMIC POLICY UNCERTAINTY AND MACROECONOMIC ACTIVITY: AN ASYMMETRIC APPROACH

by
Majid Makinayeri

The University of Wisconsin-Milwaukee, 2019
Under the Supervision of Professor Mohsen Bahmani-Oskooee

In the new global economy, uncertainty has become a critical determinant of financial and economic stability. This thesis aims to study the impact of uncertainty on a set of macroeconomic variables such as demand for money, investment, and consumption. Different measures of uncertainty are used by scholars in the investigation of money demand, investment, and consumption like monetary and output uncertainty. This study employs a more general and inclusive measure of uncertainty, policy uncertainty, which measures uncertainty in fiscal, regulatory and monetary policies. By implementing a Nonlinear Autoregressive Distributed Lag (ARDL) model, I aim to identify possible nonlinear effects of uncertainty on economic variables, which help us to have a better understanding of its role in each of the G7 economies. The advantage of choosing this methodology is that it allows researchers to explain both long-run relationships and short-run dynamics of money demand, investment, and consumption. The empirical results exhibit that policy uncertainty has asymmetric effects on the macroeconomic variables in all G7 economies. These asymmetric reactions of the macroeconomic variables to fluctuations in policy uncertainty imply positive and negative shocks in economic policy uncertainty could not offset the effects of each other,

and they have persistent impacts on demand for money, investment and consumption in the long-run.

To

My Parents

And

My Wife

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Chapter 1. Introduction

The political challenges and changes in economic and trade policies around the world lead to a rise in uncertainty about their future outcomes, and uncertainty has come to play an influential role in determining macroeconomic variables. As a result, this thesis intends to study the impact of uncertainty on major economic variables, such as demand for money, investment, and consumption.

Money demand is one of the oldest and essential topics in economics, especially in monetary economics. Therefore, it has been studied many times in past decades to help economists and policymakers to understand and conduct better monetary policy. Among other determinants of money demand, uncertainty has received considerable attention in the study of money demand, since it has been considered as a critical factor of money demand by Friedman (1984). Uncertainty is applied extensively as a crucial informative variable in money demand. In economics theories, people hold money to insure themselves against various uncertainty in the future. The first part of this thesis aims to study the effects of a particular measure of uncertainty, which is policy uncertainty on money demand to gain a better knowledge of the demand for money.

The second and third part of this thesis investigates how uncertainty affects investment and consumption, which are primary factors of economic growth around the world. Economists like Bernanke (1983) and Bloom (2009) argue that investment, consumption and consequently economic growth decline when a level of uncertainty increases in the economies. Indeed, a rise in uncertainty leads to suspension of hiring and investment by firms, and the suspension of consumer expenditure. Although economic theory predicts that change in uncertainty leads to fluctuation in investment, consumption and economic growth, it doesn't explain whether this relation between investment, consumption, and uncertainty is symmetric or asymmetric. The existence of an asymmetric relationship between consumption, investment and uncertainty could explain how a short-run increase in uncertainty could lead to the long-run decline in investment, consumption and economic growth.

Previous studies have used different measures of uncertainty in the investigation of the relationship between uncertainty and macroeconomic variables, such as dispersion in analyst forecasts or volatility of stock returns, price, output, exchange rate, etc. But, none of these measures have been designed to capture policy uncertainty, and it's not clear what percent of them are the results of the political and regulatory uncertainty. Baker, Bloom, and Davis (2013) developed an index of aggregate policy uncertainty, which helps to solve this problem. The economic policy uncertainty (EPU) is now available for 23 countries on http://www.policyuncertainty.com.

Although there are differences in the construction of this index in different countries, the primary procedure is the same. For example, economic policy uncertainty (EPU) in the U.S. is a weighted average of three separate components. The first one is based on counts of newspaper articles, which contain key terms related to policy uncertainty like 'tax,' 'spending,' 'regulation,' 'central bank,' 'budget,' and 'deficit,' etc. This component requires a search of the archive of the ten most circulated newspapers in the U.S. This element is the most important one and has the largest weight ,among other factors. The second element considers uncertainty related to change in tax codes by calculating the dollar amount of tax provisions, which are going to expire in the future. The last item focuses on fiscal and monetary uncertainty by using differences between the forecast of CPI and government expenditure and their real values. Finally, EPU is measured as the weighted average of the normalized version of these three components. The weights for each of these three parts are one-half, one-sixth, and one-third, respectively. This index could capture important economic and political phenomena like wars, financial crises, and major federal elections. Consequently, the EPU index could be a valid measure of uncertainty in economic research.[1]

This thesis implements a Nonlinear Autoregressive distributed lag (NARDL) model to assess the impact of policy uncertainty on money demand, investment, and consumption. This method captures not only long-run relationship and short-run dynamics between these variables but also assesses possible asymmetric associations between them.

This thesis is organized as follows: The current chapter provides the introduction, background, and motivation for the thesis. Chapter 2 investigates the impact of uncertainty on demand for money. Chapter 3 studies the relationship between investment and uncertainty. Chapter 4 explores how uncertainty affects consumption, and finally, Chapter 5 summarizes the findings and draws relevant conclusions.

1- Gulen, H., & Ion, M. (2015). Policy uncertainty and corporate investment. *The Review of Financial Studies*, *29*(3), 523-564.

Chapter 2. Money Demand

Demand for money is one of the most established topics in macroeconomics and plays an imperative role in monetary policy. Many scholars, policymakers, and governors focus on money demand function, which is basically due to the role of money in the economy, notably in the implementation of monetary policy. Indeed, money demand provides a significant amount of information about how people manage their asset portfolios. As a result, it is one of the most important pieces of the puzzle in an efficient and effective monetary policy strategy.

Historically, many central banks around the globe have used money demand to control inflation by proper modification in the money supply. To implement an effective monetary policy, policymakers use the money demand function to forecast money holdings by economic agents, and they try to control inflation by adjusting the money supply. As a result, proper specification and estimation of money demand play a critical role in designing both monetary and fiscal policy. The money demand model is a vital component in most traditional macroeconomic models.

Conventionally, demand for real money balances is related to a scale variable and the opportunity cost. Before 1973, the theoretical framework was considered settled, and the evidence showed that the money demand function was stable. After 1973, however, this conventional money demand function performed weakly, showing incorrect forecasting ability and instability. Consequently, researchers tried to find different reasons for this instability.

Since Friedman (1984) classified uncertainty as another determinant of the demand for money, uncertainty is employed widely as a critical explanatory variable in money demand. Based on economic theory, money plays three main roles: a medium of exchange, unit of account, and a store of value. Since each of these functions helps individuals to control the problems arising from uncertainty, demand for money is influenced by the general level and character of uncertainty in the economy. Based on different studies, uncertainty measures could affect money demand negatively or positively, depending on the applied measure of uncertainty.

This study uses a new measure of uncertainty, which is policy uncertainty to study how uncertainty affects demand for money. The policy uncertainty index was estimated by Backer et al. (2013), and it is available to the public(http://www.policyuncertainty.com). This index is measured mostly by analyzing the article in major newspapers. This index could capture important economic and political phenomena like the financial crisis and 9/11 and could be a valid measure of uncertainty in economic research.

Furthermore, different types of money demand specifications are used to explain the break down in money demand. Before the 1970s partial adjustment framework was the main specification of money demand, but after weak behavior in the missing money period in the 1970s, new specifications have been applied. One of the most popular methods is the Error-correction model, which can provide a statistical explanation for observed sluggishness in the portfolio allocation behavior of economic agents. However, some researchers point out that such slowness could be the sign of market rigidities, such as portfolio adjustment costs, which may also lead to nonlinearities in money demand functions.

The buffer stock model is one of the most important theoretical models that could explain such nonlinearity in the behavior of money demand functions. The motivation behind such a model is that, because of adjustment costs, it may not be optimal for agents to reallocate their asset portfolios after a shock to bring their balances back to the equilibrium level straight away. On the contrary, the optimal reaction may be to let monetary balances change as a temporary buffer. Only when the divergence of money demand from the preferred levels develops into relatively large or go beyond some particular- thresholds, agents bring their balances back to the target.[2]

Although money demand is an old topic in economics, until recently economists have neglected nonlinearities in empirical money demand modeling by opting a linear time series specification. Unlike the numerous studies that have used linear frameworks to test for the stability and determination of the money demand function, this thesis applies nonlinear modeling by the mean of the nonlinear ARDL approach of Shin *et al* (2014). The advantage of choosing this methodology is that it helps researchers to explain both long-run relationships in the money demand function and also short-run dynamics of money demand by considering nonlinearities and asymmetries.

2.1. Literature Review

Economists have focused on the theory of money demand as the center of macroeconomic models for many years. The classical economists believe that money being held by people as a numeraire and medium of exchange. Pigou (1917) implicitly mentions the concept of money demand through the quantity theory of money with implications that money demand increases proportionally with positive changes in real income. Cambridge economists through the cash balance approach explicitly define the demand for money as a function of real income.

Keynesian economists introduce liquidity preference theory by extending the cash balance approach. This approach considers transactions, precautionary and speculative motives for money holdings and introduces the opportunity cost of holding money as an explanatory variable in addition to real income. Real income is expected to have a positive correlation with money demand while opportunity cost is negatively correlated with money demand.

2- Laidler, D. (1984). TheBuffer Stock Notion in Monetary Economics. The Economic Journal, 94, 17-34.

Many other alternative approaches to money demand theory are introduced in literature during the post–Keynesian period, which attempts to explain the relationship between real money balances, real income, and interest rates. The inventory approach provides evidence that money demand for transaction purposes directly varies with actual income, but not so proportionally, and has an inverse relationship with interest rates. Tobin (1956b) expands the portfolio theory of money by focusing on the asset function of money. He considered money as part of a portfolio of many assets with naturally different yields and risk features. Based on this approach money demand falls when interest rate rises if the substitution effect neutralizes the income effect. He also argues that wealth and expectations could affect money demand.

The monetarist economists consider money as an asset. In their theory, the money demand function was driven the same as the demand for any other asset. They argue that since money demand is insensitive to interest rate changes, the velocity of circulation is highly predictable, and money demand is stable and can be approximated simply as a function of permanent income. Indeed, Friedman's theory of money demand was a resuscitation of the quantity theory because it restores the importance of controlling money supply as the means of controlling inflation that requires a stable money demand function.

In the buffer stock theory, money is like a buffer because it is liquid and the cost of adjusting money balances is less than the cost of adjusting holdings of other assets. Based on buffer stock, observed instability in money demand could be a sign of a time-consuming adjustment process rather than unstable money demand.

In conclusion, money demand is examined from different angles in various theories, and resulting implications are more or less the same. In all viewpoints, the real income has a positive correlation with money holdings, and the opportunity cost variables are negatively related to money demand.

Although there are differences due to the various specifications of a proper transaction (scale) variable and the best opportunity cost variables.

This literature review focuses on a selected number of studies that estimated money demand using the nonlinear approaches and uncertainty. The objective is to display the effects of uncertainty and nonlinearity in money demand in two separate subsections.

2.1.1. Empirical Analysis on Nonlinear Money Demand

Sarno (1999) examines nonlinear dynamics in demand for money in Italy for the period 1861-1991. He employs a nonlinear ECM based on the ESTR model. The empirical results show a nonlinear type of adjustment, which is consistent with the target-bounds and buffer stock models. Rothman, van Dijk, and Franses (2001) model multivariate case of STAR analysis. They report the nonlinear relationship between money and output by applying logistic smooth transition VECM (LSTVECM) for the U.S.

Huang, Lin, and Cheng (2001) also analyze the money demand for Taiwan. They employ a logistic smooth transition error correction model. Their findings support the nonlinearity hypothesis for Taiwan's money demand. Ordonez (2003) provides strong empirical evidence of asymmetric adjustment of real balances towards long-run equilibrium, and this is consistent with the target-bounds and buffer-stock models for money demand. Specifically, he uses nonlinear techniques to estimate money demand for Spain using quarterly data from 1978(Q1)–1998(Q2). Stability tests suggest the existence of a stable M3 demand function in the long-run but not in the short-run. He concludes that such instabilities are caused by nonlinear adjustments of real balances towards stable long-run equilibrium.

Sarno, Taylor, and Peel (2003) estimate a nonlinear model for the U.S. money demand, by using exponential smooth transition regression (ESTR). They find the nonlinear model to be superior to the linear model. Escribano (2004) re-examines the U.K. money demand from 1878 to 2000. Empirical results reveal that the nonlinear error correction model is stable in the parameters and satisfies all necessary misspecification tests. Choi and Saikkonen (2004) employ a cointegrated smooth transition model to estimate the money demand in the U.K. for the period 1982-1998. They find evidence of nonlinearity in the U.K. money demand function.

Chen and Wu (2005) examine the nonlinearity in money demand (M1 and M2) for the U.S. and the U.K. by using the exponential STAR model in a univariate framework. They find evidence of nonlinearity in the money demand series, and they report that nonlinear models always provide a better fit than linear models. Calza and Zaghini (2006) investigate possible nonlinearities in the dynamics of the euro area demand for the narrow aggregate M1 using a Markov switching error-correction model. The empirical findings show nonlinearity in the dynamics of euro area money demand, which are consistent with theoretical predictions by buffer stock and target threshold models.

Sahin (2013) estimates the Turkish money demand function by Smooth Transition Regression (STR) models for monthly data from January 1990 to May 2012. Based on empirical results the money demand function indicates a nonlinear behavior between high and low inflation uncertainty periods. Jawadi and Sousa (2013) use a quantile regression framework and a smooth transition regression to estimate the money demand function for the euro area, the US, and the UK. Empirical results based on the STR model reveal nonlinearity in money demand. The quantile regression shows a statistically different response of money demand to changes in its determinants at periods of extreme events, which is consistent with the result of the STR model.

Bahmani-Oskooee and Bahmani (2015) investigate nonlinearity in the relationship between the exchange rate and the money demand in Iran. Based on the results, dollar appreciation and dollar depreciation have an asymmetric effect on the demand for money in Iran, which confirms Robert Mundell's theory (1963) about including the exchange rate in money demand function. As a result, the introduction of nonlinearity in the short-run as well as in the long-run could improve the money demand function. Bahmani-Oskooee and Jungho Baek (2016) study the money demand in Japan to determine if it was affected by the Global Financial Crisis of 2008. By using a nonlinear ARDL approach of Shin et al.'s (2014), they find that not only variables in the money demand are cointegrated, but exchange rate changes have asymmetric effects. Besides the results reveal that a stable money demand, which is not affected by the 2008 financial crisis.

Bahmani-Oskooee, Xi and Bahmani (2016) investigate the asymmetric effects of exchange rate changes on money demand in China by using a nonlinear ARDL approach. The empirical results show the exchange rate has significant asymmetric effects on the demand for money in China. Alsamara, Mrabet, Dombrecht and Barkat (2016) explore asymmetric responses of money demand to oil price shocks in Saudi Arabia by employing a nonlinear ARDL approach. They find evidence of positive long-run but asymmetric effects of oil price shocks on the money demand. The empirical results suggest that positive oil price shocks are more important than negative shocks.

The review of the previous nonlinear literature about the demand for money is detailed and summarized in Table 1. This review includes the data set, methods, periods and monetary aggregates of the studies.

2.1.2. Empirical Analysis on the Effect of Uncertainty on Money Demand

Arize and Malindretos (2000) analyze the effect of the volatility of inflation on real money balances for China. Using data for the period 1952-1994, Arize and Malindretos find that inflation variability is vital in modeling the money demand for China. Carpenter and Lange (2002) estimate a risk-augmented money demand relationship for the U.S. economy. According to their results, a positive change in equity risk leads to higher demand for M2 in the long-run.

Choi and Oh (2003) emphasize the importance of uncertainty about output and monetary policy for money demand decisions in the U.S. As a result, Choi and Oh find that output uncertainty has a negative effect while monetary uncertainty positively affects money demand in their sample. Atta-Mensah (2004) estimates money demand using the economic uncertainty index in Canada. The author fits GARCH models to a vector of variables, namely the stock market index. The results indicate that a positive change in economic uncertainty is followed by an increase in the demand for M1 but a reduction in M2.

Carstensen (2006) estimates money demand by including equity returns and market volatility in the Euro area. Based on empirical results, he argues that the observed overshoot of M3 at the end of 2001 can partly be explained by a decline in equity returns as well as increased stock market volatility. The role of inflation uncertainty on money demand is examined by Higgins and Majin (2009) for both M1 and M2 money measures in the U.S. They find that an increase in inflation uncertainty has negative impacts on the demand for M1. De Bondt (2009) studies the effects of equity risk and macroeconomic uncertainty on M3 money demand for the Euro area. The demand for M3 is found to be negatively related to the expected risk-adjusted of equity return. This is in line with previous findings that there exists a substitution effect away from equity markets during turbulent times on these markets

The work by Seitz and von Landesberger (2010) study the effect of stock and bond market risks on money demand in the Euro area. Seitz and Landesberger find for the Euro area that financial market uncertainty is positively correlated with the demand for M3 through the substitution channel. Bahmani-Oskooee and Xi (2011) investigate Australian demand for money by including a measure of economic (output) uncertainty and a measure of monetary uncertainty (both GARCH-based). Empirical results reveal that indeed, these two measures of uncertainty do have short-run as well as long-run effects on demand for money in Australia. Furthermore, including these two measures and incorporating short-run dynamics into estimation procedure results in stable money demand in Australia.

Bahmani-Oskooee, Kutan, and Xi (2013) study the demand for money in emerging eastern European economies of Armenia, Bulgaria, the Czech Republic, Hungary, Poland, and Russia. They estimate money demand function by including a measure of monetary uncertainty and a measure of economic uncertainty. Empirical results reveal that both measures of uncertainty have more short-run effects than long-run effects in most countries in the sample. Besides, in almost every country, estimated money demand models were correctly specified and stable. Bahmani-Oskooee and Bahmani (2014) employ the ARDL approach to investigate the impact of monetary uncertainty on demand for money in Korea using annual data that spans over the period 1971-2010. Empirical results reveal that monetary uncertainty affects money demand in both the short-run as well as long-run, which confirm Friedman's volatility hypothesis. Furthermore, including a measure of monetary uncertainty results in a stable demand for money in Korea.

Bahmani-Oskooee and Xi (2014) examine the demand for money and test for its stability in six Asian countries by including the two uncertainty measures in an ARDL framework. The countries included in the sample are India, Indonesia, Malaysia, Pakistan, the Philippines, and Singapore. Empirical results find that in almost all countries both monetary uncertainty and economic uncertainty do have short-run effects on the demand for money. However, the short-run effects last into the long-run only in limited cases. Bahmani-Oskooee and Kones (2014) estimate money demand in 21 African countries by employing economic and monetary uncertainty in an ARDL framework. The empirical results reveal that both measures of uncertainty have a transitory impact on money demand, which does not last into the long-run. Besides, including uncertainty measures leads to stable money demand in every African nation.

Bahmani-Oskooee, Bahmani, Kones, and Kutan (2015) employ policy uncertainty as a new uncertainty measure that accounts for both monetary and output uncertainty to assess its impact on the demand for money in the UK. By using an the ARDL approach, the empirical results show that policy uncertainty only has short-run negative effects on the demand for money in the U.K. Bahmani-Oskooee, Satawatananon, and Xi (2015) study impact of economic uncertainty (volatility of real GDP) and monetary uncertainty (the volatility of nominal monetary) on money demand in Thailand by using an ARDL approach. Based on the results, both measures of uncertainty do have short-run as well as long-run effects on the demand for money in Thailand.

Bahmani-Oskooee, Kones, and Kutan (2016) investigate the impact of policy uncertainty on demand for money in the U.S. by using ARDL method. The empirical results show policy uncertainty measure carried a significantly positive coefficient, implying that an increase in policy uncertainty here in the U.S. induces the public to increase their cash holding.

Bahmani-Oskooee and Baek (2017) employed the ARDL approach to investigate the impact of economic uncertainty and monetary uncertainty (both GARCH-based) on demand for money in Korea. Empirical results show that both measures exert significant effects on the demand for money in Korea in the short-run. However, only the negative effects of output uncertainty last into the long-run. Besides, including the two uncertainty measures yield a stable demand for money in Korea. Overall, there is strong evidence that different types of uncertainty could affect money demand and uncertainty is a critical determinant of money demand. Table 2 presents details about the modeling and estimation of money demand in these studies.

2.2. Model Specification and Methodology

The baseline money demand function, in most empirical works, is written as:

$$\left(\frac{M}{p}\right)_t^d = f(Y, R) \quad (1)$$

The money demand equation (1) shows that real money demand over a period is a function of, Y a scale variable indicating the level of transactions in the economy and R a vector of opportunity cost variables. The scale variable can be real income or wealth, and R can be opportunity cost variables such as inflation or interest rate or both. The exchange rate is also a suitable variable to capture foreign influences on the money demand function for an open economy. Besides uncertainty plays a critical role in money holding decisions.

Hence, from equation (1), the empirical money demand equation can be extended to include different explanatory variables to capture the effect of a variety of factors. So, the money demand function is developed as an extension of the baseline money demand model and re-specified in semi-log linear form as:

$$LnM_t^d = \alpha + \beta_1 LnY_t + \beta_2 LnR_t + \beta_3 INF + \beta_4 LnEX_t + \beta_5 LnPU_T + \varepsilon_t \quad (2)$$

Where:

M_t^d: Demand for real money,

Y_t: *R*eal Income,

R_t: Interest rate,

EX_t: Nominal effective exchange rate,

PU_t: Measure of policy uncertainty

INF_t : Rate of inflation

Ln is the logarithmic transformation to enable the interpretation of coefficients as elasticities, and to smoothen the time series on the respective variables. Thus, equation (2) is the long-run money demand equation.

Money demand theories assume that money holdings are positively correlated to measure of real income (Y) and negatively correlated with measures of opportunity cost like interest rate(R) and inflation rate (INF). The inflation rate, which is measured by $Ln\left(\frac{P_t}{P_{t-1}}\right)$ is indeed the opportunity cost of holding money against real assets.

Furthermore, the exchange rate is included to account for currency substitution and could have positive or negative impacts on money holdings, which depend on whether the dollar appreciation increases expectations of further appreciation or is observed as an increase in wealth. Indeed, the value of foreign assets owned by domestic residents increases by the depreciation of the domestic currency. If a domestic resident considers this change as an increase in wealth, the money demand should rise (Arango and Nadiri, 1981). On the other hand, if a domestic resident expects more foreign currency appreciates in the future, this leads to an increase in demand for foreign currency and decrease domestic money demand (Bahmani-Oskooee and Pourheydarian, 1990). Consequently, money demand could rise or fall depending on the net influence of wealth or expectation effects.[3]

Policy uncertainty (PU) like the exchange rate could affect money demand positively or negatively. Indeed, different studies investigate the impact of uncertainty in various areas of the economy. Economics uncertainty and monetary uncertainty are the two most common measures of uncertainty that are employed in studies. These studies reveal that each of these two measures

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3- Bahmani-Oskooee, M., & Bahmani, S. (2015). Nonlinear ARDL approach and the demand for money in Iran. Economics Bulletin, 35(1), 381-391.

of uncertainty could have a positive or negative impact on money demand. For instance, economic agents hold less money if monetary uncertainty leads to an increase in the expected inflation rate. However, money holdings by economic agents increase if they become more cautious about the future due to economic uncertainty. Economic policy uncertainty is more comprehensive than either monetary or economic uncertainty, which captures both fiscal and monetary policy uncertainty in addition to other factors creating an uncertain environment. Since policy uncertainty is a general measure of uncertainty, it could positively or negatively affect money demand depending on how individuals allocate their assets.[4]

For equation (2), an ARDL (Pesaran et al. 2001) specification for money demand can be shown to display both short-run dynamics and the long-run relationships between real money demand and its determinants. Hence the ARDL representation of (2) can be expressed as:

$$\Delta LnM_t^d = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnM_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k} \Delta INF_{t-k} + \sum_{k=0}^{n} \beta_{4,k} \Delta LnEX_{t-k} + \sum_{k=0}^{n} \beta_{5,k} \Delta LnPU_{t-k} + \lambda_0 LnM_{t-1} + \lambda_1 LnY_{t-1} + \lambda_2 LnR_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 LnEX_{t-1} + \lambda_5 LnPU_{t-1} + \varepsilon_t \quad (3)$$

Where Δ is a first difference operator and ε_t is a random white noise error term, which is identically and independently distributed. I estimate the short-run effect as well as long-run effects

4- Bahmani-Oskooee, M., Kones, A., & Kutan, A. (2016). Policy uncertainty and the demand for money in the United States. Applied Economics Quarterly, 62(1), 37-49.

by Pesaran et al. (2001) bounds testing approach, which is a one-step estimation procedure of equation (3).

In this equation, first-difference coefficients (β_k) provide the short-run effects, and long-run effects can be found by normalization of $\lambda_1 - \lambda_5$ on λ_0. However, validation of the long-run estimates requires the presence of the cointegration relationship between variables.

Based on Pesaran et al. (2001) approach, the standard F test should be employed to test the joint significance of the lagged level variables in (3). Thought, they prove that this F test follows a different distribution with different critical values. This F distribution has two upper and lower bound critical values based on the degree of integration of variables. An upper bound critical value can be constructed if all variables in a model are I(1). On the other hand, a lower bound critical value can be created if all variables are I(0). However, if the model includes the mixture of I(1) and I(0) variables, the upper bound critical values could also be used. The great advantage of this approach is that I do not need to use a unit root test because almost all macroeconomic time-series variables are either I(1) or I(0). Moreover, the existence of cointegration could also be tested by using t-statistic. In this method, there is a long-run relationship if variables adjust to long-run equilibrium in error correction specification, which means the speed of adjustment should be negative and significant.

Equation (3) assumes that all variables have symmetric impacts on money demand, which could not be a valid assumption in reality. For instance, it assumes that falls and rises in the policy uncertainty respectively lead to increase and decrease in money demand by the same proportion. However, money demand does not react symmetrically when policy uncertainty changes in different directions. Such asymmetric behavior is in line with theory. As implied by the buffer stock theory of money demand, in the presence of adjustment costs it may not be optimal for economic agents to bring their monetary holdings back to the desired levels immediately after a shock. Therefore, the reactions to shocks can be assumed to be asymmetric.

I employ Shin et al. (2014) approach to investigate the asymmetry effects of policy uncertainty changes on money demand. To apply this method, I decompose policy uncertainty changes $(\Delta LnPU_t)$ into positive changes denoted by $(\Delta LnPU_t^+)$ and negative changes denoted by $(\Delta LnPU_t^-)$. Then, I create two new time series variables, where the partial sum of positive changes in uncertainty $(POSPU_t)$ represents increases in policy uncertainty, and the partial sum of negative changes in uncertainty $(NEGPU_t)$ reflects falls in policy uncertainty. $(POSPU_t)$ and $(NEGPU_t)$ are given by:

$$(POSPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^+ = \sum_{j=1}^{t} Max\left(\Delta LnPU_j, 0\right)$$

$$(NEGPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^- = \sum_{j=1}^{t} Min\left(\Delta LnPU_j, 0\right) \quad (4)$$

The next step is to go back to the error-correction model (3) and replace $(LnPU_t)$ by $(POSPU_t)$ and $(NEGPU_t)$ variables. I then have a new error-correction model as follows:

$$\begin{aligned}\Delta LnM_t^d = \alpha &+ \sum_{k=1}^{n} \beta_{0,k} \Delta LnM_{t-k} \\ &+ \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k} \Delta INF_{t-k} + \sum_{k=0}^{n} \beta_{4,k} \Delta LnEX_{t-k} \\ &+ \sum_{k=0}^{n} \beta_{5,k} \Delta POSPU_{t-k} + \sum_{k=0}^{n} \beta_{6,k} \Delta NEGPU_{t-k} + \lambda_0 LnM_{t-1} + \lambda_1 LnY_{t-1} \\ &+ \lambda_2 LnR_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 LnEX_{t-1} + \lambda_5 POSPU_{t-1} + \lambda_6 NEGPU_{t-1} \\ &+ \varepsilon_t \qquad (5)\end{aligned}$$

Equation (5) is classified as a nonlinear ARDL model because the short-run, as well as the long-run nonlinear effect of policy uncertainty, is inserted into this model by inclusion of $(POSPU_t)$ and $(NEGPU_t)$ variables. Shin et al. (2014) prove that Pesaran et al.'s (2001) bounds testing method explained above as well as their critical values are equally applicable to (5).

Indeed, because of inter-dependency between partial sum variables, $(POSPU_t)$ and $(NEGPU_t)$, they should be considered as one variable and assume that there are only five (and not six) exogenous variables. As a result, the same conservative critical values of the F test should be used in both the linear and nonlinear models. The next step after the estimation and cointegration test is investigating the existence of asymmetry effects. In short-run, an asymmetric behavior is recognized if:

First, the pattern of dynamic multipliers associated with $(POSPU_t)$ and $(NEGPU_t)$ variables are different, i.e., these variables take different lags. Second, the short-run asymmetry effects are verified if $\hat{\beta}_{5,k} \neq \hat{\beta}_{6,k}$ for each individual k. Third, the short-run impact asymmetry is confirmed if $\sum\hat{\beta}_{5,k} \neq \sum\hat{\beta}_{6,k}$. Moreover, the long-run asymmetry is discovered if $\frac{\hat{\lambda}_5}{-\hat{\lambda}_0} \neq \frac{\hat{\lambda}_6}{-\hat{\lambda}_0}$. The Wald test is used to establish these asymmetry effects.

2.3. The Empirical Results

In this section, I estimate both the linear and nonlinear models (3) and (5) respectively, using quarterly data for four countries among all G7 countries where data on money supply is available (Canada, Japan, the United Kingdom, and the United States). More details about the definition, source and period of the dataset in each country are presented in the Appendixes.

All models are estimated by imposing a maximum of 12 lags on each first-differenced variable and using the Akaike Information Criterion (AIC) to select optimal lags. The results of the linear models are reported in Tables 5A-8A, respectively, for Canada, Japan, the U.K., and the U.S. There are three panels in each table as follows: Panel A reports the short-run coefficient of the model, the long-run estimates are given in Panel B, and Panel C reports diagnostic tests.

Based on the results represented in Panel A, I can conclude that only income has short-run effects on the demand for money in all countries since at least one coefficient related to each first-differenced variable is significant. Interest rate also shows a meaningful relationship with money demand in three countries in the sample which are Canada, U.K., and the U.S. Besides, economic policy uncertainty and effective exchange rate only affects money demand in Canada and the U.S. Panel B reports long-run normalized coefficients, which indicate economics policy uncertainty has no significant long-run effects on demand for money in any of countries in my sample. However, the income coefficient is meaningful in all the countries, but the U.S. and its sing is in line with theoretical predictions. Besides, the Interest rate only affects the demand for money in Canada and the U.K.

From Panel C, I could confirm the existence of a cointegrating relationship between variables in all countries, but Japan since the F test for joint significance of lagged level variables (Bounds test) is much higher than its critical value of 3.35. Besides, the negative and meaningful coefficient of ECM_{t-1} supports the cointegration relationship and convergence toward long-run equilibrium in all countries except Japan and the U.S.

Panel C also includes more diagnostic statistics related to the serial autocorrelation of the coefficient, miss-specification, and stability of estimated coefficients. Lagrange Multiplier (LM) test is employed to test the existence of residuals autocorrelation. Lagrange Multiplier (LM) statistic follows a χ^2 distribution with one degree of freedom. Based on the reported LM statistic in Panel C, there is no autocorrelation between residuals in all countries since reported LM statistics is less than its critical value of 3.84 at the 5% level of significance.

Ramsey's RESET test is applied to test miss-specification in the linear model. Ramsey's RESET statistic follows a χ^2 distribution with one degree of freedom. Since the estimated statistic is higher than its critical value of 3.84 in all countries, but the U.K. I can conclude the optimum models suffer from miss-specification in Canada, Japan, and the U.K. Furthermore, CUSUM and CUSUMQ tests are employed to test for the stability of short-run and long-run coefficients. Estimated coefficients are stable (S) almost in all countries based on the results of these tests.

In conclusion, the results of the linear model reveal that policy uncertainty has no significant effect on money demand in the long-run in all countries. As discussed before, this outcome is based on the assumption of linear adjustment in the money demand. The result might get changed if I consider an asymmetric adjustment procedure in the model. This statement could be investigated by applying the nonlinear ARDL approach. As a result, equation (5) is estimated by imposing a maximum of 12 lags on each first differenced variable. I use the Akaike Information Criterion (AIC) to arrive at optimal lags. The results are summarized in Tables 5B-8B.

Based on the short-run results, reported in Panel A, income and interest rate have a significant effect on money demand in the short-run in all countries. Positive or negative changes in policy uncertainty also could significantly affect money demand in the short-run in all countries. Differences in size or sign of the short-run estimates associated with the same lag could be clear evidence of the short-run asymmetry effects of policy uncertainty changes on demand for money. This evidence related to the asymmetric effects of policy uncertainty on money demand could be tested by the Wald test. Wald statistic has a χ^2 distribution with one degree of freedom and reported as Wald-S in Panel C. Significant Wald statistic supports asymmetric effects of policy uncertainty on demand for money in the short-run for Canada, Japan, and the U.S.

Panel B summarizes Long-run coefficient estimates, which reveals that economic policy uncertainty affects the demand for money in all countries since either $(POSPU_t)$ or the $(NEGPU_t)$ variable carries a significant and meaningful coefficient. Based on this asymmetric relationship between money demand and policy uncertainty, negative and significant coefficients of $(POSPU_t)$ in Canada and the U.S. suggest that an increase in economic policy uncertainty reduces the money demand. On the other hand, negative and significant coefficients of $(NEGPU_t)$ in Japan and the U.K. imply that a decrease in economic policy uncertainty raises the demand for money in the long-run. In the next step, these long-run results should be verified by checking the existence of cointegration among variables. From Panel C, I could validate the presence of cointegration relationship between variables in all countries, since the F test for joint significance of lagged level variables (Bounds test) is much higher than its critical value of 3.52.

Based on the results, coefficients of $(POSPU_t)$ and $(NEGPU_t)$ have an opposite sign and different magnitude, which could be evidence of the asymmetric effects. These asymmetric effects are meaningful in all countries since the Wald statistic reported as Wald- L in Panel C is highly significant. Moreover, Panel C also introduces more diagnostic statistics. Based on the reported LM statistic, there is no autocorrelation between residuals in all estimated model, since reported LM statistic is less than its critical value of 3.84 at the 5% level of significance. Ramsey's RESET test is applied to test miss-specification, and Since the estimated statistic is less than its critical value of 3.84 at the 5% level of significance in all estimations, I can conclude that the optimal model is not miss-specified. Furthermore, CUSUM and CUSUMQ tests are employed to test for stability and based on results; all coefficients are stable just by CUSUM.

Chapter 3. Investment

All around the world, investment and its behavior play a significant role in economic stability and economic growth. In the short-run, investment is one of the most volatile elements of demand, and its fluctuations could lead to business cycles. In long-run, investment is the primary determinant of economic growth. As a result, understanding the behavior of investment is a crucial point to prevent economic fluctuations and boost economic growth.

Given the crucial role of investment in economics, many economic theories are presented to explain the behavior of this critical variable. Traditional theory, which was a deterministic approach, overlooks the existence of uncertainty in the economic environment. In this theory, investment in a specific project is undertaken when the present value of expected future cash flow exceeds the investment cost.

The modern theories try to complete the traditional net present value (NPV) approach by considering the effect of uncertainty on investment. However, there is disagreement about the nature of the relationship between uncertainty and investment. The real options theory, which is developed by Bernanke (1983), Mcdonald and Siegel (1986), and Dixit and Pindyck (1994), predicts a negative correlation between uncertainty and investment. Based on this theory, when uncertainty increases in the economic system, investors decide to suspend their new project and wait until uncertainty becomes clear and they have better information about economic conditions. This theory assumes that investment is irreversible, and the firm has the ability to delay investment in the competitive market.

On the other hand, Hartman (1972) and Abel (1983) claim that uncertainty is positively correlated with investment. They assume the marginal product of capital is a convex function of uncertainty, and an increase in uncertainty leads to a rise in both the marginal product of capital and investment.

Besides, the theory of growth options, which is presented by Kulatilaka and Perotti (1998) claim that investment is positively correlated with investment. In this theory, investors look at uncertainty as an opportunity to increase their investment in research and development(R&D), which leads to an increase in the future growth of the firm and discourages potential competitor firms from entering their market. This theory is based on the imperfect competitive market.[5]

As this short review indicates, there is no clear-cut correlation between uncertainty and investment in theory and based on different assumptions I could have a positive or a negative correlation between these two variables. This doubt has led to many empirical studies, which aim to clarify the investment-uncertainty relationship by using different econometric methods and various measures of uncertainty. The purpose of this chapter is to provide new evidence on the effect of uncertainty on investment by using a new measure of uncertainty, which is policy uncertainty, as well as implementing Nonlinear Autoregressive Distributed Lag (NARDL) to capture possible asymmetries between these two variables. The economic policy uncertainty (EPU), which is constructed by Baker et al. (2013), is available for 23 countries. This measure mainly counts the frequency of words related to economic policy and uncertainty in the top newspaper in each country. Since policy uncertainty measures government economic policy uncertainty, it's a critical variable in the investor's decision-making process.

Although there is evidence of an asymmetric relationship between investment and uncertainty, most empirical studies overlook this issue and are based on linear assumption. For example, sluggish recovery of advanced economies after the financial crisis in 2008 could be a sign of an asymmetric relationship in which a decrease in uncertainty after crisis didn't have the same impact

5- Carruth, A., Dickerson, A., & Henley, A. (2000). What do we know about investment under uncertainty?. Journal of economic surveys, 14(2), 119-154.

as an increase in uncertainty during the crisis. If uncertainty has a symmetric impact on investment, then the short-run rise in uncertainty should not have a long-run impact on investment. However, a short-run uncertainty increase could have a persistent effect on investment in the long-run, which is a sign of an asymmetric relationship between these two variables.[6]

3.1. Literature Review

Many empirical studies have been conducted to investigate the associations between uncertainty and investment, since there is no theoretical agreement on this topic. In this section, we analyze the empirical literature, which investigates the relationship between uncertainty and investment using either policy uncertainty or a nonlinear approach.

Linsink (2002) examines the effect of uncertainty on aggregate investment in a set of developed countries for the period of 1970-1997. In this study, He uses the volatility of the stock market as a proxy for uncertainty in each country. He finds that there is nonlinearity in relationship between uncertainty and aggregate investment. Bo and Lensin (2003) investigate the impact of uncertainty on the firm's investment in the Netherlands over the 1984-96 period. They implement the generalized method of moments (GMM) to estimate the relationship between uncertainty and investment, and they use the volatility of the individual firm's daily stock market returns as a proxy of uncertainty. The empirical results show that there is a nonlinear correlation between these two variables. A rise in uncertainty increases the firm's investment in low level of uncertainty, on the other hand when the initial value of uncertainty is high a rise in uncertainty reduces the firm's investment.

Menashe (2005) uses a panel dataset on 459 US manufacturing industries to investigate the impact of uncertainty on firm-level investment for the period 1958 to1996. By using different proxies for

6- Foerster, A. (2014). The asymmetric effects of uncertainty. Economic Review, (Q III), 5-26.

uncertainty, which includes output price, productivity, and factor costs volatility, the empirical results reveal that uncertainty affects the firm's investment in a nonlinear manner. His findings verify that there is an inverted U- curve relationship between these two variables. This means investment and uncertainty are positively correlated in low levels of uncertainty, but in high levels of uncertainty their relationship is negative. Lensink and Murinde (2006) investigate how corporate investment is related to uncertainty in the U.K. over the period 1995-1999. They use a panel dataset consist of 197 firms and apply the volatility of firm's stock return as a proxy of uncertainty. Estimated results by using the system-generalized methods of moments (GMM) suggest that there is a nonlinear relationship between the firm's investment and uncertainty. There is a positive correlation between investment and uncertainty at a low level of uncertainty, but there is a negative relationship at the high level of uncertainty.

Kang, Lee, and Ratti (2013) study the relationship between policy uncertainty and firm-level investment in the U.S. for the period 1985 to 2010. They use the generalized method of moments (GMM) to estimate how policy uncertainty would affect 2700 firm's investment. The empirical result reveals that a positive shock in policy uncertainty could negatively affect the firm's investment and reduce investment for a long period of time. This result is consistent with general empirical results that increase in uncertainty could lead to a reduction in the level of investment. Wanga, Chen, and Huang (2014) examine the correlation between economic policy uncertainty and corporate investment for Chinese companies over the period of 2003 to 2012. The empirical results find that economic policy uncertainty negatively affects the firm's investment.

Gulen and Ion (2015) estimate the relationship between uncertainty and firm-level investment in 10463 U.S. firms over the period of 1985 to 2013. The empirical results indicate that policy uncertainty can reduce the firm's investment by inducing precautionary delays due to investment irreversibility.

In conclusion, although theoretical analyses suggest that uncertainty could have both positive and negative impacts on uncertainty, most empirical papers by using linear assumption find evidence for a negative correlation between uncertainty and investment. Few studies assume a nonlinear relation between these two variables and almost all of them use firm-level data. Unlike the existing empirical literature, this paper examines the presence of an asymmetric relationship between aggregate investment and economic policy uncertainty in the G-7 countries.

The review of the previous literature about the investment-uncertainty relationship is detailed and summarized in Table 3. This review includes the data set, methods, periods and proxy for uncertainty.

3.2. Model Specification

In most studies, aggregate investment is a function of income and interest rate. My model adds policy uncertainty to this basic model to consider the effects of policy uncertainty on aggregate investment. Hence, a log-linear specification of the model is presented in the following equation:

$$LnI_t = \alpha + \beta_1 LnY_t + \beta_2 LnR_t + \beta_3 LnPU_T + \varepsilon_t \qquad (1)$$

Where:

I_t: Aggregate Investment,

Y_t: *R*eal Income,

R_t: Interest rate,

PU_t: Measure of policy uncertainty,

Ln is the logarithmic transformation to enable the interpretation of coefficients as elasticities and to smoothen the time series on the respective variables. Based on theoretical and empirical studies, income should be positively correlated with investment since a high level of income could be a sign of economic prosperity and make investors more optimistic about the economic and financial condition. On the other hand, the interest rate as a measure of borrowing cost is expected to have an adverse effect on investment. Finally, policy uncertainty could have a positive or negative impact on investment in different theories with different assumptions. In real options theory (Bernanke (1983), Mcdonald and Siegel (1986), and Dixit and Pindyck (1994)), an increase in uncertainty leads to a reduction in investment since investors decide to suspend their new project and wait until uncertainty resolve, and they have better information about economic conditions. On the other hand, Hartman (1972) and Abel (1983) show that uncertainty could positively affect investment under certain assumptions. They assume, in a perfect competitive market, the marginal product of capital is a convex function of uncertainty and a rise in uncertainty by increasing the marginal product of capital leads to an increase in investment. Furthermore, growth options theory (Kulatilaka and Perotti (1998)) also state that investment could be positively correlated with investment since investors consider uncertainty as an opportunity to increase their investment in research and development(R&D) that lead to an increase in future growth of the frim and discourage potential competitor firms from entering their market. Although this investment-uncertain relationship is unclear from a theoretical point of view, most empirical studies provide evidence supporting a negative effect of uncertainty on investment.

Estimation of equation (1) only provides long-run effects of explanatory variables on investment. By using Pesaran et al.'s (2001) bound testing approach and rewriting equation (1) as an ARDL specification, I could drive both long-run and short-run effects in a single equation. Therefore, equation (1) can be expressed by following ARDL representation:

$$\Delta LnI_t = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnI_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k}\, \Delta LnPU_{t-k}$$
$$+ \lambda_0 LnI_{t-1} + \lambda_1 LnY_{t-1} + \lambda_2 LnR_{t-1} + \lambda_3 LnPU_{t-1}$$
$$+ \varepsilon_t \qquad (2)$$

The short-run, as well as the long-run effects of explanatory variables on investment, could be estimated in one-step by applying the OLS method on equation (2). In the estimated equation, first-difference coefficients (β_k) present the short-run effects, and long-run effects can be inferred by the estimate of $\lambda_1 - \lambda_3$ normalize on λ_0. However, a valid long-run estimate needs the existence of a cointegration relationship between investment and explanatory variables. Pesaran and et al. (2001) recommend two tests to investigate the presence of cointegration. First, one is the standard F-test with two upper and lower critical bound. Based on this test, all the variables are cointegrated if F-statistic is larger than the upper bound critical values. In the second test, there is a cointegration relationship between variables if variables adjust to long-run equilibrium in error correction specification, which means the speed of adjustment (δ) should be significant and negative in equation (3).

$$\Delta LnI_t = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnI_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k}\, \Delta LnPU_{t-k}$$
$$+ \delta ECM_{t-1}$$
$$+ \varepsilon_t \qquad (3)$$

Where:

$$ECM_{t-1} = \quad LnI_{t-1} + \frac{\lambda_1}{\lambda_0} LnY_{t-1} + \frac{\lambda_2}{\lambda_0} LnR_{t-1} + \frac{\lambda_3}{\lambda_0} LnPU_{t-1} \qquad (4)$$

Equation (2) and equation (3) like most of the other empirical studies assume that all explanatory variables have a symmetric impact on investment. Based on this assumption, decreases in uncertainty offset increases, and the short-run spikes in uncertainty don't have a persistent effect in the long-run. However, the slow recovery of advanced economies after the financial crisis in 2008 could be a sign of an asymmetric relationship in which a short-run uncertainty increase could have a persistent effect on investment in the long-run. Following Shin et al. (2014) approach, to investigate asymmetry effects of policy uncertainty changes on investment, I replace $(LnPU_t)$ by the positive partial sum of policy uncertainty $(POSPU_t)$ and the negative partial sum of uncertainty $(NEGPU_t)$. The asymmetric error correction specification can be presented as follows:

$$\Delta LnI_t = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnI_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k} \Delta POSPU_{t-k} + \sum_{k=0}^{n} \beta_{4,k} \Delta NEGPU_{t-k} + \lambda_0 LnI_{t-1} + \lambda_1 LnY_{t-1} + \lambda_2 LnR_{t-1} + \lambda_3 POSPU_{t-1} + \lambda_4 NEGPU_{t-1} + \varepsilon_t \quad (5)$$

Where:

$$(POSPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^+ = \sum_{j=1}^{t} Max(\Delta LnPU_j, 0)$$

$$(NEGPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^- = \sum_{j=1}^{t} Min(\Delta LnPU_j, 0) \quad (6)$$

I can estimate equation (5) by OLS and test the validity of long-run relationship by implementing Pesaran et al.'s (2001) approach. Equation (5) consists of both the short-run and the long-run asymmetric effects of uncertainty on investment by the inclusion of $(POSPU_t)$ and $(NEGPU_t)$ variables.

There are different signs of asymmetric correlation between uncertainty and investment in both the short-run as well as long-run. In the short-run, the asymmetric relationship could be detected if:

1- The number of lags on the positive partial sum of policy uncertainty $(POSPU_t)$ and the negative partial sum of uncertainty $(NEGPU_t)$ were different.

2- The size and sign of estimates of $\hat{\beta}_{3,k}$ and $\hat{\beta}_{4,k}$ were different.

3- Wald test confirm that $\sum\hat{\beta}_{3,k} \neq \sum\hat{\beta}_{4,k}$

The long-run asymmetric effect is discovered by using Wald test on normalized coefficients of $(POSPU_t)$ and $(NEGPU_t)$, and $\frac{\hat{\lambda}_3}{-\hat{\lambda}_0} \neq \frac{\hat{\lambda}_4}{-\hat{\lambda}_0}$ is a sign of asymmetries in the long-run.

3.3. The Empirical Results

In this section, quarterly data are used to carry out the estimations of equations (3) and (6) in all G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States). Data appendixes include more information about the definition, source and period of the dataset in each country. The linear investment model in equation (3) is estimated by imposing a maximum of 8 lags, and the Akaike Information Criterion (AIC) is applied to select optimal lags. The results are reported in Tables 9A-15A in three panels. Panel A reports the short-run coefficient of the model, the long-run estimates are given in Panel B, and Panel C reports diagnostic tests.

Based on the results represented in Panel A, I can conclude that only income has short-run effects on investment in all countries. The interest rate also affects investment in all countries but Canada and the U.K. Besides, economic policy uncertainty shows a significant relationship with investment in all countries except France and the U.K. Panel B reports long-run normalized coefficients, which indicates that economic policy uncertainty has no significant effect on investment in any of the G7 countries. However, Income affects investment in Canada, France, the

U.K and the U.S. Besides, the interest rate shows a meaningful correlation with investment in Japan and the U.S.

From Panel C, I could confirm the existence of a cointegration relationship between variables only in the U.S. since the F test is less than its critical value of 3.77 in all other G7 countries. Furthermore, the coefficient of ECM_{t-1} is also insignificant and does not support the cointegration relationship and convergence toward the long-run equilibrium in all the G7 countries.

Panel C also includes more diagnostic statistics related to the serial autocorrelation of the coefficient, miss-specification, and stability of estimated coefficients. Lagrange Multiplier (LM) test is employed to test the existence of residuals autocorrelation. Lagrange Multiplier (LM) statistic follows a χ^2distribution with one degree of freedom. Based on the reported LM statistic in Panel C, there is no autocorrelation between residuals in all countries, since reported LM statistic is less than its critical value of 3.84 at the 5% level of significance.

Ramsey's RESET test is applied to test miss-specification in the linear model. Ramsey's RESET statistic follows a χ^2 distribution with one degree of freedom. Since the estimated statistic is less than its critical value of 3.84 at the 5% level of significance, I can conclude that equation (3) is correctly specified in France, Germany, Japan, and the U.K.

Furthermore, CUSUM and CUSUMQ tests are employed to test for the stability of short-run and long-run coefficients. Based on the results, all coefficients are stable in all countries but in Germany.

In conclusion, the results of the linear model reveal that policy uncertainty has no significant effect on investment in the long-run for the concerned period in all G7 countries. As discussed before, this outcome is based on the assumption of linear adjustment in the investment equation. The result might get changed if I consider an asymmetric adjustment procedure in the model. This statement could be investigated by applying the nonlinear ARDL approach. As a result, equation (6) is estimated by imposing a maximum of 8 lags on each first differenced variable using the AIC criterion to arrive at optimal lags. The results are summarized in Table 8.

Based on the short-run results reported in Panel A, the income coefficient is significant in all G7 countries. Interest rate and policy uncertainty have a short-run effect on investment in all countries but the U.K. since interest rate, $(POSPU_t)$ and $(NEGPU_t)$ carry at least one significant lagged coefficient. Furthermore, the difference in size and sing of short-run coefficients could be a sign of asymmetric effects of economic policy uncertainty changes on investment. This evidence related to the asymmetric effects of policy uncertainty on investment could be investigated by the Wald test. Based on the Wald statistic reported as Wald-S in Panel C, these asymmetric effects are meaningful in Germany, Italy, and the U.S.

Panel B summarizes the long-run coefficient estimates. Contrary to the linear model, all variables are significant in almost all G7 countries, which can be a sign of correct specification and superiority of the nonlinear model. Based on the results, the positive sign of the income coefficient implies economic growth plays the role of stimuli for further investment in all countries. However, the negative sign of interest rate means that a higher interest rate by increasing borrowing cost for new project reduces investor's invectives and consequently investment in all G7 countries. The significant and negative coefficient of $(POSPU_t)$ in Canada, Japan, and the U.K. suggests that any increase in economic policy uncertainty lowers the investment in these economies. Moreover, $(NEGPU_t)$ carries a significant and negative coefficient in Canada and Germany, which implies resolving economics policy uncertainty raises investment in these countries. In the next step, these long-run results should be verified by checking the existence of cointegration among variables. From Panel C, I could validate the presence of the cointegration relationship between variables in all G7 countries by using either a high value of F-test or a significant and negative coefficient of ECM_{t-1}. Besides, $(POSPU_t)$ and $(NEGPU_t)$ carry coefficients with different sizes and signs which could be evidence of asymmetric relation between investment and economic policy uncertainty. These asymmetric effects are meaningful in all countries but Germany, Since the Wald statistic reported as Wald- L in Panel C is highly significant.

Panel C also introduces more diagnostic statistics. Based on the reported LM statistic, there is no autocorrelation between residuals in all countries, since reported LM statistic is less than its critical value of 3.84 at the 5% level of significance. According to Ramsey's RESET test, the Nonlinear specification also is correctly specified in all countries but Canada and Italy, since the estimated statistic is less than its critical value of 3.84 at the 5% level of significance. Furthermore, the CUSUM and CUSUMQ tests confirm that all coefficients are stable in all countries.

Chapter 4. Consumption

The global economy has been experiencing tremendous financial and political uncertainty during the last decade like the financial crisis in 2007-2008 and the Brexit referendum in the United Kingdom. These events affect economies around the world and lead to many theoretical and empirical studies to identify the connection between uncertainty and economic variables like investment and consumption.

In most economies, the share of consumption in the demand side is between 50% to 75%, which makes it the most significant component of the total demand. Consequently, any fluctuation in consumer expenditure could lead to business cycles in the short-run and change the economic growth path in the long-run. The modern consumption theories have investigated the effects of the main determinant of consumer expenditure including uncertainty.

Life Cycle Hypothesis (LCH) and the Permanent Income Hypothesis (PIH) are the two fundamental consumption theories, which propose to correct the inconsistency between Keynesian consumption theory and the real economy. Based on these theories, consumers maximize their utility of her/his lifetime consumption subject to her/his income through all her/his life, which is an intertemporal decision process. In these theories, people save to smooth their consumption path in their life because rational consumer expects that her/his income decline in the future. Hall (1978) added the rational expectation hypothesis to these consumption theories and assumes that utility function is quadratic with its third derivative equal zero. Under this assumption, one faces the certainty-equivalent case in which consumption and saving decision is similar under both certain and uncertain income. However, these theories couldn't wholly explain consumer behavior in reality.

In a modified model, where the quadratic utility function is replaced by a utility function with convex marginal utility (U'''>0), uncertainty could change consumption decision and lead to an extra positive saving, the so-called "precautionary saving." In this context, consumption decreases when uncertainty rises in an economy since people tend to behave prudently, and precautionary saving arises. This reduction in consumption could lead to a contraction in the economy in the short-run, but its long-run effects are not evident.[7]

The most empirical studies confirm the adverse impact of uncertainty on consumption, but there is no agreement about the most relevant measure to estimate uncertainty. In this chapter, I use economic policy uncertainty as a proxy for uncertainty. Policy uncertainty is a widely used uncertainty indicator, which is introduced by Baker et al. (2013). This measure mainly counts the frequency of words related to economic policy and uncertainty in the top newspapers in each country.

Despite a considerable number of studies, which study the effects of uncertainty on consumption and saving decision, there are few studies, which investigate possible nonlinearity in the relationship between uncertainty and consumption. In this chapter, I implement a Nonlinear Autoregressive distributed lag (NARDL) model to assess the impact of policy uncertainty on consumption. This method captures not only the long-run relationship and the short-run dynamics between these variables but also evaluating possible asymmetric associations between them. If uncertainty has a symmetric impact on consumption, then the short-run rise in uncertainty should not have a long-run effect on consumption. However, a short-run uncertainty increase could have a persistent effect on consumer expenditure in the long-run, which is a sign of an asymmetric relationship between these two variables.

[7]- Lugilde, A., Bande, R., & Riveiro, D. (2017). Precautionary Saving: a review of the theory and the evidence.

4.1. Literature Review

According to modern consumption theory, uncertainty could affect optimal consumption and saving decision by assuming the convexity of the marginal utility of consumption. Under this condition, any positive shock in uncertainty reduces consumption through a positive extra saving, the so-called "precautionary saving." This section provides a brief review of the empirical literature and discusses the primary results of the studies addressing the effects of uncertainty on consumer expenditure and saving.

Miles (1997) investigates how consumption is related to human capital and earnings uncertainty in the U.K. He uses simple OLS to estimate the cross-sectional effect of uncertainty on consumption using microdata in different years from 1968 to 1990. The estimated results suggest that income uncertainty could affect consumption and saving due to precautionary saving incentives. Hahm and Steigerwald (1999) investigate the impact of uncertainty on consumption in the U.S. for the period 1981 to1994. By using income uncertainty as a proxy for uncertainty, Empirical results find evidence of a precautionary saving motive, which leads to a rise in saving and decrease in consumption when uncertainty is high in the economy. Besides, results show that the existence of income uncertainty in the model decreases the power of income growth in the explanation of consumption changes.

Banks, Blundell, and Brugiavini (2001) examine the effect of income uncertainty on consumption growth in the U.K. for the period of 1968-1992. In this study, they find that income uncertainty could explain changes in consumption growth particularly after considering demographic and labor market conditions. Guariglia and Rossit (2002) examine the impact of uncertainty on consumption in the U.K. over the period of 1992 to 1997. They apply labor income uncertainty as a proxy of uncertainty and find that labor income uncertainty and past changes in consumption could affect current consumption. Benito (2005) investigates the existence of a precautionary saving motive in the U.K. by using microdata on British households. He uses unemployment risk as a proxy of uncertainty and finds that any positive shock to unemployment risk could reduce consumer expenditure. Indeed, households consume 1.6% less when unemployment risk increases one standard deviation. He finds younger people without any non-labor income react more severely to change in unemployment risk, and durable consumption also is more affected by uncertainty compared to non-durable consumption.

Menegatti (2007) examines the relationship between income uncertainty and consumption growth for Italy over the period of 1981 to 2000. Empirical results find that income uncertainty affects consumption and saving through the precautionary saving motive. Menegatti (2010) investigates the impact of uncertainty on saving and consumption in 24 OECD countries over the period 1955-2000. By using output growth uncertainty as a measure of uncertainty, the empirical result suggests that the saving rate increases due to any rise in the level of uncertainty, which confirms precautionary saving motives.

Pericoli and Ventura (2010) investigate how the risk of family disruption affects household consumption and saving decision in Italy over the period 1995-1999. They use Italian Survey on Households Income and Wealth and the probability of marital splitting as a proxy of uncertainty. Estimated results suggest that family disruption risk leads to an extra positive saving, the so-called precautionary saving, which reduces consumption level in households. Bahmani-Oskooee and Xi (2011) investigate how exchange rate volatility is related to domestic consumption in a sample of seventeen countries over the period of 1964 to 2008. By implementing the bounds testing approach, estimated results suggest exchange rate volatility could affect consumption in twelve countries in the short-run and nine countries in the long-run.

Bande and Riveiro (2012) investigate the impact of uncertainty on aggregate saving and consumption in the different regions in Spain over the 1980-2007 period. They implement the generalized system method of moments (GMM) to estimate the relationship between uncertainty and aggregate consumption and saving by using the volatility of aggregate income in each region as a proxy of uncertainty. The empirical results show that precautionary motives lead to a rise in aggregate saving and reduction in consumption after the increase in uncertainty during the recession. Baiardi, Manera, Menegatti (2013) studied how the various source of uncertainty could affect the relationship between saving and consumption. They use the generalized method of moments (GMM) to estimate how financial risk and environmental risk would affect this correlation in the six advanced economies for the period 1965 to 2007. The empirical result suggests that both financial risk and the interaction between financial and environmental risks could negatively affect consumption growth, which confirms the precautionary saving theory.

Bahmani-Oskooee, Kutan, and Xi (2015) examine the relationship between exchange rate uncertainty and consumption for twelve emerging economies over the period of 1991 to 2014. Empirical results find that exchange rate uncertainty affects consumption in the short-run in all countries. However, the existence of long-run effects is confirmed in half of the sample. Lugilde, Bande, and Riveiro (2016) studied the relationship between uncertainty and private consumption in Spain by using microdata on household consumption. They used several measures of uncertainty including job insecurity. The empirical results support the existence of a precautionary motive, which leads to an increase in saving and a reduction in consumption when an economy experiences high uncertainty periods. Besides, the result shows that the source of uncertainty could be different in each step of the business cycle.

The review of the previous literature about the effects of uncertainty on consumption is summarized in Table 4. This review includes the data set, methods, periods and proxy for uncertainty.

4.2. Model Specification

According to most theoretical and empirical studies, income and interest rate are the main determinants of consumption. In this chapter, I use economic policy uncertainty as a proxy for uncertainty to investigate how uncertainty in economic policies implemented by governments and central banks could affect consumer decision-making processes. Hence, a log-linear specification of the model is presented in the following equation:

$$LnC_t = \alpha + \beta_1 LnY_t + \beta_2 LnR_t + \beta_3 LnPU_t + \varepsilon_t \qquad (1)$$

Where:

C_t: Aggregate Consumption,

Y_t: *R*eal Income,

R_t: Interest rate,

PU_t: Measure of policy uncertainty,

Ln is the logarithmic transformation to enable the interpretation of coefficients as elasticities and to smoothen the time series on the respective variables. Based on theoretical and empirical studies, a growing income level is positively correlated with rising consumer expenditure, and I expect that the estimated coefficient of real income to be positive. On the other hand, a rise in interest rate is supposed to reduce consumption by inducing an intertemporal substitution of consumption for savings. Therefore, the estimated coefficient of interest rate is expected to be negative. Finally, a rise in policy uncertainty is supposed to be associated with a fall in consumption based on precautionary saving motives. Indeed, when uncertainty rises in the economy, consumers could easily delay their purchase until uncertainty resolves in the economy, and this effect is stronger in durable consumption compared to non-durable consumption. Hence, the estimated coefficient on policy uncertainty is likely to be negative.

Estimation of equation (1) only provides long-run effects of explanatory variables on consumption. By using Pesaran et al.'s (2001) bound testing approach and rewriting equation (1) as an ARDL specification, I could drive both the long-run and the short-run effects in a single equation. Therefore, equation (1) can be expressed by following ARDL representation:

$$\Delta LnC_t = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnC_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k} \Delta LnPU_{t-k} + \lambda_0 LnC_{t-1} + \lambda_1 LnY_{t-1} + \lambda_2 LnR_{t-1} + \lambda_3 LnPU_{t-1} + \varepsilon_t \qquad (2)$$

The short-run, as well as the long-run effects of explanatory variables on consumption, could be estimated in one-step by applying the OLS method on equation (2). In the estimated equation, first-difference coefficients (β_k) present the short-run effects, and the long-run effects can be inferred by the estimate of $\lambda_1 - \lambda_3$ normalize on λ_0. However, a valid long-run estimate needs the existence of cointegration between consumption and explanatory variables. Pesaran and et al. (2001) recommend two tests to investigate the presence of cointegration. First, one is the standard F-test with two upper and lower critical bound. Based on this test, all the variables are cointegrated if F-statistic is larger than the upper bound. In the second test, there is cointegration between variables if variables adjust to long-run equilibrium in error correction specification, which means the speed of adjustment (δ) should be significant and negative in equation (3).

$$\Delta LnC_t = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnC_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k}\, \Delta LnPU_{t-k} + \delta ECM_{t-1} + \varepsilon_t \quad (3)$$

Where:

$$ECM_{t-1} = LnC_{t-1} + \frac{\lambda_1}{\lambda_0} LnY_{t-1} + \frac{\lambda_2}{\lambda_0} LnR_{t-1} + \frac{\lambda_3}{\lambda_0} LnPU_{t-1} \quad (4)$$

Equation (2) and equation (3) like most of the other empirical studies assumes that all explanatory variables have a symmetric impact on consumption. Based on this assumption, decreases in uncertainty offset increases, and short-run spikes in uncertainty don't have a persistent effect in the long-run. Following Shin et al. (2014) approach, to investigate asymmetry effects of policy uncertainty changes on consumption, I replace $(LnPU_t)$ by the positive partial sum of policy uncertainty $(POSPU_t)$ and the negative partial sum of uncertainty $(NEGPU_t)$. The asymmetric error correction specification can be presented as follows:

$$\Delta LnC_t^d = \alpha + \sum_{k=1}^{n} \beta_{0,k} \Delta LnC_{t-k} + \sum_{k=0}^{n} \beta_{1,k} \Delta LnY_{t-k} + \sum_{k=0}^{n} \beta_{2,k} \Delta LnR_{t-k} + \sum_{k=0}^{n} \beta_{3,k} \Delta POSPU_{t-k} + \sum_{k=0}^{n} \beta_{4,k} \Delta NEGPU_{t-k} + \lambda_0 LnC_{t-1} + \lambda_1 LnY_{t-1} + \lambda_2 LnR_{t-1} + \lambda_3 POSPU_{t-1} + \lambda_4 NEGPU_{t-1} + \varepsilon_t \quad (5)$$

Where:

$$(POSPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^+ = \sum_{j=1}^{t} Max(\Delta LnPU_j, 0)$$

$$(NEGPU_t) = \sum_{j=1}^{t} \Delta LnPU_j^- = \sum_{j=1}^{t} Min(\Delta LnPU_j, 0) \quad (6)$$

I can estimate equation (5) by OLS and test the validity of the long-run relationship by implementing Pesaran et al.'s (2001) approach. Equation (5) consists of both the short-run and long-run asymmetric effects of uncertainty on consumption by the inclusion of $(POSPU_t)$ and $(NEGPU_t)$ variables.

There are different signs of asymmetric correlation between uncertainty and consumption in both short-run as well as long-run. In the short-run, the asymmetric relationship could be detected if:

1- The number of lags on the positive partial sum of policy uncertainty $(POSPU_t)$ and the negative partial sum of uncertainty $(NEGPU_t)$ were different.

2- The size and sign of estimates of $\hat{\beta}_{3,k}$ and $\hat{\beta}_{4,k}$ were different.

3- Wald test confirm that $\sum\hat{\beta}_{3,k} \neq \sum\hat{\beta}_{4,k}$

The long-run asymmetric effect is discovered by using Wald test on normalized coefficients of $(POSPU_t)$ and $(NEGPU_t)$, and $\frac{\hat{\lambda}_3}{-\hat{\lambda}_0} \neq \frac{\hat{\lambda}_4}{-\hat{\lambda}_0}$ is a sign of asymmetries in the long-run.

4.3. The Empirical Results

In this section, quarterly data are used to estimate equations (3) and (6) for following G7 countries: Canada, France, Germany, Italy, Japan, the U.K., and the U.S. More details about the definition, source and period of the dataset in each country are presented in the Appendixes. The linear consumption model in equation (3) is estimated by imposing a maximum of 8 lags, and Akaike Information Criterion (AIC) is used to select optimal lag. The results of linear models are reported in Tables 16A-22A in three panels. Panel A reports the short-run coefficient of the model, the long-run estimates are given in Panel B, and Panel C reports diagnostic tests.

Based on the results represented in Panel A, economic policy uncertainty has short-run effects on consumption just in Canada, Italy, and the U.S. Interest rate could affect consumer expenditure only in Germany, Italy, and the U.S. However, income shows a meaningful relationship with consumption in all G7 countries. Panel B reports long-run normalized coefficients, which indicates that income carries a significant coefficient in all G7 countries but Canada. Besides, the positive sign of the estimated coefficients in the long-run implies that higher income increases consumption level in almost all G7 countries. The interest rate has a long-run adverse effect on consumption only in Germany and Italy. Economic policy uncertainty shows a long-run impact on consumer expenditure just in Italy and the U.S. From Panel C, the F test confirms the existence of the cointegration relationship between variables only in Italy. However, the coefficients of ECM_{t-1} are significant in Germany, Italy, and the U.S., which support the cointegration relationship and convergence toward the long-run equilibrium in these countries.

Panel C also includes more diagnostic statistics related to the serial autocorrelation of the residuals, miss-specification, and stability of estimated coefficients. Lagrange Multiplier (LM) test is employed to test the existence of residuals autocorrelation. Lagrange Multiplier (LM) statistic follows a χ^2distribution with one degree of freedom. Based on the reported LM statistic in Panel C, there is autocorrelation between residuals only in Germany and Italy, since reported LM statistics is higher than its critical value of 3.84 at the 5% level of significance in these two countries.

Ramsey's RESET test is applied to test miss-specification in the linear model. Ramsey's RESET statistic follows a χ^2 distribution with one degree of freedom. Since the estimated statistic is much higher than its critical value of 3.84 at the 5% level of significance in Canada, France, Germany, Italy, Japan, and the U.K., I can conclude that the linear model or equation (3) is miss-specified in all these economies.

Furthermore, CUSUM and CUSUMQ tests are employed to test for the stability of short-run and long-run coefficients. Based on the results of these two tests, estimated coefficients are stable almost in all countries.

In conclusion, the results of the linear model reveal that policy uncertainty has no significant effect on consumption in the short-run and long-run for more than half of G7 countries (France, Germany, Japan, the U.K.). As discussed before, this outcome is based on the assumption of linear adjustment of policy uncertainty in the consumption equation. The result might get changed if I consider an asymmetric adjustment procedure in the model. This statement could be investigated by applying the nonlinear ARDL approach. As a result, equation (6) is estimated by imposing a maximum of 8 lags on each first differenced variable using the AIC criterion to arrive at optimal lags. The results for each country are summarized in Tables 16B-22B.

Based on the short-run results reported in Panel A, income coefficients are significant in all G7 countries, which confirm the findings of the linear model. The interest rate has a meaningful effect on consumption in all G7 countries but Germany and Italy. The Positive and negative change in economic policy uncertainty carries at least one significant coefficient in all countries, which implies that economic policy uncertainty has short-run effects in all these economies. Besides, differences in size or sign of the short-run estimates associated with the same lag could be clear evidence of short-run asymmetry effects of policy uncertainty changes on consumption. This evidence related to the asymmetric effects of policy uncertainty on consumption could be investigated by the Wald test. Based on the results of this test, significant Wald statistic could support the asymmetric effects of policy uncertainty on consumption in the short-run for France, Italy, the U.K.

Panel B summarizes the long-run coefficient estimates. Income show positive and meaningful relationship with consumer expenditure in all G7 countries, which suggests economic growth could raise the consumer expenditure in these countries. The interest rate has adverse and significant effects on consumption in all G7 countries but Germany. This result indicates that any increase in interest rate lowers the consumption by inducing intertemporal substitution of consumption for savings. Moreover, a positive and negative change in policy uncertainty could affect consumption in all G7 countries. Coefficients of $(POSPU_t)$ is significant and negative in Canada, Germany, and Italy, which indicates a higher level of economic policy uncertainty reduces consumption by inducing the precautionary savings. On the other hand, coefficients of $(NEGPU_t)$ are meaningful and positive in Italy, the U.K. and the U.S., which suggest resolving economic policy uncertainty increases the level of consumer expenditure in these economies. In the next step, these long-run results should be verified by checking the existence of a cointegration relationship among variables. From Panel C, I could validate the presence of the cointegration relationship between variables in all countries by using either F-test or the significant and negative coefficient of ECM_{t-1}.

Furthermore, $(POSPU_t)$ and $(NEGPU_t)$ carries coefficient with a different size or sing in almost all G7 countries, which could be clear evidence of asymmetric effects on economic policy uncertainty of consumer expenditure. These asymmetric effects are meaningful in all G7 countries, but Italy and the U.S. since the Wald statistic reported as Wald- L in Panel C is highly significant. Panel C also introduces more diagnostic statistics. Based on the reported LM statistic, there is no autocorrelation between residuals in all countries but the U.K. According to Ramsey's RESET test, the nonlinear specification is correctly specified in all countries except Canada, since estimated statistic is less than its critical value of 3.84 at the 5% level of significance. Furthermore, the CUSUM and CUSUMQ test confirms that coefficients are stable almost in all G7 countries.

Chapter 5. Conclusion

This thesis studies the effects of uncertainty on major economic variables, such as demand for money, investment, and consumption. Various measures of uncertainty have been used to investigate how uncertainty affects macroeconomic variables, such as dispersion in analyst forecasts or volatility of stock returns, price, output, exchange rate, etc. In this thesis, I use the economic policy uncertainty index (EPU) to capture uncertainties which are the results of the political and regulatory uncertainty. Moreover, I implement a Nonlinear Autoregressive distributed lag (NARDL) model to assess possible asymmetric associations between money, investment, consumption and economic policy uncertainty.

First, I examine the effects of economic policy uncertainty on demand for money in following G7 economies: Canada, Japan, the U.K., and the U.S. In economics theories, people hold money to insure themselves against various uncertainty in future. Many researchers have investigated the effects of different measures of uncertainty on money demand since Friedman (1984) argued that the volatility of monetary growth rate could explain observed instability in money demand.

According to the estimation results of linear models, the economic policy uncertainty has no significant long-run effects on money demand in all countries in my sample and only has significant short-run effects in Canada and the U.S. However, the estimation results of the nonlinear model suggest that economic policy uncertainty significantly affects demand for money in all countries in my sample in both short-run and long-run. According to estimation results, a higher level of economic policy uncertainty reduces demand for money in Canada and the U.S. However, a lower level of economic policy uncertainty raises the demand for money in Japan and U.K in the long-run. Moreover, policy uncertainty shows an asymmetric effect on money demand in Canada, Japan, and the U.S. in the short-run. Policy uncertainty also has an asymmetric effect on the demand for money in all the countries in the long-run.

In the second section of this thesis, I investigate how uncertainty affects investment in following G7 countries: Canada, France, Germany, Italy, Japan, the U.K., and the U.S. Economists argue that investment, and consequently economic growth decline when a level of uncertainty increases in the economies. The estimation results of linear suggest that policy uncertainty shows a significant short-run effect on domestic investment in Canada, Germany, Italy, Japan, and the U.S., but no meaningful long-run effects in any of the G7 countries. According to the estimation results of the nonlinear model, policy uncertainty carries a significant short-run coefficient in all countries but the U.K. Besides, the estimated long-run coefficient of economic policy uncertainty is significant in all G7 countries. Indeed, in the long-run, any decrease in policy uncertainty raise investment in Canada and Germany, but reduce investment in Italy and the U.S. On the other hand, any increased policy uncertainty hurt investment in Canada, Japan, and the U.K., but boost investment in France and Germany. Moreover, the results of the Wald test confirm the existence of an asymmetric relationship between economic policy uncertainty in Germany, Italy, and the U.S. in the short-run, and in all G7 countries but Germany in the long-run.

The third part of this thesis studies the relationship between consumer expenditure and economic policy uncertainty in all G7 countries. Economic theory suggests that any positive shocks in uncertainty could reduce consumer expenditure since consumers behave prudently and save for precautionary motives. Based on the results of the linear model, economic policy uncertainty has meaningful effects on consumption only in Canada, Italy and the U.S. in the short-run and in Italy, and the U.S. in the long-run. However, economic policy uncertainty affects consumer expenditure in all countries according to the results of the nonlinear model. According to estimated coefficients, a higher level of economic policy uncertainty reduces consumption in Canada, Germany, and Italy. On the hand resolving economic policy uncertainty increase the level of consumer expenditure in Italy, the U.K. and the U.S. Moreover, results of Wald test confirm presence of an asymmetric relationship between consumption and economic policy uncertainty in France, Italy, and the U.K. in the short-run, and in Canada, France, Germany, Japan, and the U.K. in the long-run. The asymmetric relationship between economic policy uncertainty and consumption could not be confirmed in the U.S. in both the short-run and the long-run, although economic policy uncertainty has a significant effect on consumption.

In conclusion, the nonlinear model could more effectively capture the possible connection between uncertainty and macroeconomics variables compared to the linear model according to empirical results. Furthermore, the estimation results confirm the presence of the asymmetric relationship between uncertainty and money demand, investment and consumption in almost all countries in my sample. These asymmetric reactions of the macroeconomics variable to ups and downs in policy uncertainty mean positive and negative shocks in economic policy uncertainty could not offset the effects of each other, and they have persistent impacts of demand for money, investment and consumption in the long-run.

Table 1. Literature Review on Nonlinear Money Demand				
Author(s)	**Country**	**Sample Period**	**Monetary Aggregate**	**Method**
Ordonez (2003)	Spain	1978-1998	M3	ESTR
Sarno (1999)	Italy	1861-1991	M1	ESTR
Chen and Wu (2005)	U.S.-U.K.	1960Q1-1990Q1	M1-M2	ESTAR
Sarno, Taylor and Peel (2003)	U.S.	1869-1997	M1	ESTR
Choi and Saikkonen (2004)	U.S.	1959Q1-2000Q4	M1	Cointegrating STR
Nakashima (2009)	Japan	1980Q1-2001Q1	M1	Cointegrating STR
Rothman, van Dijk and Franses (2001)	U.S.	1959M1-1999M12 (Monthly)	M2	STVEC
Escribano (2004)	U.K.	1878-2000	M1-M2	NECM
Calza and Zaghini (2006)	E.U.	1971Q4-2003Q4	M1	Markov Switching ECM
Sahin(2013)	Turkey	1990M1-2015M5 (Monthly)	M2	STR
Bahmani-Oskooee and Bahmani (2015)	Iran	-	M2	Nonlinear ARDL
Bahmani-Oskooee and Jungho Baek (2016)	Japan	1973Q1-2014Q3	M2	Nonlinear ARDL
Bahmani-Oskooee, Xi and Bahmani (2016)	China	-	M2	Nonlinear ARDL
Alsamara, Mrabet, Dombrecht and Barkat (2016)	Saudi Arabia	1990Q1–2014Q4	-	Nonlinear ARDL
Jawadi and Sousa (2013)	U.K.-EU-U.S.	1878-2000	M2 for US M3 for EU M4 for UK	NECM

Table 2. Literature Review on Effect of Uncertainty on Money Demand				
Author(s)	**Country**	**Sample Period**	**Monetary Aggregate**	**Measure of Uncertainty**
Arize and Malindretos (2000)	China	1952-1994	M0-M2-M3	Inflation Uncertainty
Carpenter and Lange (2003)	U.S.	1995Q4-2002Q1	M2	Equity Uncertainty
Choi and Oh (2003)	U.S.	1959Q1-1996Q2	M1	Output Uncertainty Monetary Uncertainty
Atta-Mensah (2004)	Canada	1960Q1-2003Q4	M1-M2	Stock Market Uncertainty
Carstensen (2006)	EU	1978Q1-2004Q4	M3	Stock Market Uncertainty
Higgins and Majin (2009)	U.S.	1960M1- 2006M6 (Monthly)	M1-M2	Inflation Uncertainty
de Bondt (2009)	EU	1983Q1-2007Q2	M3	equity risk macroeconomic uncertainty
Seitz and von Landesberger (2010)	EU	1991-2009	M3	Stock Market Uncertainty
Bahmani-Oskooee and XI (2011)	Australia	1975Q1-2010Q4	M3	Economic and monetary Uncertainty
Bahmani-Oskooee, Kutan and Xi (2013)	Armenia, Bulgaria, the Czech Republic, Hungary, Poland and Russia	-	M2	Economic and monetary Uncertainty
Bahmani-Oskooee and Bahmani (2014)	Korea	1971-2010	M2	monetary Uncertainty
Bahmani-Oskooee and XI (2014)	India, Indonesia, Malaysia, Pakistan, the Philippines, and Singapore	1994Q1– 2011Q4	M2	Economic and monetary Uncertainty
Bahmani-Oskooee and Kones(2014)	21 African Nations	-	M2	Economic and monetary Uncertainty
Bahmani-Oskooee, Kones and Kutan (2015)	U.S.	1997Q1 – 2013Q3	M2	Policy uncertainty
Bahmani-Oskooee, Bahmani, Kones and Kutan (2015)	U.K.	1997Q1-2013Q3	M2	Policy uncertainty
Bahmani-Oskooee, Satawatananon and Xi (2015)	Thailand	-	M2	Economic and monetary Uncertainty
Bahmani-Oskooee and Baek (2017)	Korea	-	-	Economic and monetary Uncertainty

Table 3. Literature Review on Effect of Uncertainty on Investment				
Author(s)	**Country**	**Sample Period**	**Measure of Uncertainty**	**Method**
Bow and Lensinwz (2003)	Netherlands	1984-1996	volatility of individual firms' daily stock market return	GMM
Kang, Lee, and Ratti	U.S.	1985 -2010	Economic policy uncertainty	GMM
Lensink and Murinde (2006)	U.K.	1995-1999	volatility of individual firms' daily stock market return	GMM
Linsink (2002)	Australia, Austria, Belgium, Canada, Denmark, France, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, U.K., U.S.	1970-1997	volatility of stock market return	Panel-GLS
Menashe	U.S.	1958-1996	Output price, productivity, and factor price volitivity	Panel-Fixed effect
Wanga, Chen, and Huang (2014)	China	2003-2012	Policy uncertainty	Panel-Fixed effect
Gulen and Ion (2015)	U.S.	1985-2013	Policy Uncertainty	Panel-Fixed effect

Table 4. Literature Review on Effect of Uncertainty on Consumption

Author(s)	Country	Sample Period	Measure of Uncertainty	Method
Bande and Riveiro(2012)	Spain	1980-2007	Income uncertainty	GMM
Baiardi, Manera, and Menegatti (2013)	Canada, France, Italy, Spain, U.K. and U.S.	1965–2007	financial risk and environmental risk	GMM
Miles (1997)	U.K.	1968-1977-1983-1986-1990	Income uncertainty	OLS
Bahmani-Oskooee and Xi (2011)	U.K., U.S., Switzerland, Singapore, Sweden, Norway, New Zealand, Korea, Japan, Ireland, Greece, Germany, France, Belgium, Austria, Australia, Canada	1964-2008	Exchange rate uncertainty	ARDL
Banks, Blundell, and Brugiavini (2001)	U.K.	1968-1992	Income uncertainty	ARIMA
Bahmani-Oskooee, Kutan and Xi (2015)	Armenia, Czech, Bulgaria, Poland, Bolivia, South Africa, Malaysia, Colombia, Russia, Philippines, Chile, Hungary	1991-2014	Exchange rate uncertainty	ARDL
Guariglia, and Rossit (2002)	U.K.	1992-1997	Income uncertainty	Panel
Hahm and Steigerwald (1999)	U.S.	1981-1994	Income uncertainty	2SLS
Menegatti (2007)	Italy	1981-2000	Income uncertainty	ARIMA
Benito (2005)	U.K.	1992-1998	unemployment risk	GMM
Menegatti (2010)	24 OECD countries	1955-2000	Conditional variance of output growth	ARIMA
Lugilde, Bande, and Riveiro (2016)	Spain	2008,2011	Self-perceived income shock, expectations about future income, subjective probability of job loss, job insecurity indicator, unemployment rates by five-year age groups	OLS
Pericoli and Ventura (2010)	Italy	1989-2006	Probability of marital splitting	Probit analysis

Table 5-A: Full-information estimates of the Linear Money Demand for Canada

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11
ΔLnM	-	0.45**	0.04	0.44**	-0.20**	0.15*	0.05	-0.11	-0.13*	0.09	0.10	0.13*
		(5.72)	(0.61)	(4.80)	(-2.76)	(2.28)	(0.51)	(-1.34)	(-1.92)	(1.45)	(1.46)	(1.85)
ΔLnY	-0.16*											
	(-1.94)											
ΔLnR	-0.01**	0.01	-0.003	0.002	0.01*							
	(-2.27)	(1.14)	(-0.36)	(0.24)	(1.90)							
ΔLnLEX	-0.08**	0.06**	-0.05*	0.02	0.05*	-0.06*	0.06**	-0.07**	0.08**	-0.02	-0.06**	
	(-4.72)	(2.58)	(-1.67)	(0.92)	(1.95)	(-1.87)	(2.03)	(-2.32)	(2.21)	(-0.74)	(-3.63)	
ΔLnPU	-0.0003	-0.002	-0.002	0.001	0.005**	-0.003*	0.002	-0.004*	0.01**	0.001	-0.002	-0.003**
	(-0.21)	(-0.84)	(-0.93)	(0.51)	(2.57)	(-1.69)	(1.34)	(-1.78)	(3.81)	(0.82)	(-1.09)	(-3.38)

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnEX	LnPU
17.95**	0.59**	-0.26**	0.54**	0.04
(23.70)	(5.13)	(-4.84)	(7.23)	(1.19)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
7.99**	-0.07**	1.21	7.29**	0.78	S (S)
	(-6.48)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are four exogenous variables is 3.52 (4.01) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.66 (-3.99) at the 10% (5%) level when k =4. The comparable figures when k = 5 in the nonlinear model are -3.86 and -4.19 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 5-B: Full Information Estimate of the Nonlinear Money Demand for Canada

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11
ΔLnM	-	0.17**	-0.02	0.36**	-0.10	0.09	0.08	-0.21**	-0.27**	0.10		
		(2.68)	(-0.29)	(4.93)	(-1.41)	(1.30)	(1.25)	(-2.92)	(-3.64)	(1.55)		
ΔLnY	-0.11**	-0.06	-0.22*	0.32**	-0.14	-0.12	0.08	0.01	0.08	0.02	0.06	-0.21**
	(-2.01)	(-0.49)	(-1.92)	(3.71)	(-1.29)	(-1.08)	(0.82)	(0.08)	(0.98)	(0.23)	(0.55)	(-3.81)
ΔLnR	-0.02**	0.01	-0.001	-0.001	0.01	0.01	0.01*	-0.003	-0.006	-0.002	0.02**	
	(-2.96)	(1.61)	(-0.26)	(-0.17)	(1.50)	(1.16)	(1.83)	(-0.59)	(-0.95)	(-0.39)	(3.57)	
ΔLnLEX	-0.07**	0.03*	-0.05**	0.01	0.05**	-0.06**	0.08**	-0.05**	0.07**	0.01	-0.08**	
	(-7.79)	(1.90)	(-2.28)	(0.31)	(2.26)	(-2.07)	(3.39)	(-1.97)	(2.63)	(0.19)	(-3.91)	
ΔPOS	0.005**	0.01**	-0.003	-0.004*	0.01**	-0.002	0.01**	-0.01**	0.01**	0.01**		
	(2.70)	(2.49)	(-0.94)	(-1.77)	(4.45)	(-0.63)	(3.08)	(-4.10)	(2.40)	(3.01)		
ΔNEG	-0.01**	-0.01**	-0.001	0.003	-0.001	-0.002	-0.01*	0.01**	0.01**	-0.001	0.005**	-0.01**
	(-4.17)	(-4.98)	(-0.25)	(0.87)	(-0.25)	(-0.66)	(-1.80)	(2.05)	(2.82)	(-0.53)	(2.04)	(-3.13)

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnEX	POS	NEG
14.33**	1.99*	-1.04**	0.60**	-0.24**	-0.10
(3.15)	(1.83)	(-4.43)	(3.55)	(-2.01)	(-1.24)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
9.64**	-0.05	0.02	2.22	0.85	S (S)	4.55**	34.22**
	(-3.15)						

Notes:

a. Numbers inside the parentheses are absolute value of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are four exogenous variables is 3.52 (4.01) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.66 (-3.99) at the 10% (5%) level when k =4. The comparable figures when k = 5 in the nonlinear model are -3.86 and -4.19 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 6-A: Full-information estimates of the Linear Money Demand for Japan

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-	0.39**											
		(4.43)											
ΔLnY	-0.068**												
	(-3.17)												
ΔLnR	-0.001												
	(-1.40)												
ΔLnLEX	0.001												
	(0.17)												
ΔLnPU	0.003												
	(1.47)												

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnEX	LnPU
12.07**	4.03**	0.044	-0.049	-0.19
(2.42)	(3.32)	(1.08)	(-0.16)	(-1.14)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
2.60	0.017	1.13	4.96**	0.35	US (US)
	(1.90)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are four exogenous variables is 3.52 (4.01) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.66 (-3.99) at the 10% (5%) level when k =4. The comparable figures when k = 5 in the nonlinear model are -3.86 and -4.19 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 6-B: Full Information Estimate of the Nonlinear Money Demand for Japan

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-	0.16	0.25**	0.19**	0.07	0.25**	0.31**	0.08	0.02	0.16	0.24**		
		(1.38)	(2.46)	(2.12)	(0.70)	(2.99)	(4.12)	(0.86)	(0.24)	(1.52)	(2.88)		
ΔLnY	0.14	0.11	-0.05	-0.09**									
	(1.57)	(1.18)	(-0.76)	(-2.09)									
ΔLnR	0.0004	0.001	0.0003	-0.004**	0.01**	-0.003	-0.0001	0.003*	0.0005	-0.003	0.002		
	(0.41)	(0.56)	(0.19)	(-2.78)	(3.31)	(-1.47)	(-0.03)	(1.67)	(0.24)	(-1.42)	(1.49)		
ΔLnLEX	0.002	0.01	0.03*	-0.05**	0.01	-0.03**	0.05**						
	(0.17)	(0.38)	(1.66)	(-3.20)	(0.69)	(-2.44)	(4.55)						
ΔPOS	-0.001	-0.01	-0.01*	0.01	0.002	-0.01	0.01	-0.003	-0.0002	0.001	0.02**		
	(-0.20)	(-0.67)	(-1.96)	(1.40)	(0.22)	(-1.52)	(1.33)	(-0.43)	(-0.02)	(0.19)	(3.79)		
ΔNEG	0.01	0.02**	0.01	-0.03**	-0.004	0.03**	-0.01	-0.01					
	(0.60)	(2.27)	(1.53)	(-3.00)	(-0.49)	(4.29)	(-0.91)	(-1.28)					

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnEX	POS	NEG
27.91**	0.28**	-0.005**	-0.01	0.02**	-0.05**
(95.01)	(4.17)	(-3.82)	(-0.61)	(2.05)	(-6.16)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
11.03**	-0.55**	2.47	0.42	0.62	S (S)	1796.71**	8.40**
	(-8.06)						

Notes:

a. Numbers inside the parentheses are absolute value of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are four exogenous variables is 3.52 (4.01) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.66 (-3.99) at the 10% (5%) level when k =4. The comparable figures when k = 5 in the nonlinear model are -3.86 and -4.19 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 7-A: Full-information estimates of the Linear Money Demand for the U.K.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-												
ΔLnY	0.33** (4.15)	0.21 (0.82)	-0.12 (-0.61)	-0.21** (-2.44)									
ΔLnR	-0.01** (-3.69)												
$\Delta Ln(P_t/P_{t-1})$	-0.01** (-7.75)												
ΔLnLEX	0.01 (0.61)												
ΔLnPU	0.002 (0.93)												

Panel B: long-run coefficient estimates

Constant	LnY	LnR	$Ln(P_t/P_{t-1})$	LnEX	LnPU
-5.97**	3.36**	-0.08**	-0.10**	0.09	0.01
(-2.57)	(7.55)	(-3.17)	(-3.63)	(0.55)	(0.87)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
22.06**	-0.10**	2.36	2.13	0.70	S (S)
	(-4.11)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are five exogenous variables is 3.35 (3.79) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.86 (-4.19) at the 10% (5%) level when k =5. The comparable figures when k = 6 in the nonlinear model are -4.04 and -4.38 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 7-B: Full Information Estimate of the Nonlinear Money Demand for the U.K.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-												
ΔLnY	0.32** (3.50)	0.23 (0.87)	-0.38** (-2.75)										
ΔLnR	-0.01** (-4.38)												
$\Delta Ln(P_t/P_{t-1})$	-0.01** (-8.92)												
$\Delta LnLEX$	0.03 (1.60)												
ΔPOS	0.01** (2.73)												
ΔNEG	-0.01** (2.17)												

Panel B: long-run coefficient estimates

Constant	LnY	LnR	$Ln(P_t/P_{t-1})$	LnEX	POS	NEG
-4.52**	2.85**	-0.08**	-0.11**	0.27	0.08**	-0.06*
(-2.13)	(6.84)	(-2.68)	(-3.44)	(1.22)	(2.08)	(-1.70)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
20.80**	-0.09 (-3.60)	0.81	1.70	0.66	S (US)	4.44**	2.04

Notes:

a. Numbers inside the parentheses are absolute value of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are five exogenous variables is 3.35 (3.79) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.86 (-4.19) at the 10% (5%) level when k =5. The comparable figures when k = 6 in the nonlinear model are -4.04 and -4.38 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 8-A: Full-information estimates of the Linear Money Demand for the U.S.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-												
ΔLnY	-0.32** (-2.08)												
ΔLnR	-0.01** (-2.02)	-0.002 (-0.94)	0.002 (0.52)	0.004 (1.34)	-0.01** (-2.24)	0.004 (1.57)	-0.004 (-1.32)	-0.003 (-0.60)	0.01** (1.97)				
$\Delta Ln(P_t/P_{t-1})$	-0.02** (-4.54)	0.01 (1.33)	0.01** (2.67)										
ΔLnLEX	0.11** (2.93)	-0.04 (-1.24)	0.07** (2.11)	0.003 (0.09)	-0.08** (-2.81)	0.05** (2.80)							
ΔLnPU	0.01** (3.98)												

Panel B: long-run coefficient estimates

Constant	LnY	LnR	$Ln(P_t/P_{t-1})$	LnEX	LnPU
131.45 (0.77)	-14.06 (-0.74)	0.39 (0.65)	0.51 (0.79)	0.69 (0.89)	-0.87 (-0.64)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
3.46*	0.01 (0.64)	0.32	23.32**	0.55	S (US)

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are five exogenous variables is 3.35 (3.79) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.86 (-4.19) at the 10% (5%) level when k =5. The comparable figures when k = 6 in the nonlinear model are -4.04 and -4.38 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 8-B: Full Information Estimate of the Nonlinear Money Demand for the U.S.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8	9	10	11	12
ΔLnM	-	-0.20**	-0.23**	-0.09	0.02	-0.19**							
		(-2.93)	(-4.03)	(-1.34)	(0.38)	(-2.26)							
ΔLnY	-0.39**												
	(2.53)												
ΔLnR	-0.01**	-0.002	0.003	0.01**	-0.003	0.004**	-0.005**	-0.004	0.01**				
	(-5.56)	(-1.13)	(1.31)	(2.31)	(-1.34)	(2.62)	(-2.34)	(-1.01)	(5.23)				
$\Delta Ln(P_t/P_{t-1})$	-0.02**	0.001	0.003	0.01	-0.003	-0.01	-0.01	0.02**	-0.02**				
	(-5.04)	(0.40)	(0.84)	(1.26)	(-0.65)	(-1.51)	(-1.29)	(3.24)	(-4.49)				
ΔLnLEX	0.08**	-0.02	0.06*	-0.01	-0.08**	0.02	-0.01	-0.01	0.07**	-0.10**			
	(3.37)	(-0.63)	(1.70)	(-0.31)	(-2.88)	(0.78)	(-0.24)	(-0.52)	(2.05)	(-4.24)			
ΔPOS	0.002	-0.01*	0.01	0.01**	0.004	0.01**	-0.01**	0.01	0.01**	0.01**	0.01**		
	(0.32)	(-1.94)	(1.22)	(2.35)	(1.10)	(3.17)	(-2.27)	(1.45)	(2.48)	(2.35)	(2.37)		
ΔNEG	0.02**												
	(2.60)												

Panel B: long-run coefficient estimates

Constant	LnY	LnR	$Ln(P_t/P_{t-1})$	LnEX	POS	NEG
-4.29	0.49	-0.28**	0.13**	1.52**	-0.78**	0.22
(-0.46)	(0.52)	(-3.31)	(5.10)	(5.33)	(-3.81)	(1.58)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
6.08**	-0.07	0.29	2.57	0.67	S (US)	9.01**	58.30**
	(-2.95)						

Notes:

a. Numbers inside the parentheses are absolute value of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are five exogenous variables is 3.35 (3.79) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.86 (-4.19) at the 10% (5%) level when k =5. The comparable figures when k = 6 in the nonlinear model are -4.04 and -4.38 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 9-A: Full Information Estimate of the Linear Investment for Canada

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.16*							
		(1.78)							
ΔLnY	0.76**	0.89**	-0.53**						
	(2.79)	(2.14)	(-2.17)						
ΔLnR	0.01								
	(0.70)								
ΔLnPU	-0.02**								
	(-4.38)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	LnPU						
22.13**	1.01**	-0.17	-0.29*						
(10.58)	(3.22)	(-1.51)	(-1.91)						
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)				
2.94	-0.05	2.39	7.34**	0.40	S (S)				
	(-2.07)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 9-B: Full Information Estimate of the Nonlinear Investment for Canada

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.11	0.16*	0.09	-0.16*				
		(1.31)	(1.91)	(1.03)	(-1.96)				
ΔLnY	0.75**	0.81*	-0.15	-0.66**					
	(2.53)	(1.93)	(-0.35)	(-2.21)					
ΔLnR	-0.001	-0.01	0.03	-0.02	0.02	-0.01	-0.02	0.03**	
	(-0.11)	(-0.71)	(1.52)	(-0.94)	(1.49)	(-0.41)	(-1.01)	(2.64)	
ΔPOS	-0.02**	-0.002	-0.02**	0.02**					
	(-1.97)	(-0.16)	(-2.33)	(3.03)					
ΔNEG	-0.02**								
	(-2.88)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	POS	NEG					
17.83**	1.86**	-0.31**	-0.27**	-0.21**					
(6.78)	(2.76)	(-3.35)	(-3.18)	(-2.24)					
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S		
4.82**	-0.10*	0.004	12.54**	0.46	S (S)	2.76*	1.44		
	(-3.59)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 10-A: Full Information Estimate of the Linear Investment for France

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.19**	0.07	-0.08	0.03	-0.20**	0.02	0.15**	
		(2.34)	(0.82)	(-0.89)	(0.35)	(-2.29)	(0.34)	(2.48)	
ΔLnY	1.45**	0.04	-0.31	0.66*	-0.44*	0.25			
	(11.18)	(0.14)	(-1.12)	(2.23)	(-1.90)	(1.40)			
ΔLnR	-0.001*								
	(-1.90)								
ΔLnPU	0.002								
	(1.50)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	LnPU						
-4.28**	1.89**	0.02	0.04						
(-2.20)	(4.35)	(1.38)	(1.53)						
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)				
1.38	-0.05	0.05	1.15	0.77	S (S)				
	(-2.20)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 10-B: Full Information Estimate of the Nonlinear Investment for France

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.21**	0.14*	-0.04	0.07	-0.20**	-0.01	0.23**	
		(2.56)	(1.85)	(-0.39)	(0.92)	(-2.94)	(-0.12)	(4.59)	
ΔLnY	1.43**	0.12	-0.46	0.92**	-0.38**				
	(10.06)	(0.54)	(-1.53)	(3.06)	(-2.56)				
ΔLnR	-0.001**	0.0001	0.001	0.001	-0.002*	0.001	-0.002**	0.005**	
	(-1.97)	(0.09)	(1.13)	(1.22)	(-1.71)	(1.20)	(-2.09)	(4.98)	
ΔPOS	-0.001	-0.003	0.004	-0.01	0.01**				
	(-0.38)	(-0.69)	(0.69)	(-1.33)	(2.19)				
ΔNEG	0.001	0.002	-0.01**	0.01**					
	(0.52)	(0.75)	(-2.65)	(2.35)					

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
-3.33**	1.77**	-0.02*	0.05**	-0.003
(-2.82)	(6.31)	(-1.77)	(3.18)	(-0.13)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
2.17	-0.10**	0.12	0.02	0.78	S (S)	12.02**	1.62
	(-3.79)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 11-A: Full Information Estimate of the Linear Investment for Germany

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.16**	-0.04	-0.04	0.13				
		(-2.44)	(-0.57)	(-0.61)	(1.55)				
ΔLnY	1.91**								
	(8.83)								
ΔLnR	0.02**	-0.004	-0.01	0.04**	-0.02*	-0.03**	0.03**		
	(2.63)	(-0.33)	(-0.40)	(2.95)	(-1.65)	(-2.05)	(2.66)		
ΔLnPU	0.003	0.01**							
	(0.59)	(2.56)							
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	LnPU						
5.66	-0.29	-0.05	0.03						
(0.90)	(-0.20)	(-1.61)	(0.53)						
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)				
1.72	-0.11	0.09	0.46	0.68	US (US)				
	(-2.11)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 11-B: Full Information Estimate of the Nonlinear Investment for Germany

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.39**	-0.21**	-0.21**					
		(-4.68)	(-2.34)	(-3.10)					
ΔLnY	1.76**	0.48	-0.001	-0.04	0.23	-0.26	-0.37**		
	(10.37)	(1.35)	(-0.003)	(-0.13)	(1.03)	(-1.16)	(-2.26)		
ΔLnR	0.03**	0.01	-0.01	0.04**	-0.01	-0.04**	0.04**		
	(2.48)	(0.63)	(-0.62)	(3.46)	(-0.61)	(-2.14)	(3.59)		
ΔPOS	0.0001								
	(0.01)								
ΔNEG	0.03**	-0.003	-0.01	0.02	0.02*	0.02*	0.01		
	(3.41)	(-0.36)	(-0.69)	(1.37)	(1.82)	(1.73)	(1.53)		

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
-7.13**	2.72**	-0.07**	0.06**	-0.06**
(-3.84)	(6.36)	(-5.15)	(2.62)	(-2.42)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
5.14**	-0.28**	1.08	0.83	0.74	S (S)	2.46	21.30**
	(-4.70)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 12-A: Full Information Estimate of the Linear Investment for Italy

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.43**	-0.20	0.17	0.40**	0.15	0.13		
		(-3.09)	(-1.27)	(1.09)	(2.86)	(1.51)	(1.56)		
ΔLnY	1.25**	-0.07	1.37**	0.19	-0.71*				
	(4.24)	(-0.13)	(2.60)	(0.37)	(-1.88)				
ΔLnR	0.003	-0.07**	0.02						
	(0.23)	(-3.13)	(1.62)						
ΔLnPU	0.01	0.02**							
	(0.99)	(2.11)							

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
-30.42	7.09	0.73	0.33
(-0.49)	(0.58)	(0.48)	(0.30)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
1.89	0.02	0.19	5.49**	0.64	S (S)
	(0.38)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 12-B: Full Information Estimate of the Nonlinear Investment for Italy

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.33**	-0.32**	-0.31**	-0.20**	-0.18*	-0.17*	-0.24**	
		(-3.23)	(-3.23)	(-3.09)	(-2.09)	(-1.92)	(-1.80)	(-2.46)	
ΔLnY	1.56**								
	(7.93)								
ΔLnR	0.02	-0.04	-0.005	0.03	0.03**				
	(1.29)	(-1.58)	(-0.21)	(1.11)	(1.98)				
ΔPOS	-0.02	-0.01	0.01	-0.02	0.01	-0.02	-0.001	0.03**	
	(-1.60)	(-0.42)	(0.62)	(-0.89)	(0.34)	(-0.98)	(-0.04)	(2.11)	
ΔNEG	0.01	0.01	-0.01	-0.03	-0.03*	0.04**	0.01	-0.02	
	(0.93)	(0.60)	(-0.48)	(-1.61)	(-1.72)	(2.20)	(0.31)	(-1.40)	

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
-9.99**	3.28**	-0.17**	0.02	0.09**
(-16.60)	(24.14)	(-6.12)	(1.15)	(4.01)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
4.89**	-0.47**	0.52	5.72**	0.73	S (US)	108.01**	4.22**
	(-8.06)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 13-A: Full Information Estimate of the Linear Investment for Japan

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.22**	0.24**	-0.01	0.12	0.07	-0.05	0.34**	
		(2.45)	(2.67)	(-0.07)	(1.33)	(0.72)	(-0.57)	(3.30)	
ΔLnY	0.75**								
	(5.19)								
ΔLnR	-0.01**								
	(-2.25)								
ΔLnPU	-0.0003	-0.02**							
	(-0.04)	(-2.56)							

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
-0.36	1.16*	-0.07**	0.01
(-0.12)	(1.89)	(-2.83)	0.28

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
2.10	-0.16	0.005	0.40	0.57	S (S)
	(-3.23)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 13-B: Full Information Estimate of the Nonlinear Investment for Japan									
				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	0.29**	0.27**	0.06	0.16	0.06	0.02	0.36**	
		(3.01)	(2.80)	(0.57)	(1.68)	(0.70)	(0.19)	(3.39)	
ΔLnY	0.69**								
	(4.84)								
ΔLnR	-0.02**								
	(-2.98)								
ΔPOS	-0.02*								
	(-1.83)								
ΔNEG	0.02								
	(1.37)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	POS	NEG					
2.70	0.55	-0.10**	-0.08**	0.04					
(1.38)	(1.30)	(-4.45)	(-2.18)	(1.10)					
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S		
1.69	-0.22**	0.03	0.24	0.57	S (S)	4.39**	0.19		
	(-3.79)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 14-A: Full Information Estimate of the Linear Investment for the U.K.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.26**							
		(-2.23)							
ΔLnY	0.82*	-0.50	1.23**						
	(1.71)	(-0.76)	(2.79)						
ΔLnR	-0.02								
	(-1.14)								
ΔLnPU	0.02								
	(1.43)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
1.29	0.81**	-0.09	-0.05
(1.21)	(3.73)	(-1.17)	(-1.14)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
3.09	-0.23	0.32	0.16	0.35	S (US)
	(-3.06)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 14-B: Full Information Estimate of the Nonlinear Investment for the U.K.

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-								
ΔLnY	0.65**								
	(3.00)								
ΔLnR	-0.02	-0.02	-0.01	0.03	0.04				
	(-0.78)	(-0.54)	(-0.40)	(0.79)	(1.45)				
ΔPOS	0.02								
	(1.21)								
ΔNEG	-0.01								
	(-0.63)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	POS	NEG					
-2.02	1.57**	-0.21**	-0.07**	-0.02					
(-1.38)	(4.76)	(-4.28)	(-2.65)	(-0.61)					
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S		
5.13**	-0.41**	0.38	1.52	0.32	S (US)	8.74**	0.0006		
	(-4.51)								

Notes:
a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.
b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).
c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).
d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.
e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.
f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 15-A: Full Information Estimate of the Linear Investment for the U.S.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-	-0.05	0.06	0.15*	0.13				
		(-0.65)	(0.78)	(1.95)	(1.57)				
ΔLnY	1.28**	0.46**	0.01	-0.26	0.21	0.29	-0.59**	0.38**	
	(8.84)	(2.00)	(0.02)	(-1.13)	(0.95)	(1.42)	(-2.84)	(2.70)	
ΔLnR	0.01**	-0.01	0.02**	-0.02**	-0.003	0.01**			
	(2.89)	(-0.77)	(2.27)	(-3.13)	(-0.37)	(2.32)			
ΔLnPU	-0.01*	0.002	0.001	0.0003	0.001	-0.01**	-0.01**		
	(-1.92)	(0.62)	(0.29)	(0.10)	(0.31)	(-2.83)	(-2.28)		

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
-11.19**	1.82**	0.02**	0.05
(-28.19)	(59.52)	(3.27)	(1.54)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
9.05**	-0.16**	0.32	6.55**	0.78	S (S)
	(-5.50)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 15-B: Full Information Estimate of the Nonlinear Investment for the U.S.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnI	-								
ΔLnY	1.26**	0.34	-0.02	-0.33	0.49**	0.40*	-0.62**	0.27*	
	(9.96)	(1.62)	(-0.10)	(-1.56)	(2.31)	(1.95)	(-2.96)	(1.85)	
ΔLnR	0.01	-0.01**	0.02**	-0.02**	-0.005	0.01*	-0.005	0.01**	
	(1.25)	(-2.21)	(2.66)	(-2.84)	(-0.74)	(1.74)	(-0.71)	(2.19)	
ΔPOS	-0.01**	0.01	-0.001	-0.001	0.003	-0.01**	-0.01*		
	(-3.11)	(1.36)	(-0.24)	(-0.10)	(0.61)	(-2.14)	(-1.72)		
ΔNEG	0.005	-0.01*							
	(0.80)	(-1.80)							

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
-16.23**	2.44**	-0.03**	0.03	0.09**
(-9.54)	(12.51)	(-2.04)	(0.93)	(2.14)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
9.88**	-0.16**	1.23	1.85	0.79	S (S)	14.00**	16.74**
	(-5.09)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 16-A: Full Information Estimate of the Linear Consumption for Canada

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.18*							
		(-1.93)							
ΔLnY	0.38**								
	(3.46)								
ΔLnR	-0.002								
	(-1.38)								
ΔLnPU	-0.004**								
	(-3.25)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
1.67	0.74	-0.05	-0.11
(0.92)	(1.56)	(-1.49)	(-1.42)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
2.86	-0.04	0.63	18.87**	0.36	S (US)
	(-1.61)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 16-B: Full Information Estimate of the Nonlinear Consumption for Canada

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.18* (-1.95)							
ΔLnY	0.37** (3.71)								
ΔLnR	-0.003** (-2.72)								
ΔPOS	-0.01** (-4.25)								
ΔNEG	-0.005** (-2.16)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
0.18	0.97**	-0.04**	-0.08**	-0.01
(0.18)	(3.83)	(-2.74)	(-2.44)	(-0.84)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
4.78**	-0.08	0.57	19.74**	0.41	S (US)	7.78**	0.09
	(-2.81)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 17-A: Full Information Estimate of the Linear Consumption for France

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.80**	-0.30**							
	(5.35)	(-3.07)							
ΔLnR	-0.0007								
	(-0.76)								
ΔLnPU	-0.0005								
	(-0.56)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
-0.29	1.08**	-0.009	-0.008
(-0.32)	(5.13)	(-0.69)	(-0.49)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
3.30	-0.08	1.68	2.72*	0.37	US (S)
	(-2.15)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 17-B: Full Information Estimate of the Nonlinear Consumption for France

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.83**	-0.32**							
	(6.79)	(-3.78)							
ΔLnR	-0.003**								
	(-2.26)								
ΔPOS	0.01**	0.003							
	(5.28)	(0.84)							
ΔNEG	-0.01**								
	(-3.04)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	POS	NEG					
0.30	0.93**	-0.02**	0.01	-0.02**					
(0.76)	(9.56)	(-2.48)	(0.90)	(-2.25)					
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S		
4.65**	-0.19	0.06	0.80	0.49	S (US)	19.88**	19.64**		
	(-3.35)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 18-A: Full Information Estimate of the Linear Consumption for Germany

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.22**							
		(-2.09)							
ΔLnY	0.10**								
	(2.49)								
ΔLnR	-0.003**								
	(-3.22)								
ΔLnPU	0.001								
	(1.02)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	LnPU						
1.95**	0.58**	-0.02**	0.01						
(2.10)	(2.76)	(-2.84)	(0.93)						
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)				
3.68	-0.17**	4.56**	2.77*	0.14	S (S)				
	(-4.14)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 18-B: Full Information Estimate of the Nonlinear Consumption for Germany

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.20*	-0.22**							
	(1.82)	(-3.65)							
ΔLnR	-0.0004								
	(-0.37)								
ΔPOS	-0.003								
	(-1.62)								
ΔNEG	0.004**								
	(2.01)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
3.02**	0.33**	-0.001	-0.01**	0.02**
(5.61)	(2.69)	(-0.35)	(-1.97)	(2.37)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
6.08**	-0.29**	0.15	1.31	0.28	S (S)	14.62**	0.02
	(-4.67)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 19-A: Full Information Estimate of the Linear Consumption for Italy

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	0.17	0.10	0.23**					
		(1.49)	(0.86)	(1.99)					
ΔLnY	0.40**	0.26	-0.05	-0.27*	0.12	0.26**	-0.25**		
	(4.84)	(1.46)	(-0.29)	(-1.76)	(0.90)	(2.11)	(-3.81)		
ΔLnR	-0.003**								
	(-2.38)								
ΔLnPU	-0.002	-0.001	-0.004*	0.001	0.003	0.004*			
	(-0.97)	(-0.25)	(-1.77)	(0.59)	(1.34)	(1.75)			

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
1.86**	0.64**	-0.02**	-0.04**
(2.71)	(4.89)	(-1.96)	(-1.98)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
6.44**	-0.14	5.05**	4.04**	0.61	S (S)
	-3.67				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 19-B: Full Information Estimate of the Nonlinear Consumption for Italy

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.38**	0.29*	-0.14	-0.14	0.07	0.25**	-0.23**		
	(4.97)	(1.85)	(-0.90)	(-0.98)	(0.53)	(2.07)	(-3.32)		
ΔLnR	0.001								
	(0.28)								
ΔPOS	-0.01**	0.003	-0.01**	0.01*	-0.004	0.01**	-0.01**	0.01**	
	(-2.88)	(0.64)	(-2.46)	(1.95)	(-0.92)	(2.23)	(-2.55)	(2.12)	
ΔNEG	0.01	-0.01	0.005	-0.01*	0.01	0.001	0.01*		
	(1.53)	(-1.60)	(1.02)	(-1.68)	(1.59)	(0.21)	(1.72)		

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
2.03**	0.58**	-0.06**	-0.06**	-0.05**
(3.52)	(4.61)	(-2.24)	(-2.99)	(-2.72)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
12.28**	-0.13	0.07	1.40	0.78	S (US)	2.27	7.10**
	(-2.87)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 20-A: Full Information Estimate of the Linear Consumption for Japan

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.27**							
		(-4.17)							
ΔLnY	0.65**								
	(3.71)								
ΔLnR	0.001								
	(0.99)								
ΔLnPU	0.01*								
	(1.90)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
0.16	0.88**	0.01	0.09
(0.12)	(2.86)	(1.08)	(1.24)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
1.81	-0.06	0.71	4.65**	0.003	S (US)
	(-0.89)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 20-B: Full Information Estimate of the Nonlinear Consumption for Japan

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.61**								
	(3.80)								
ΔLnR	0.003**								
	(2.74)								
ΔPOS	0.01**								
	(2.19)								
ΔNEG	0.0003								
	(0.10)								

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
2.40**	0.45**	0.01**	0.02**	0.001
(4.08)	(3.44)	(4.78)	(2.64)	(0.11)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
4.01*	-0.31	1.33	1.86	0.48	S (US)	27.62**	1.96
	(-2.90)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 21-A: Full Information Estimate of the Linear Consumption for the U.K.

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-								
ΔLnY	0.27**	-0.004	0.30**	-0.12					
	(2.59)	(-0.02)	(1.96)	(-1.20)					
ΔLnR	0.0004								
	(0.28)								
ΔLnPU	-0.001								
	(-0.62)								
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	LnPU						
0.15	0.98**	0.003	-0.01						
(0.37)	(10.84)	(0.29)	(-0.62)						
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)				
3.67	-0.15	1.08	7.06**	0.35	S (S)				
	(-2.97)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 21-B: Full Information Estimate of the Nonlinear Consumption for the U.K.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.15	-0.21*						
		(-1.19)	(-1.69)						
ΔLnY	0.42**	-0.11	0.27**	-0.04	0.03	-0.16	-0.20		
	(3.77)	(-0.72)	(1.87)	(-0.29)	(0.22)	(-1.12)	(-1.56)		
ΔLnR	-0.002	0.01	0.002	-0.002	0.005	0.005	-0.02	0.02**	
	(-0.39)	(0.97)	(0.19)	(-0.14)	(0.41)	(0.39)	(-1.80)	(2.94)	
ΔPOS	-0.002								
	(-0.63)								
ΔNEG	-0.002	0.001	0.003	-0.002	0.01	-0.01*	0.001	-0.01**	
	(-0.42)	(0.21)	(0.56)	(-0.44)	(1.30)	(-1.52)	(0.14)	(-1.85)	

Panel B: long-run coefficient estimates

Constant	LnY	LnR	POS	NEG
-3.42**	1.80**	-0.03**	-0.005	0.04**
(-4.55)	(10.09)	(-2.46)	(-0.62)	(4.66)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S
5.98**	-0.40**	7.09**	0.25	0.61	S (S)	10.11**	5.90**
	(-4.11)						

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

Table 22-A: Full Information Estimate of the Linear Consumption for the U.S.

Panel A: short-run coefficient estimates

Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.12	0.12	0.37**					
		(-1.47)	(1.36)	(4.74)					
ΔLnY	0.44**	0.19**	0.05	-0.15**					
	(6.83)	(2.16)	(0.54)	(-2.11)					
ΔLnR	0.001*								
	(1.94)								
ΔLnPU	-0.002	0.001	0.001	-0.002	0.001	-0.003**	0.0002	-0.003**	
	(-1.34)	(0.49)	(0.36)	(-1.17)	(0.94)	(-2.21)	(0.16)	(-0.24)	

Panel B: long-run coefficient estimates

Constant	LnY	LnR	LnPU
-5.57**	1.03**	0.01*	0.04**
(-9.82)	(16.79)	(1.92)	(2.76)

Panel C: Diagnostics

F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)
3.12	-0.14**	0.78	0.02	0.62	S (S)
	(-3.85)				

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

Table 22-B: Full Information Estimate of the Nonlinear Consumption for the U.S.

				Panel A: short-run coefficient estimates					
Lag order	0	1	2	3	4	5	6	7	8
ΔLnC	-	-0.06	0.14	0.42**					
		(-0.94)	(1.44)	(5.10)					
ΔLnY	0.37**	0.15*	-0.01	-0.05	-0.08				
	(5.09)	(1.68)	(-0.15)	(-0.63)	(-1.43)				
ΔLnR	0.001**								
	(3.88)								
ΔPOS	-0.002	0.01**	-0.004*	0.0001	0.003	-0.004*	0.00	-0.005**	
	(-0.94)	(3.03)	(-1.92)	(0.04)	(1.20)	(-1.77)	(0.00)	(-2.38)	
ΔNEG	-0.004*	-0.01**	0.01*	-0.005	-0.002	-0.003	-0.005**		
	(-1.73)	(-2.32)	(1.83)	(-1.60)	(-0.71)	(-0.77)	(-2.11)		
				Panel B: long-run coefficient estimates					
Constant	LnY	LnR	POS	NEG					
-4.64**	0.95**	0.01**	0.03**	0.07**					
(-7.25)	(13.23)	(3.15)	(2.44)	(2.54)					
				Panel C: Diagnostics					
F	ECM_{t-1}	LM	RESET	$\bar{R}^2$	CUSUM (CUSUMQ)	Wald-L	Wald-S		
3.14	-0.13**	1.86	0.23	0.64	S (S)	2.41	1.82		
	(-4.14)								

Notes:

a. Numbers inside the parentheses are t-ratios. *, ** indicate significance at the 10% and 5% levels respectively.

b. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures when k = 4 in the nonlinear model are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

d. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with 1 degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.

f. Both Wald tests are also distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level

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Appendix A. Definition of the Variables

- M_2 = Real Money Supply Measured by Real M2.
- I = Real Gross Capital Formation Index.
- C = Real Private Final Consumption Index.
- Y = Real GDP Index.
- R = Interest rate. Interest Rate on 3-Month Treasury Bill.
- PU = Economic Policy Uncertainty.
- EX= Index of Nominal Effective Exchange Rate.

Appendix B. Data Source

- Real Money Supply: Federal Reserve Bank of St. Louis (FRED)
- Real Gross Capital Formation Index: Federal Reserve Bank of St. Louis (FRED)
- Real Private Final Consumption Index: Federal Reserve Bank of St. Louis (FRED)
- Real GDP Index: Federal Reserve Bank of St. Louis (FRED)
- Interest rate: International Monetary Fund (IMF)
- Economic Policy Uncertainty: Economic Policy Uncertainty Group
- Index of Nominal Effective Exchange Rate: Bank for International Settlements

Appendix C: Data period

- Canada: 1985I-2017IV
- France: 1987I-2017IV
- Germany: 1993I-2017IV
- Italy: 1997I-2017IV
- Japan: 1994I-2017IV
- The U.K.: 1997I-2017IV
- The U.S.: 1985I-2017IV

Curriculum Vita
Majid Makinayeri
December 2019

Education

2014- 2019 **University of Wisconsin-Milwaukee**
Milwaukee, WI
Ph.D. in Economics,
M.Sc. in Economics

2008 **University of Tehran**
Tehran, Iran
M.Sc. in Economics

2006 **University of Shahid Beheshti**
Tehran, Iran
B.Sc. in Economics

Research Interests

Macroeconomics	Monetary Economics	Financial Economics
International Finance	Applied Econometrics	Machine Learning

Publications

" The relationship between oil revenues and economic growth, using threshold methods (the case of Iran)", 2010, *OPEC Energy Review*, Vol 34, No.1, P. 1-14. (with Mohsen Mehrara, and Hossein Tavakolian)

"Policy Uncertainty and the Demand for Money in Korea: An Asymmetry Analysis", 2018, *International Economic Journal*, Vol 32, No.2, P. 219-234. (with Mohsen Bahmani-Oskooee)

"Policy Uncertainty and the Demand for Money in Australia: An Asymmetry Analysis", 2018, *Australian Economic Papers*, Vol 57, No.4, P. 456-469. (with Mohsen Bahmani-Oskooee)

"Asymmetric Effects of Policy Uncertainty on the Demand for Money in the United States", 2019, *Journal of Risk and Financial Management*, Vol 12, No.1, P. 1-13. (with Mohsen Bahmani-Oskooee).

"On the Link between Real Effective Value of Tunisia's Dinar and its Sectoral Trade with the Rest of the World: New Evidence from Asymmetry Analysis.", *The Quarterly Review of Economics and Finance*, Forthcoming. (with Mohsen Bahmani-Oskooee, Thouraya Hadj Amor, and Farhang Niroomand)

"Policy Uncertainty and the Demand for Money in Canada: An Asymmetry Analysis", *Applied Economics Quarterly,* Forthcoming. (with Mohsen Bahmani-Oskooee)

"Asymmetric Effects of Policy Uncertainty on Domestic Investment in G7 Countries", *Open Economies Review,* Forthcoming. (with Mohsen Bahmani-Oskooee)

"Policy Uncertainty and the Demand for Money in the United Kingdom: An Asymmetry Analysis", submitted to *Applied Economics Letters*. (with Mohsen Bahmani-Oskooee)

"Policy Uncertainty and the Demand for Money in Japan", submitted to *Review of Economic Analysis, (*with Mohsen Bahmani-Oskooee)

Work in Progress

"Policy Uncertainty and Consumption in the G7 Countries: An Asymmetry Analysis".

"Financial Literacy and Household Performance in Financial Markets".

Academic Experience

2016-2018 Instructor
Department of Economics, University of Wisconsin – Milwaukee

- Principles of Macroeconomics: Fall 2016, Spring 2017, Spring 2019
- Economic Statistics: Fall 2017
- Money and Banking: Spring 2018
- Economics of Personal Finance (Online): Summer 2018

2015-2018 Graduate Teaching Assistant
Department of Economics, University of Wisconsin – Milwaukee

- Principles of Microeconomics: Spring 2015
- Principles of Macroeconomics: Fall 2015, Spring 2016
- Economic Forecasting Methods: Fall 2016, Spring 2018, Spring 2019
- Econometrics Method II: Spring 2017, Fall 2017, Spring 2019
- International Economic Relations: Spring 2016
- Economic Development: Fall 2015

Professional Experience

2015-To date Instructor and Graduate Teaching Assistant
University of Wisconsin-Milwaukee, Department of Economics

2018 Graduate Intern
Key Bank National Association

2011-2014 Data Analyst and Research Associate
Central Bank of Iran
Research projects carried out:

- The Estimation of the Natural Interest Rate in Iran (Kalman Filter Approach).
- The Monetary Transmission Mechanism in Iran (VAR Approach).
- The Leverage Ratio and Investment Decision in Tehran Stock Market.
- How Do House Prices Affect the Monetary Transmission Mechanism?
- Forecasting Crude Oil Price Using Artificial Neural Networks

Honors and Awards

2018 William L. Holahan Prize for Outstanding Teaching
University of Wisconsin-Milwaukee
2017 J Walter Elliot Award for Excellence in Macroeconomics
University of Wisconsin-Milwaukee

Skills

Programming:
R, SQL, EViews.

Machine Learning:
Regression Methods, Classification Methods, Clustering Methods, Association Rule Learning, Reinforcement Learning, Natural Language Processing (NLP), Dimensionality Reduction, Deep Learning, Model Selection.

Feature Engineering:
Engineering Missing Values, Engineering Outliers, Engineering Rare Values in Categorical Variables, Feature Scaling, Gaussian Transformation, Discretization.

Certificates

- R for Data Science Certificate
- The Ultimate MySQL Bootcamp Certificate
- Feature Engineering for Machine Learning Certificate
- Deep Learning A-Z™ Certificate