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ANALYSIS OF DIFFERENT TYPES OF GOVERNMENT SPENDING SHOCKS AND TURKISH TRILEMMA CONFIGURATION

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by

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ABSTRACT

ANALYSIS OF DIFFERENT TYPES OF GOVERNMENT SPENDING SHOCKS AND TURKISH TRILEMMA CONFIGURATION

by

ORCAN CORTUK

In the first two chapters, I examine different types of government spending while literature usually treats government spending as a homogenous compound. I disaggregate the government spending into three parts; namely, government investment, government wage component consumption (i.e. wage expenditure) expenditure, and non-wage component consumption (i.e. purchases of goods and services). In the first chapter, I perform a Vector autoregression (VAR) analysis and compare the effects of different types of government spending shocks using US data. All types of spending shocks produce a rising effect on output; however their magnitudes differ i.e. government wage expenditure has the biggest impact while non-wage consumption expenditure has the lowest. I showed that this is due to the varying effects of spending types on private consumption. In the second chapter I estimate a DSGE model that distinguishes between these different types of government spending where each type of spending produces different effects on macroeconomic variables. Estimation results obtained from the US data indicate complementarity between private consumption and government production. This feature enables the model to generate a positive response of private consumption following a spending shock which has been a puzzle in the literature.

In the last chapter, I study the trilemma configuration of Turkish economy. This chapter starts with testing the concept of the impossible trinity for Turkey following Aizenman, Chinn and Ito (ACI) approach. However, I also introduce alternative techniques in order to deal with the misspecification problem detected in ACI approach. These techniques include employing additional terms, Two Stage Least Squares, General Method of Moments and Kalman filtering. I show how the contributions of financial integration and/or monetary independence have increased from the first period to the last, with corresponding limitations on exchange rate stability. The analysis also explores the implications of these changes (captured by the corresponding indices) for macroeconomic outcomes by revealing evidence for the impacts of trilemma indices on growth volatility, inflation and inflation volatility for each sub-period. Finally, I find that there is a key role for raising international reserves as trilemma trade-offs and their effects on macroeconomic variables have both been mitigated with reserve accumulation.

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My special thanks to my wife, Sonay, for her patience, understanding and support. She has always been a great help during my PhD education. All errors remaining are mine.

Chapter 1 : A Disaggregated Approach to the Determination of Government Spending Multipliers: An Empirical Analysis

1.1. Introduction

In this study, I examine the effects of different types of government spending and show that components of government spending have varied effects on economic variables. To do so, I initially divide total government spending into government investment and government consumption. Next, I decompose total government consumption into wage and non-wage components, following Giordano et al. (2007) and Benatrix and Lane (2009). Wage component government consumption is basically wage expenditure of government whereas non-wage component government consumption corresponds to government purchases of intermediate goods and services. I empirically evaluate the impact of these alternative types of government spending on output, consumption and investment, along with their size. Regarding this aspect, I offer answers to the following questions throughout the paper: Where should each dollar be spent to achieve higher growth, what form should stimulus packages have, how does the economy respond to a rise in government spending and do consumption, output and investment rise?

The main findings of the study are as follows:

- All types of government spending shocks have positive effects on output, at least on impact. However, the effects of government consumption shocks on output differ from each other in terms of their size. The largest effect on output is due to the wage component of government consumption shocks whereas the smallest effect belongs to non-wage component government consumption shocks.

- While wage component government consumption shocks maintain their positive effect on consumption throughout the forecast horizon, this positive effect is significant only on impact for government investment which quickly dies out. On the contrary to these shocks, non-wage component government spending shocks have negative effect on private consumption bis mostly insignificant. Thus, the varying effect of different types of spending on output is mainly driven by their effects on consumption, which is the main component of output.
- Both types of government consumption have negative and mostly insignificant effects on private investment throughout the forecast horizon. Same effect is positive in the case of government investment shocks but only on impact which becomes insignificant thereafter.

These results, on one hand, support the claim that government spending is an aggregate of different tools. On the other, they run somewhat counter to received wisdom that government investment is a more superior type of spending than government consumption. However, I show in this study that this common wisdom is true only for non-wage component government consumption. Because government investment multipliers are not greater than multipliers of government wage component consumption both in the short and long run. These differences on output multipliers stem from the varied effects of government investment and government consumption shocks on (private) consumption, given that share of (private) consumption in output is around 65 percent. Average shares of all components of US output are displayed in Figure 1.1. According to the figure, shares of government spending and private investment are around 20 and 15 percent respectively. Net exports constitutes only 1 percent of total GDP during the investigated period, hence government spending effects on net exports are ignored and not analyzed.

In this paper, I differentiate the effects of different government spending types by using multipliers. Nonetheless, this study is not aimed at obtaining the exact multiplier figures that represent the impact of government spending shocks. Rather, multipliers are used as references in order to capture the differences. In fact, it is complicated to get an exact multiplier figure that characterizes all time periods, all countries, and all types of spending. For instance, in Gali et al. (2007), the exact multiplier figures vary to some extent depending on the sample period, number of lags, and number of variables exploited in the analysis. Table 1.1 shows the findings of Gali et al (2007). Table 1.1 shows the findings of Gali et al (2007) where multipliers take different values that are mostly between 0.5 and 1.

The rest of the paper is organized as follows. The next section reviews the literature. Section 3 and Section 4 describe the data and methodology, respectively. Section 5 presents the findings and Section 6 concludes.

1.2. Literature Review

Questions regarding the economic effects of government spending and their obvious policy implications have always been attractive to researchers looking for answers. However, no certain consensus has yet been reached and output multipliers of government spending obtained from various researches differ tremendously. Robert Barro has argued that peacetime fiscal multipliers were essentially zero. At the other extreme, Christina Romer, Chair of President Obama's Council of Economic Advisers at the time, used multipliers as high as 1.6. The United States passed a fiscal stimulus plan of 787 billion USD in line with the second view whereas it was just a waste of resources according to the former view.

One reason for the huge variation is due to the methodology used to extract fiscal shocks in empirical studies.[1] This is mainly because the identification of government spending shocks is problematic and different identification schemes lead to adverse conclusions about the responses of key variables. At first sight, the literature seems to be divided on which of the two approaches should be implemented in order to deal with the identification issues. The first approach is the VAR approach which mainly employs two strategies to identify the shocks, namely Choleski decomposition and sign restrictions. Studies identifying the shocks by Choleski decomposition[2] typically follow Blanchard and Perotti (2002) and exploit quarterly data by assuming that government spending is predetermined in quarterly data. This is based on the idea that there is no automatic or discretionary response of government spending to shocks within a quarter due to decision and implementation lags. Ilzeztki et al. (2010) examined the validity of this claim by analyzing the datasets from Botswana and Uruguay and concluded that government consumption typically reacts with a lag of a quarter or more to these shocks. Using US data, studies employing Choleski decomposition typically find that a rise in total government spending (a positive spending shock) raises both GDP and private consumption (e.g. Blanchard and Perotti (2002), Fatás and Mihov (2001), Gali et al (2007), Monacelli and Perotti (2008)). Regarding the response of private investment, it is found to be insignificant in Fatás and Mihov (2001) and Gali et al (2007), but slightly negative in Blanchard and Perotti (2002).

In the case of *sign restrictions*, researchers use qualitative information to help identify VAR shocks. Mountford and Uhlig (2002, 2008), Pappa (2005) and Caldara and Kamps

[1] See Perotti (2007) and Ramey (2009) for a summary of the issues.

[2] With Choleski decomposition, government spending comes first in the ordering and identification is achieved accordingly. See Section 4 for more detail (i.e. the exact A matrix used for identification)

(2006) employed this method for identification. Despite the different identification scheme, Mountford and Uhlig (2008), Pappa (2005) and Caldara and Kamps (2006) agree that this method delivers similar responses to those that are obtained with the Choleski decomposition.[3]

The second approach is the “Narrative Approach” or also known as the "Event Study Approach". With this approach, identification is attained by defining a dummy variable capturing the main episodes of military buildups and tracing the effects of a shock imposed to this dummy variable on several endogenous variables. Using US data, Ramey and Shapiro (1998) were the first to perform such analysis by identifying the exact quarter when the expectations of the Korean, Vietnam and Carter-Reagan military buildups first took hold. In their study, the authors defined the "war dummy variable" as taking the value of 1 for time periods 1950:3, 1965:1 and 1980:1. Later, Burnside, Eichenbaum and Fisher (2004) add 2003:1 to those dates in order to capture the expectation of the post September-11 military buildup. Most of these analyses using the given “war dates” typically find that government spending raises GDP and working hours, but lowers consumption.

The main controversy in the empirical literature stems primarily from the response of consumption as the two approaches, namely VAR and Narrative approaches are in conflict with it. This disagreement also has an effect on the size of the output response, even though both are in agreement of increasing output in response to government spending[4].

Yet, empirical exercises on the effects of different types of government spending shocks are scarce in the literature. A few exceptions are Benetrix and Lane (2009), Perotti (2004),

[3] There are at least no contrary results of significantly decreasing consumption
[4] Generally, the response of output is larger with the VAR approach

and Ilzetzki et al (2010), all of which exploit the VAR approach. The former study uses a US data series whereas the latter employs panel data of mainly developed countries. Perotti (2004) and Ilzeztki et al. (2010) disaggregates government spending into two parts, government consumption and government investment. However, this study follows the disaggregation methodology of Benetrix and Lane (2009), in which government spending is broken into three sub-components by further disaggregating government consumption into wage and non-wage component. Benetrix and Lane (2009) focuses on the effects of government spending on the exchange rate whereas the main interest of Perotti (2004) and Ilzeztki et al (2010) is on output.

1.3. Data

I use U.S. quarterly data from 1960 to 2007.[5] Data is obtained from the NIPA Tables of the Bureau of Economic Analysis.[6] Total government spending (Federal + State Spending) [7] is defined as government investment plus government consumption, where the latter consists of two sub-components, namely: wage and non-wage government consumption.

Under this classification, the non-wage component of government consumption is mainly composed of purchases of intermediate goods and services whereas the wage consumption of government is simply the compensation of government employees. Government

[5] The dataset starts from 1960 in order to exclude the Korean War period from the sample, which has been in the center of discussions between the supporters of the two approaches in identifications of fiscal shocks. Additionally, the dataset ends with 2007 as data from 2008 and 2009 may be subject to significant revisions.
[6] Appendix A describes the data in more detail.

[7] The government spending definition covers Federal, State and Local authorities' spending. As states are required to balance their budgets, one might think that this restriction might be problematic in the analysis. However, balanced-budget rules are valid only for operating budgets not capital budgets. Besides, this restriction is not rigid in practice as it does not forbid new borrowing or realization of total expenditures above total revenues in any year. By this standard, states routinely run deficits because they borrow to finance capital expenditures.

investment consists of government expenditures on fixed asset. Nevertheless, my classification of two items, namely fixed capital formation and purchases of weapons and weapon delivery systems, differs from NIPA Tables. This is because I follow System of National Accounts (Commission of the European Communities et al. 1993) which assumes gross fixed capital formation (depreciation) as government investment and purchases of weapons as government (non-wage) consumption rather than the opposite. Within this categorization, Figure 1.2 shows how these three spending types of government evolve during the period of 1960-2007.[8] According to this figure, the share of non-wage government consumption and government investment in total US government spending fluctuate around 25 percent level throughout the whole period. Regarding government wage expenditure, it initially showed an increasing trend during 1960s and raised its share from 43 percent to over 50 percent where it later became stable.

1.4. Methodology: Identification of Fiscal Shocks

In the analysis, I exploit a Choleski decomposition of a VAR approach by employing US data. The main objective is to estimate the following system of equations:

$$AY_t = \sum_{k=1}^{K} C_k Y_{t-k} + Bu_t \quad (1)$$

where Y_t is a vector of variables comprising the government expenditure variables (e.g. government wage expenditure, government non-wage consumption, government

[8] The share of government non-wage consumption reflects the net purchases of intermediate goods and services as only this part takes part in the output definition. Besides, government sales to other sectors constitute 10 % of total government spending.

investment), output and its components[9] for a given quarter *t*. C_k is a matrix of the own and cross-effects of the k^{th} lag of the variables on their current observations. The matrix *B* is diagonal. u_t is an orthogonal vector of i.i.d. shocks to different types of government spending and output such that $E(u_t,u_t')$ is an identity matrix. Lastly, the matrix *A* allows for the possibility of simultaneous effects between the endogenous variables Y_t. I assume that the matrices A, B, and C are invariant across time and A takes the form $A = \begin{pmatrix} 1 & 0 \\ a_{21} & 1 \end{pmatrix}$ following Blanchard and Perotti (2002). This is equivalent to a Choleski decomposition with government spending ordered before output or the assumption that government spending requires at least one quarter to respond to shocks. However, regarding the different types of spending, it is hard to think of plausible reasons for selecting one ordering over another. In the benchmark case, I follow Perotti (2004) and Ilzeztki et al. (2010) in ordering government investment before government consumption and the wage component of government consumption before the non-wage component of government consumption. Nevertheless, results are not affected by how they are ordered and in all cases the differences with the benchmark specification are minimal.

In the analysis, subsets of total government spending and the economic variables of output, private consumption and private investment are all specified in logs and per capita terms. Additionally, I deflate all data by using the corresponding deflator which was already seasonally adjusted by the original source.[10] Furthermore, as displayed in Table 1.2, all

[9] The analysis covers the effects of government spending on private consumption and private investment. As net exports constitutes only 1.5 percent of total GDP during the period, government spending effects on net exports are not provided.

[10] Some variant of the X11 method was used.

variables were initially non-stationary at the 95 percent confidence level. Hence, the data used in the reported regressions are deviations of the non-stationary variables from their linear trend. After detrending the data, the series were stationary (again at the 95 percent confidence level) for all variables in a KPSS test.

1.4.1. Lag Structure

In choosing *K*, the number of lags included in system (1), I exploit the Akaike Information Criteria (AIC). According to the AIC, the number of lags was set as 6 in most cases.[11] This choice is usually confirmed by other information criteria i.e. Final Prediction Error, Hannan-Quinn information criteria. Results do not exhibit significant changes as the number of lags used in the regressions is altered.

1.4.2. Output Multipliers

Following Blanchard and Perotti (2002), studies generally summarize the effects of government spending by the impact multiplier. This is the increase in the level of output *k* periods ahead in response to a change in the fiscal variable of interest given by ΔG_t at time *t*.[12]

Impact multiplier *k* periods ahead = $\frac{\Delta Y_{t+k}}{\Delta G_t}$

In order to be consistent with the literature, I provide the multipliers and related figures based on this definition. Adopting such a definition of the output multiplier enables us to pursue the effect of government spending shocks at each point on the forecast horizon.

[11] In some cases, number of lags employed in the analysis are chosen as 2.

[12] For instance the government spending multiplier is computed as follows, $\frac{\Delta Y_{t+k}}{\Delta G_t} = \frac{\%\Delta Y_{t+k}}{\%\Delta G_t}\frac{Y}{G}$, where Y and G are the steady state values of output and government spending respectively.

Besides, adding such point effects give us a total net effect of the government spending shock.

1.5 Results

In order to elaborate how the composition of government spending affects the economic variables, I conduct the analysis in two steps. In the first step, the effect of total government spending is investigated. This is for the purpose of checking the consistency of own results with the results of other studies. In the second step, the effects of each type of government spending on the economic variables are examined in detail.

As the first step, the estimated impulse responses for the shocks of total government spending are displayed in Figure 1.3. These findings are in line with other studies employing the VAR approach (Blanchard and Perotti (2002), Gali et al (2007) Monacelli and Perotti (2008), and Fatas and Mihov (2001)). Accordingly, output and consumption rise in response to the shock and remains persistently above zero although it becomes insignificant over time. Regarding the response of private investment, it is highly insignificant.

Furthermore, output multipliers obtained from this analysis are in the range of other studies' multiplier figures. The impact multiplier is 1.1 and it reduces to below 1 over the forecast horizon in the analysis. Similarly, Blanchard and Perotti (2002) and Gali et al. (2007) find a spending multiplier for output around 1 in their benchmark studies. On the other hand, there is no consensus in the literature regarding the multipliers as they all somewhat differ from each other.

Leeper (2010) discusses such a difference occurs mainly because responses of economic variables to government spending shocks depend on many factors, i.e. composition or type of government spending, how the spending is financed and how monetary policy responds. As a potential factor of explaining this differentiation, I focus on the composition of the government spending in this study. In order to see this better, I perform a VAR analysis of the disaggregated series of government spending, namely government investment, the wage component of government consumption and the non-wage component of government consumption.

Figures 1.4 -1.12 display the impulse responses of the economic variables to 1 % shock of the each government spending types. In these figures, the x-axis shows quarters after the shock hits the economy and the y-axis shows percent deviations from the steady state given a one percent shock to any type of government spending. Following Ilzeztki et al. (2010), displayed error bands in the figures reflect 90% confidence intervals based on 1,000 Monte Carlo replications even though much of the literature has used one-standard error bands following Blanchard and Perotti (2002).

1.5.2 Effects of Different Types of Government Spending

In this section, I compare three types of government spending: government investment and the wage and non-wage component government consumption. In this context, Figures 1.4, 1.7 and 1.10 display impulse responses from a 4-variable VAR, in which the wage component of government consumption, the non-wage component of government consumption, government investment and output are included. All types of government spending have positive effects on output on impact whereas only government investment and wage expenditure keep this boosting effect throughout the forecast horizon.

Likewise, Figures 1.5, 1.8 and 1.11 display the responses of private consumption (together with other types of government expenditure) given a shock to government investment, government wage and non-wage consumption, respectively. Responses of (private) consumption vary depending on the type of spending shock. In the case of wage component consumption shocks, responses remain positive throughout the period. For other types, private consumption responses are insignificant. Lastly, the responses of private investment are again insignificant and negligible for all types of spending where these responses are displayed in Figures 1.6, 1.9 and 1.12.

Overall, different types of government spending have varying effects on economic variables. The impact of government wage expenditure on these economic variables is the highest whereas the impact of government purchases of intermediate goods and services (non-wage component consumption) shock is the smallest. These impacts are shown in Figure 1.13 in the form of output multipliers. Naturally, shocks to government wage expenditure have the largest figures regardless of the horizon.

Lastly, persistence of shocks also differs from each other in addition to differences in the size of their effects on economic variables. Accordingly, government consumption shocks are more persistent than government investment shocks. Furthermore, among all types of spending, government wage expenditure shocks are the most persistent.

1.5.3 Robustness

As a robustness check, I replicate the analysis by changing the detrending method, the information criteria, and the ordering of the government spending types in the VAR. Excluding the responses that display insignificant features throughout the horizon period

(i.e. responses of private investment) yield results similar to our main findings. On the other hand, multipliers display variations to some extent depending on the sample period. This might be due to the changing composition of government spending in these periods which supports our main argument in the paper. However, this needs further investigation as the transmission of fiscal shocks might have also changed over time.

1.6 Conclusion

In this paper, I have shown that effects of government spending on economic variables vary depending on the type of spending. With this perspective I initially performed a VAR analysis with Choleski decomposition employing total government spending for the whole period of 1960-2007. Responses of output given the total spending shocks are in consistent with the studies of the literature that use same methodology. Results of this analysis indicate to positive and significant effects both on output and private consumption but insignificant and negative effects on private investment.

Next, I disaggregate total government spending into government investment, wage and non-wage component government consumption in order to investigate the effects of sub-components of government spending by replicating the VAR analysis. Figures 1.4-1.12 show these effects on output, private consumption and private investment. According to the figures, government wage component consumption possesses the biggest effects on output and private consumption when compared to the effects of other spending shocks. In contrast effects of government non-wage component consumption are the smallest. Effects on private investment are generally insignificant for all spending types of shocks.

All types of government consumption have varying effects on output and its components. This variation of the effects can be seen in terms of both direction and size depending on the investigated economic variable. For output, this is displayed as output multipliers in Figure 1.13. In this context, government wage expenditure is the most effective type of spending boosting the output the most hence has the largest multipliers. Besides, this type of government consumption shock is the most persistent spending type.

Table 1-1 Estimated Effects Multipliers of Government Spending on Output

1948-2003	**1st Q**	**4th Q**	**8th Q**
Baseline Spending			
Small VAR	0.51	0.31	0.28
Larger VAR	0.41	0.31	0.68
Excluding military			
Small VAR	0.15	-0.12	0.34
Larger VAR	0.36	0.62	1.53
1954-2003	**1st Q**	**4th Q**	**8th Q**
Baseline Spending			
Small VAR	0.74	0.75	1.22
Larger VAR	0.68	0.70	1.74
Excluding military			
Small VAR	0.63	1.95	2.60
Larger VAR	0.74	2.37	3.50
1960-2003	**1st Q**	**4th Q**	**8th Q**
Baseline Spending			
Small VAR	0.91	1.05	1.32
Larger VAR	0.81	0.44	0.76
Excluding military			
Small VAR	0.72	1.14	1.19
Larger VAR	1.13	1.89	2.38

Source: Understanding the effects of government spending on consumption, Gali et al. (2007)

Note: Large VAR corresponds to the 8-variable VAR and Small VAR corresponds to the 4-variable VAR

Table 1-2 KPSS Stationary Tests

Variable Name	KPSS Test Statistic
Government Investment	1.374***
Total Government Consumption	1.526***
Government Wage Component Consumption	0.555***
Government Non-Wage Component Consumption	1.638***
Private Investment	1.630***
Private Consumption	1.683***
Output	1.687***
De-trended Government Investment	0.266
De-trended Total Government Consumption	0.148
De-trended Government Wage Component Consumption	0.317
De-trended Government Non-Wage Component Consumption	0.079
De-trended Private Investment	0.106
De-trended Private Consumption	0.185
De-trended Output	0.158

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

Null Hypothesis: Interested Variable is stationary

Asymptotic critical values:	**1% level**	0.739
	5% level	0.463
	10% level	0.347

Figure 1-1 Average Shares of Components in US Output, 1960-2007(%)

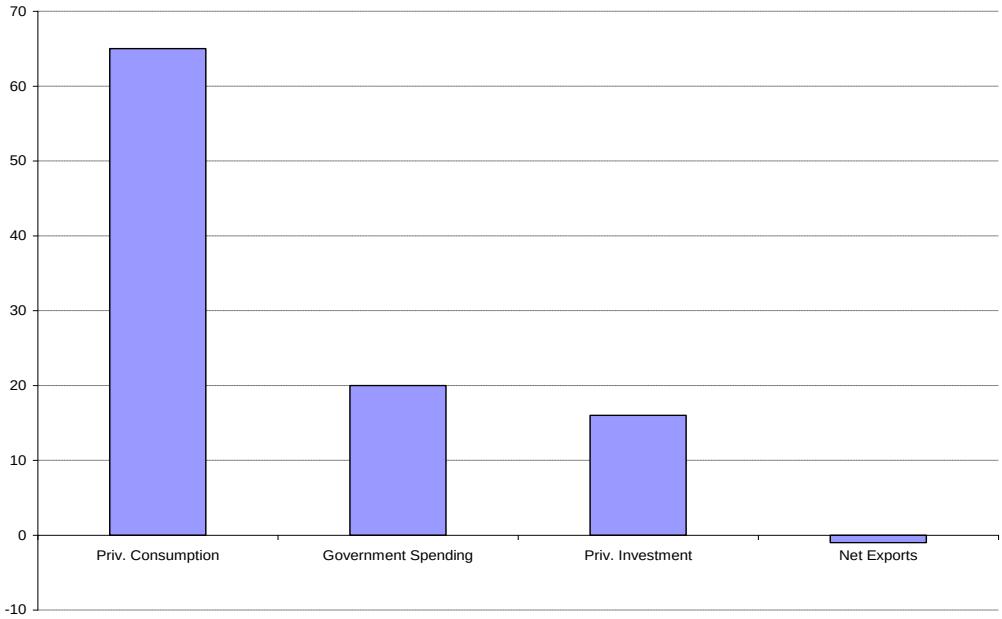


Figure 1-2 Shares of Components in Total US Government Spending (%)

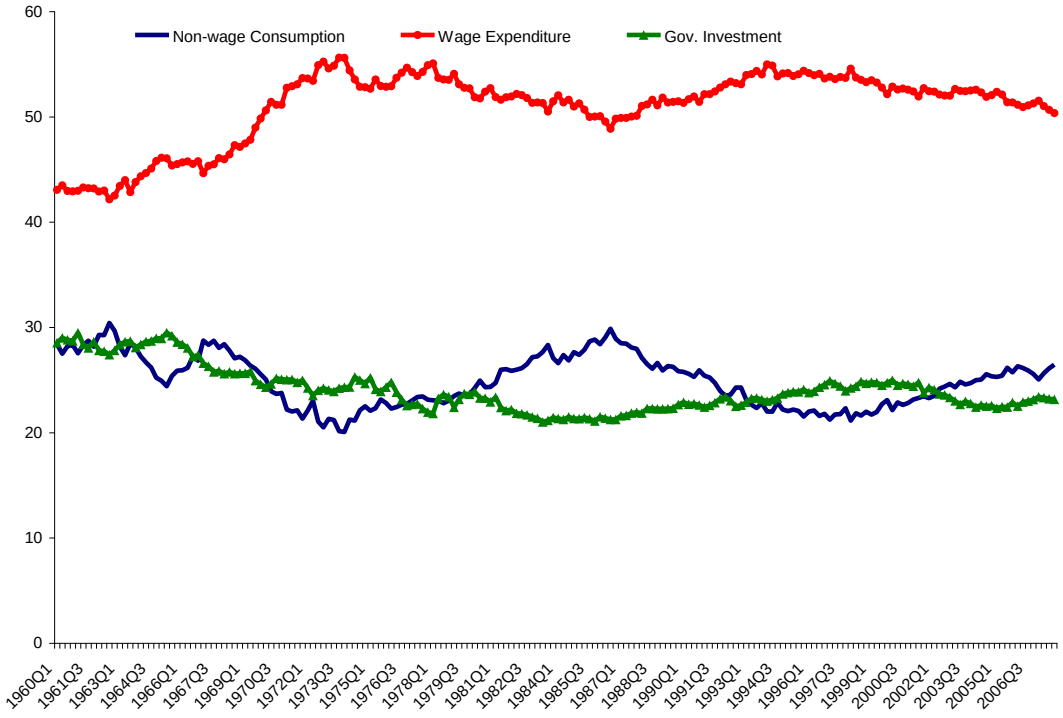
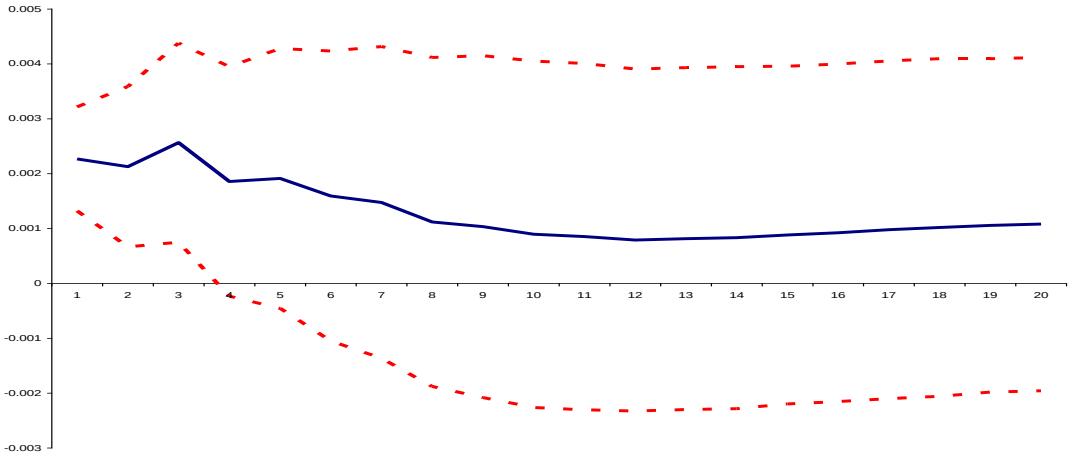
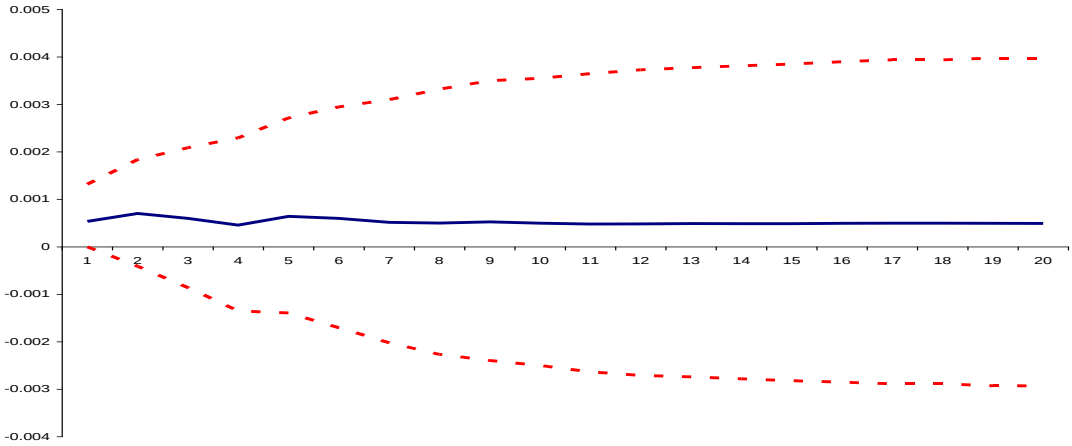


Figure 1-3 Responses to Total Government Spending Shock

Output



Consumption



Investment

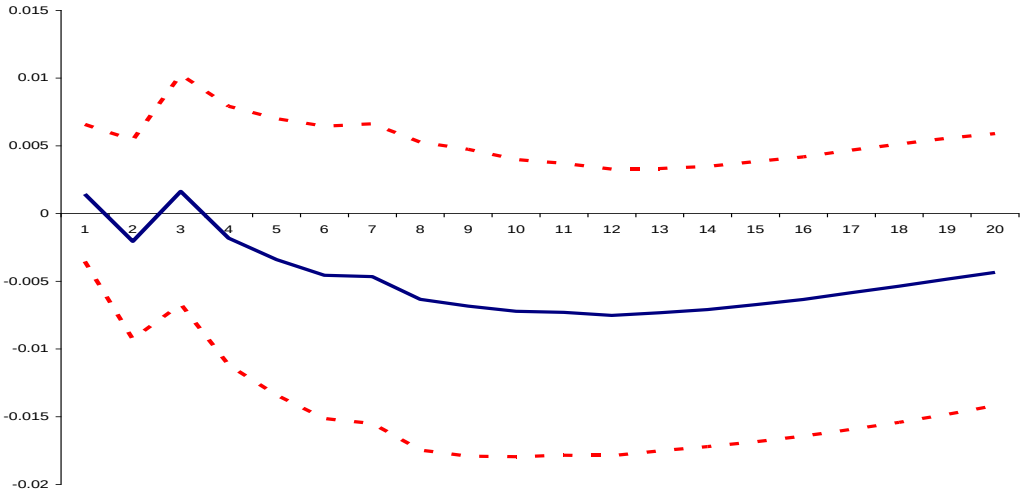
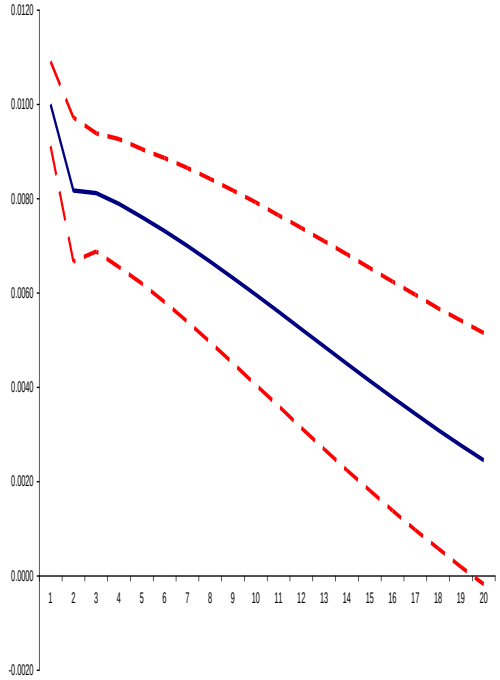
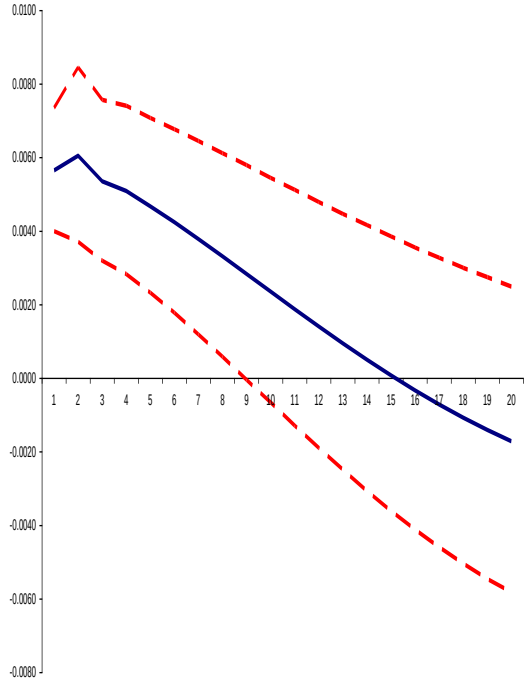


Figure 1-4 Responses to a Government Investment Shock

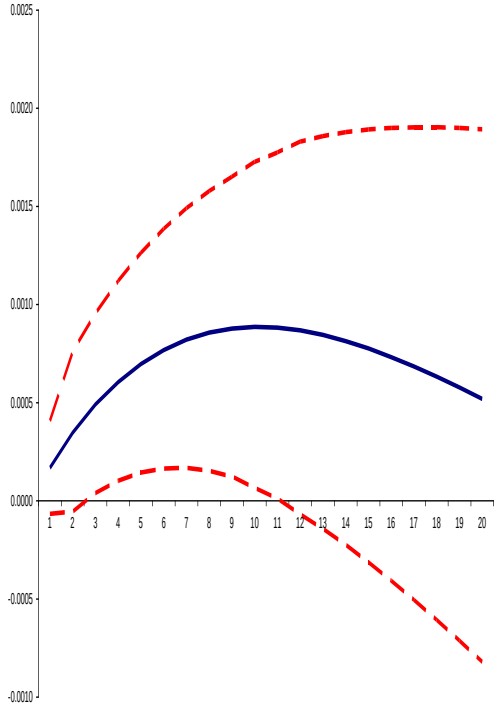
Government Investment



Government Non-Wage Consumption



Government Wage Consumption



Output

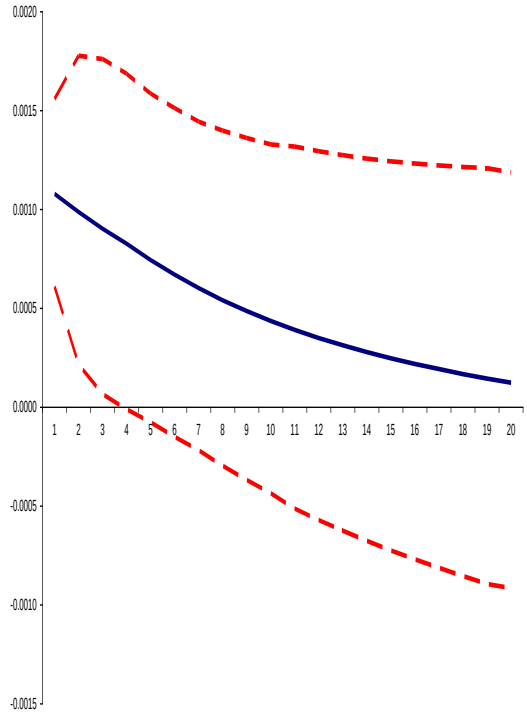
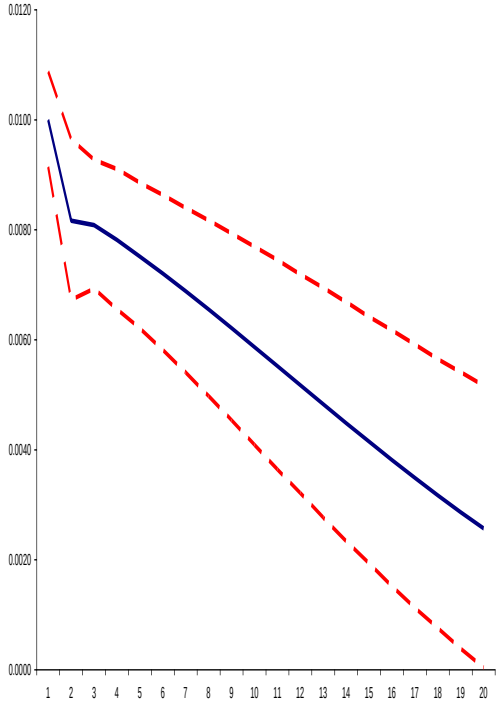
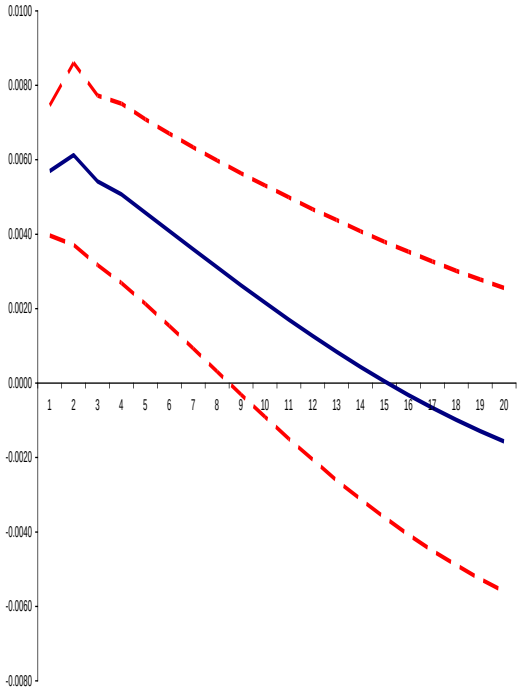


Figure 1-5 Responses to a Government Investment Shock

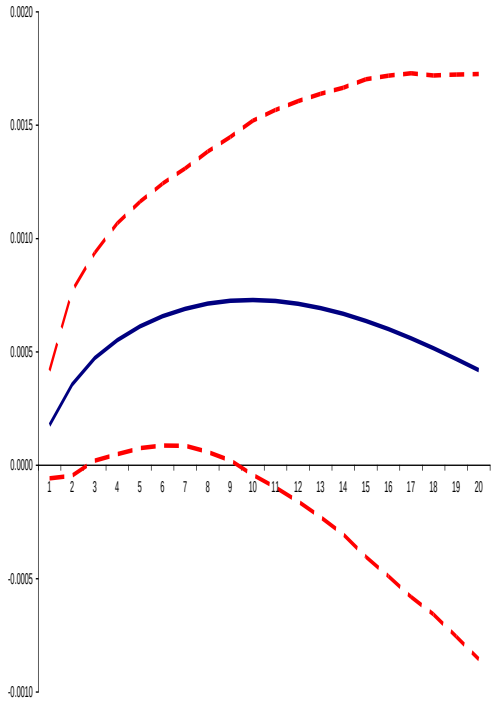
Government Investment



Government Non-Wage Consumption



Government Wage Consumption



Private Consumption

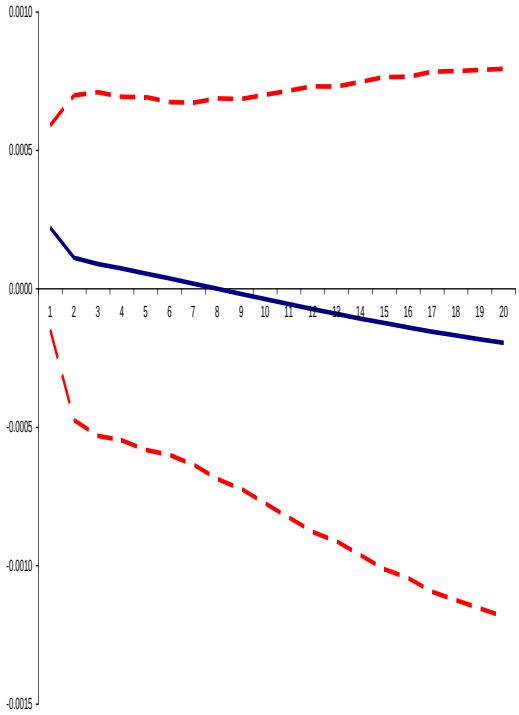
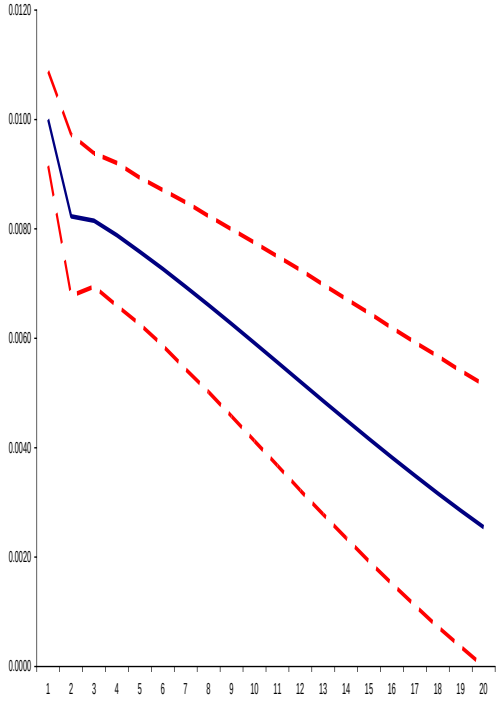
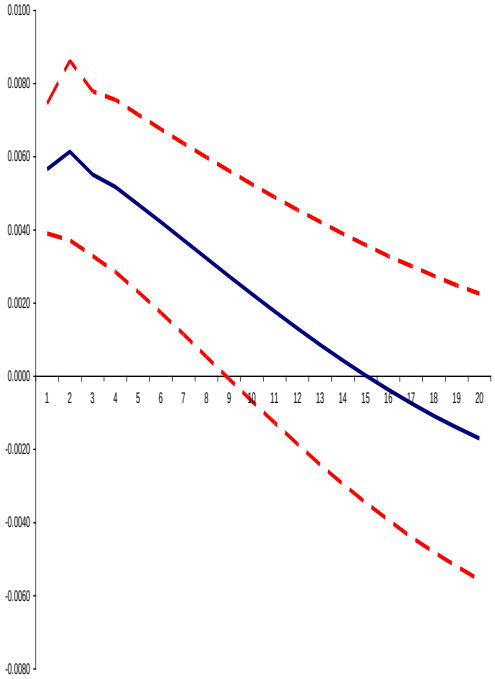


Figure 1-6 Responses to a Government Investment Shock

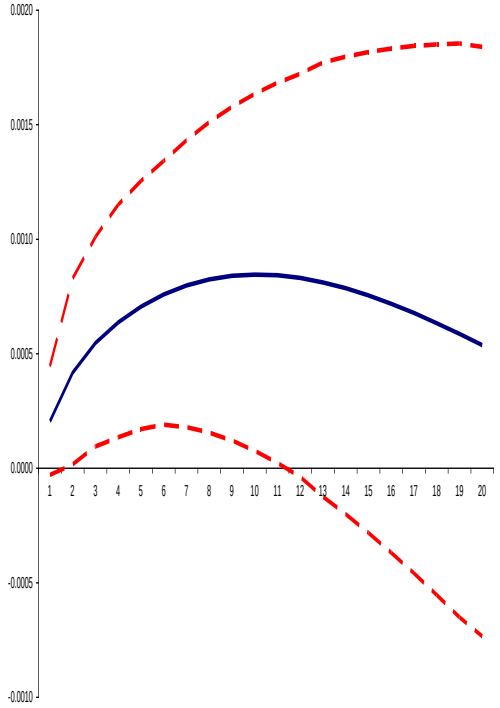
Government Investment



Government Non-Wage Consumption



Government Wage Consumption



Private Investment

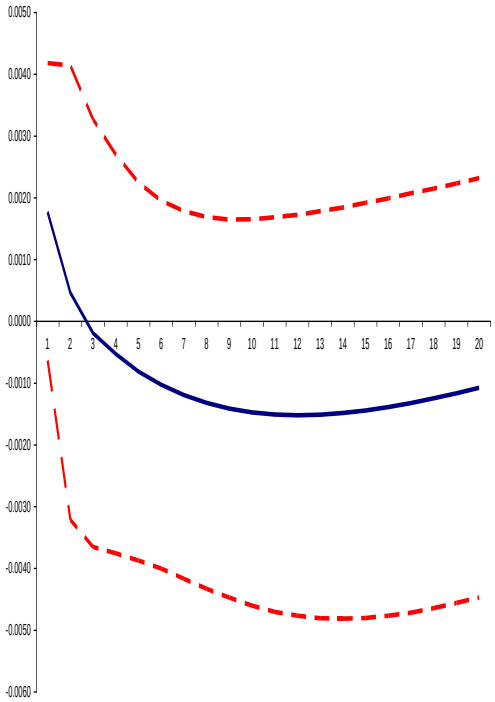
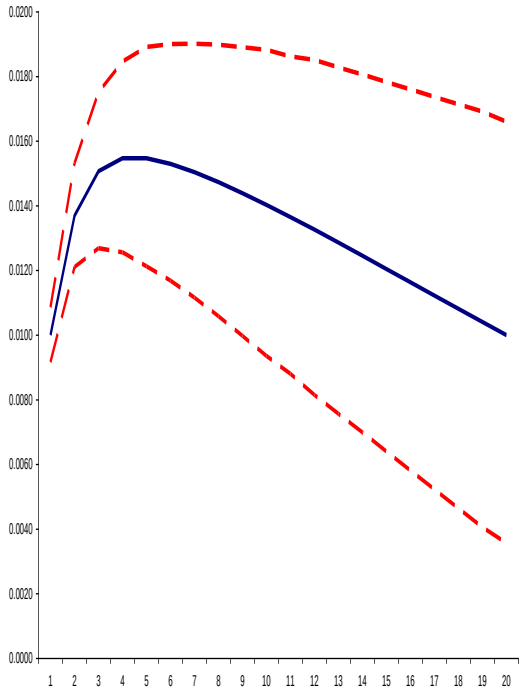
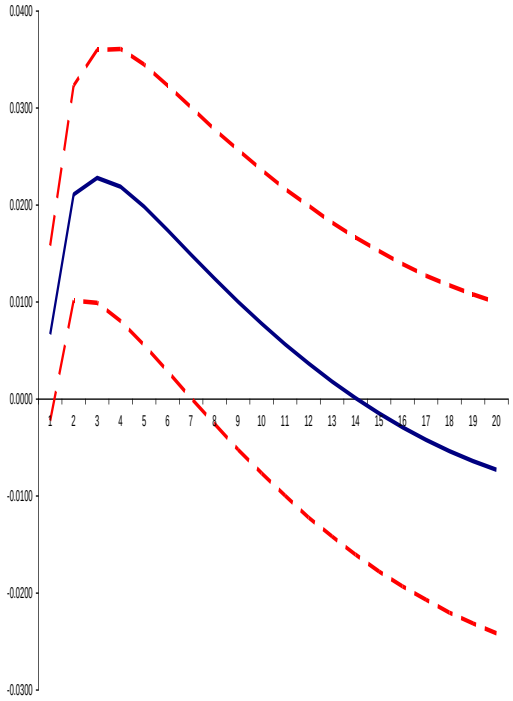


Figure 1-7 Responses to a Wage Expenditure Shock

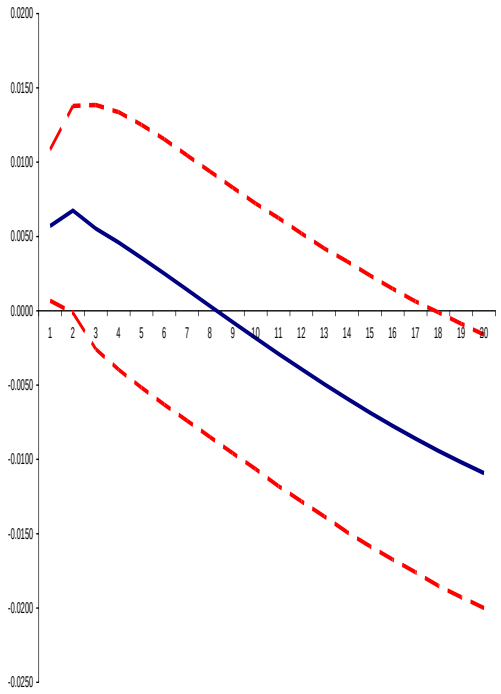
Government Wage Expenditure



Government Non-Wage Consumption



Government Investment Expenditure



Output

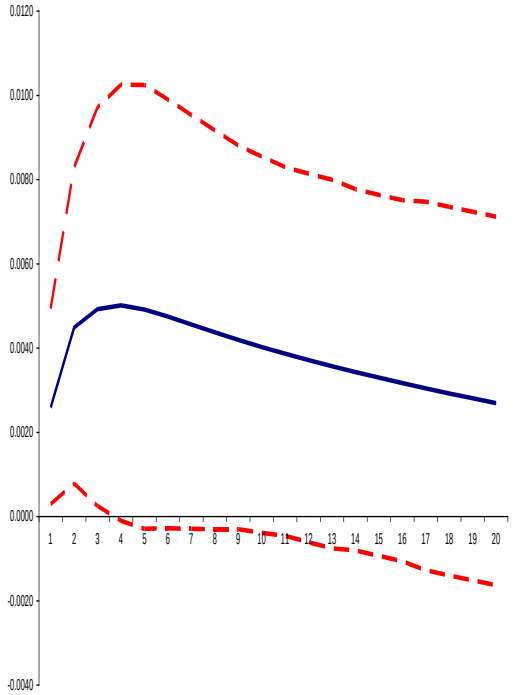
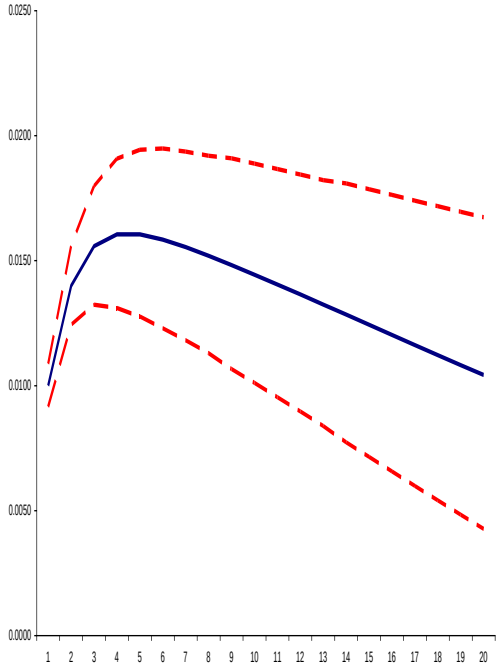
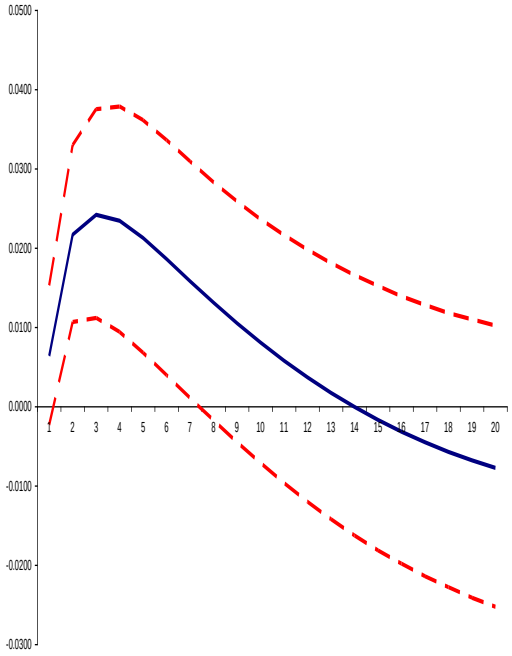


Figure 1-8 Responses to a Wage Expenditure Shock

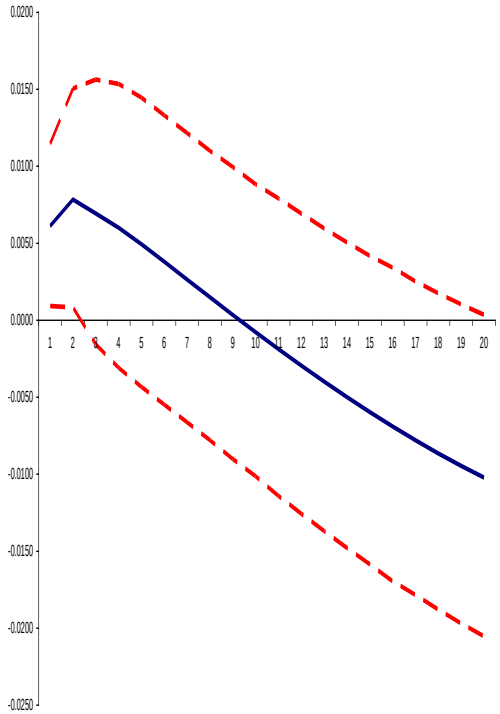
Government Wage Expenditure



Government Non-Wage Consumption



Government Investment Expenditure



Private Consumption

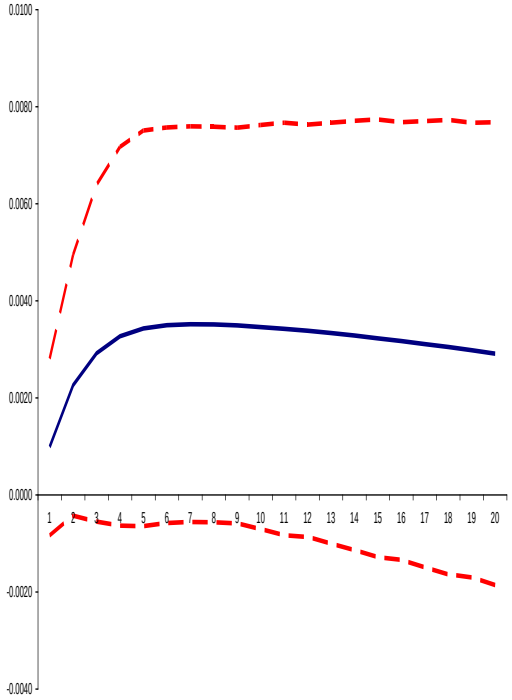
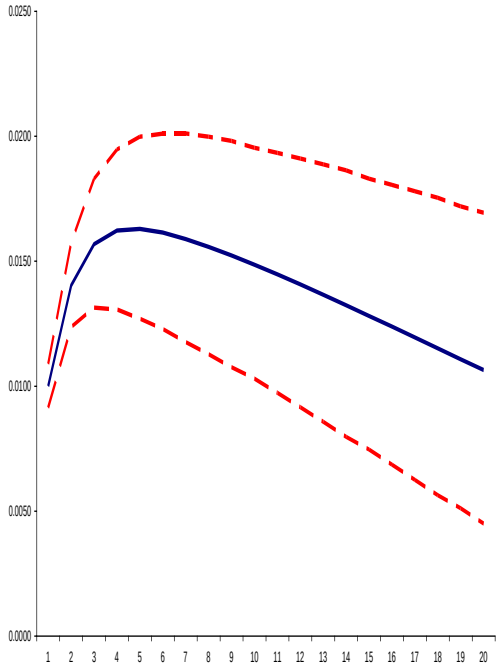
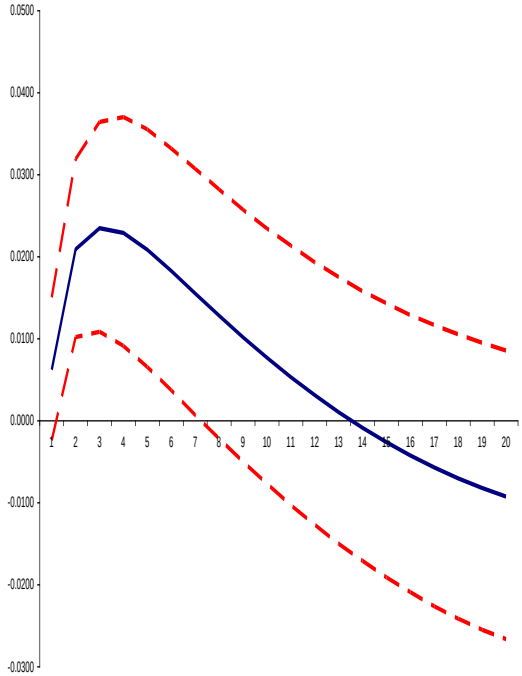


Figure 1-9 Responses to a Wage Expenditure Shock

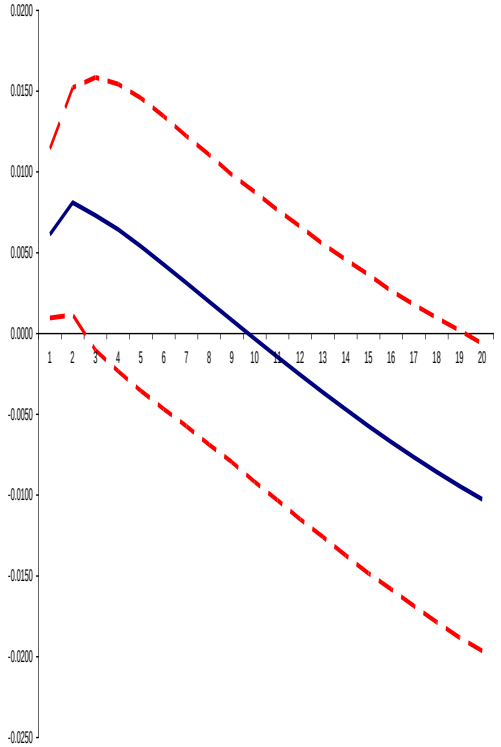
Government Wage Expenditure



Government Non-Wage Consumption



Government Investment Expenditure



Private Investment

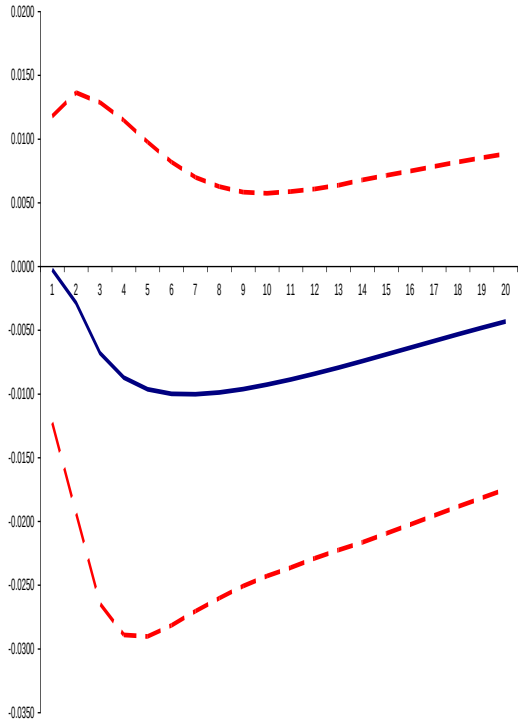
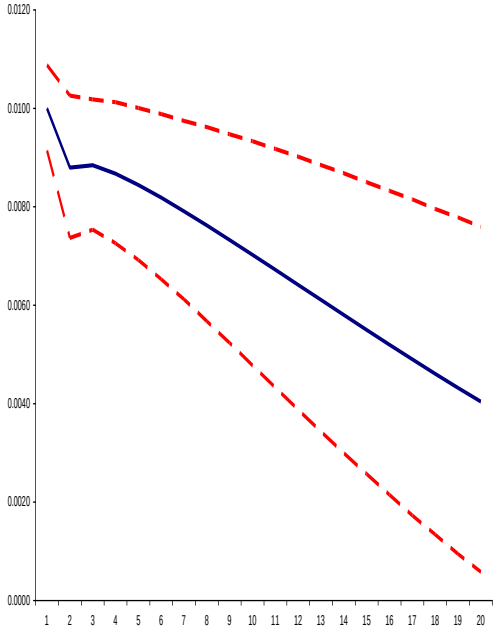
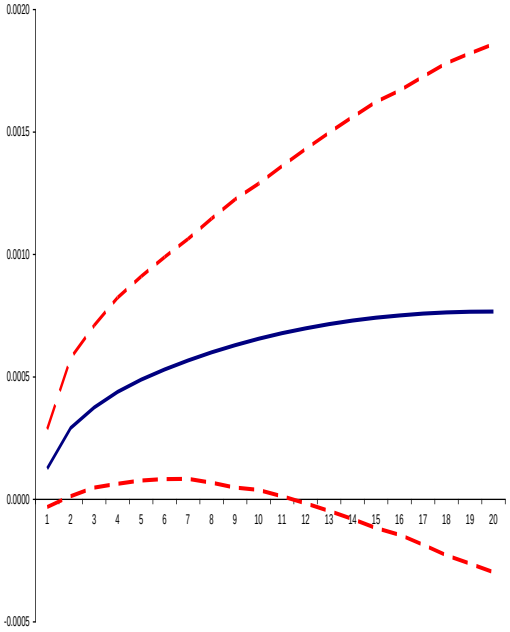


Figure 1-10 Responses to a Non-Wage Consumption Shock

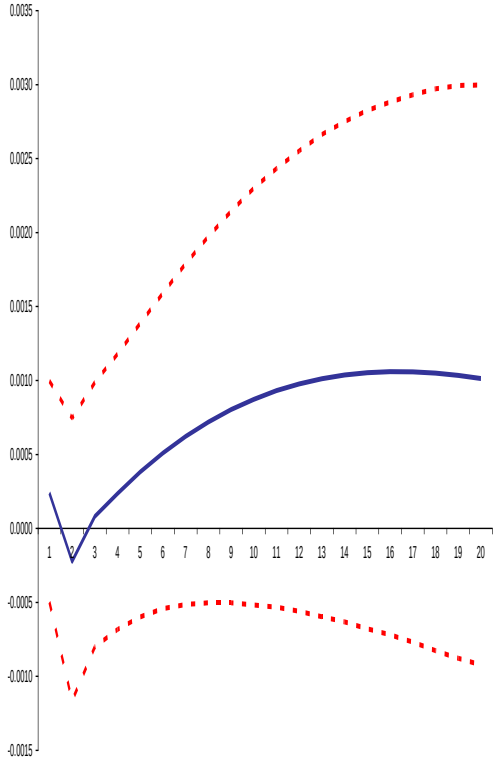
Government Non-Wage Consumption



Government Wage Expenditure



Government Investment Expenditure



Output

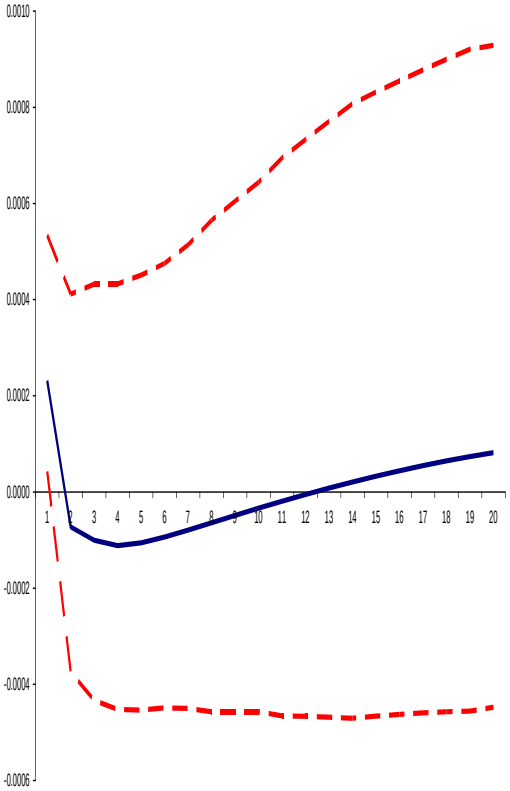
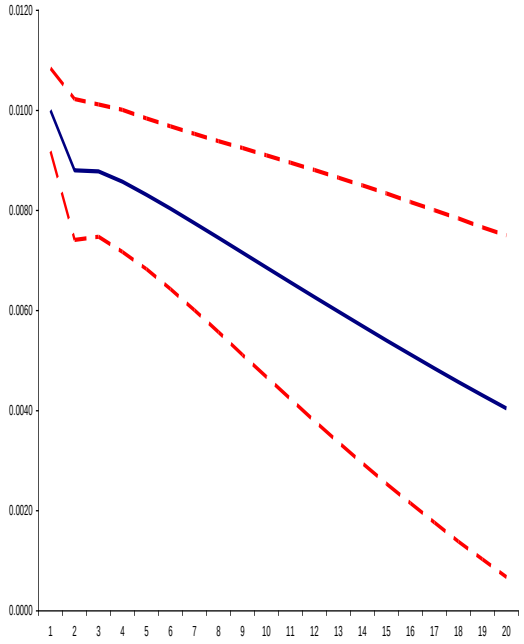
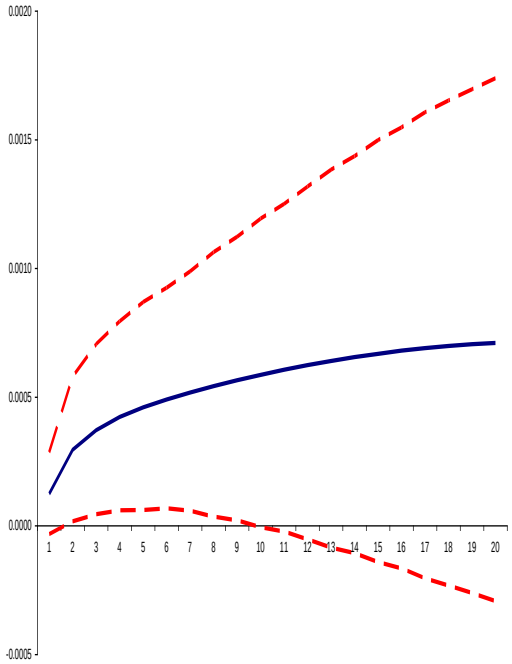


Figure 1-11 Responses to a Non-Wage Consumption Shock

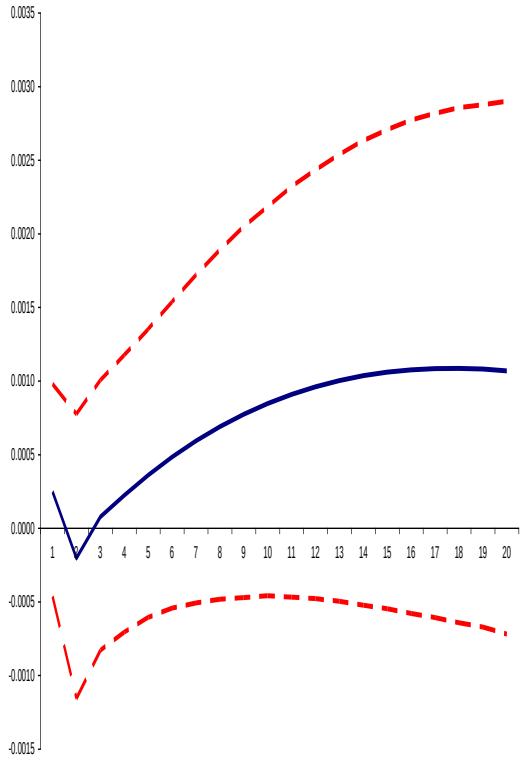
Government Non-Wage Consumption



Government Wage Expenditure



Government Investment Expenditure



Private Consumption

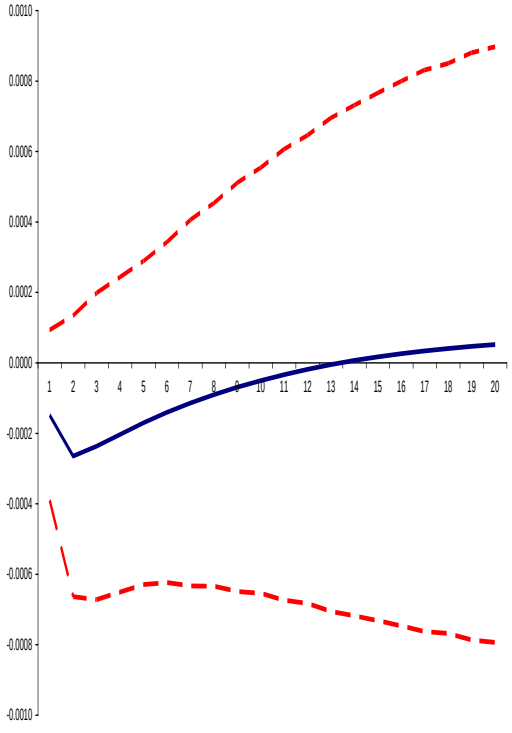
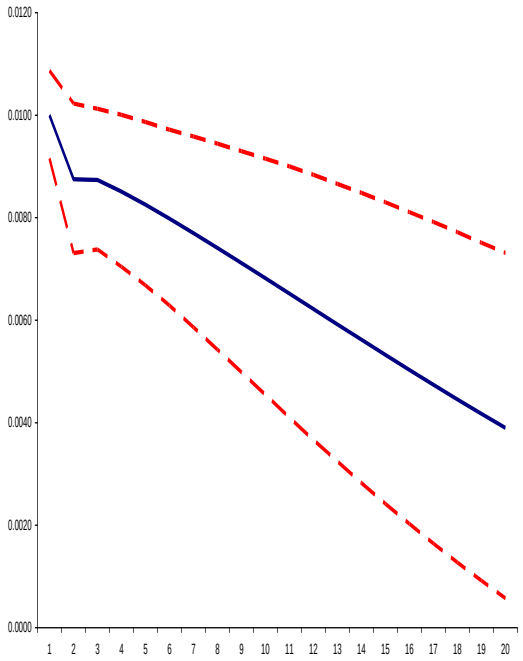
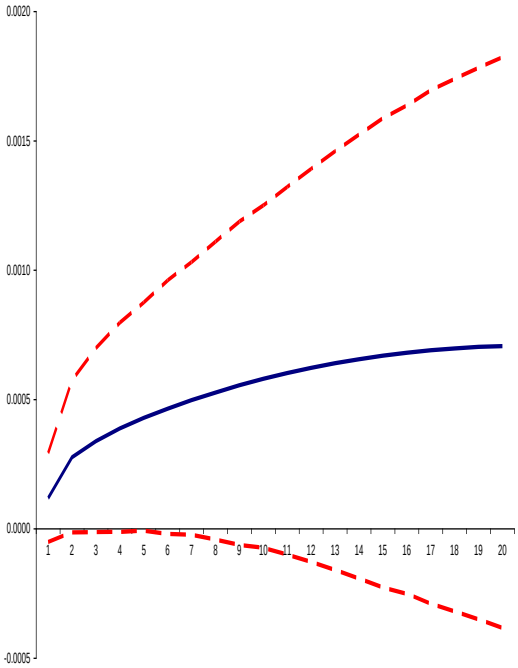


Figure 1-12 Responses to a Non-Wage Consumption Shock

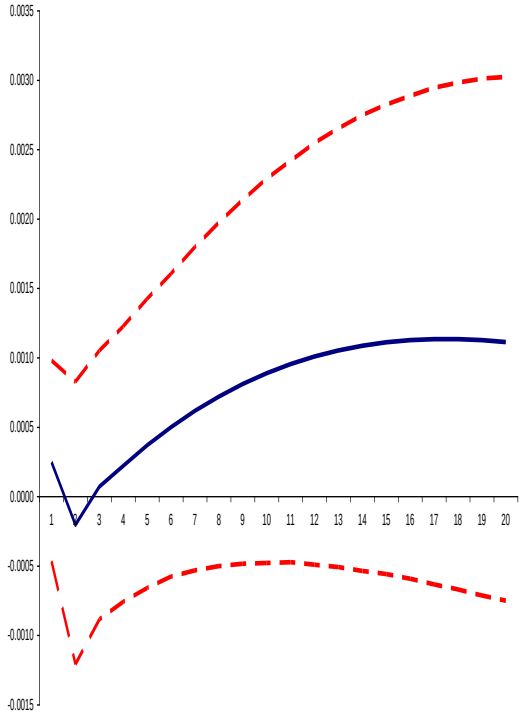
Government Non-Wage Consumption



Government Wage Expenditure



Government Investment Expenditure



Private Investment

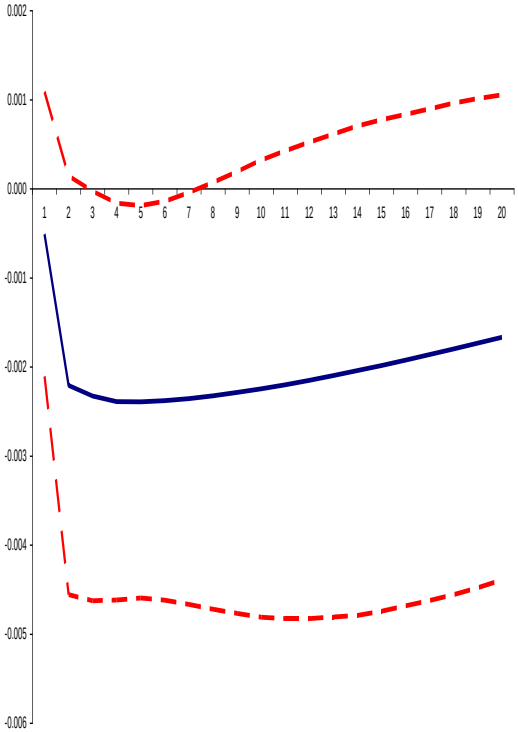
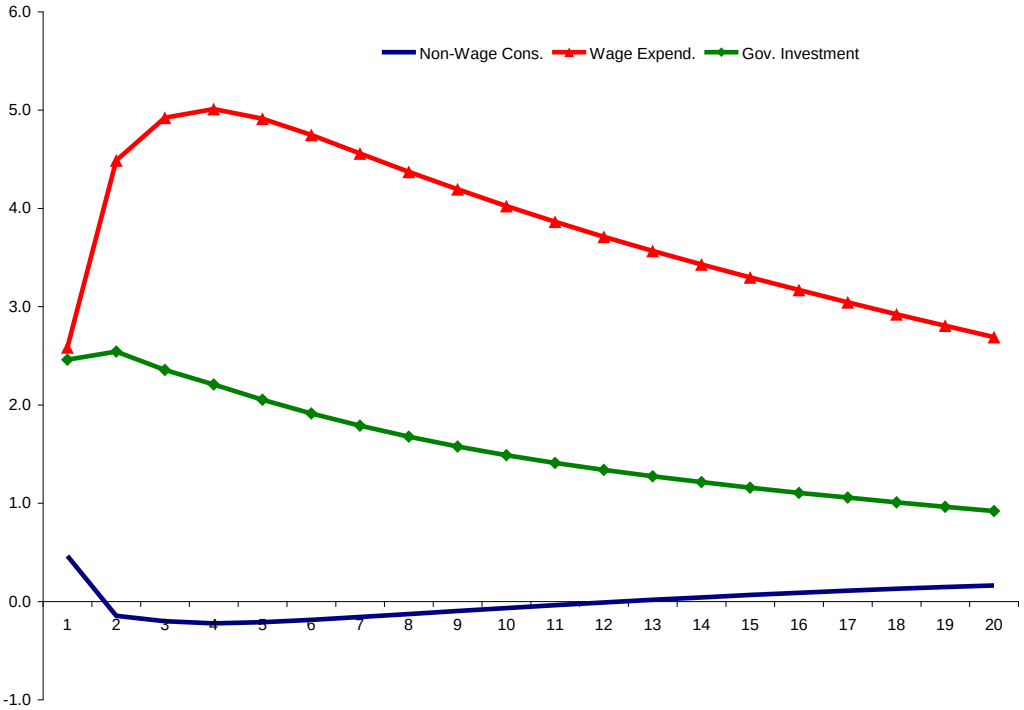


Figure 1-13 Output Multipliers



Chapter 2 A Disaggregated Approach to the Government Spending Shocks: An Theoretical Analysis

2.1. Introduction

The main contribution of this paper is that it features a transmission mechanism with different types of government spending: namely government investment, wage component government consumption and non-wage component government consumption. This mechanism works through government production which is estimated for US to have a complementary relation with private consumption. Hence, government spending types that are used in the formation of government production have influence on households' preferences and should not be considered as wasteful due to their additional easing effects on the economy.

In the model, government production which plays a crucial role in attaining positive effects of private consumption, is a function of government capital and government employment. Government capital is the accumulation of government investment and government employment is measured by government wage expenditure. These two types of spending are channeled into useful dispositions unlike government non-wage component consumption. Moreover, effects of government investment and government wage expenditure also differ from each other as government investment needs to be accumulated as government capital rather than used directly in the government production. Within this context, I claim that the composition of government spending is critical in the

determination of spending multipliers and different types of government spending have varied effects on economic variables.

Nevertheless, government spending has been treated uniformly in most of the studies and as Leeper et al (2010) discusses, estimates of multipliers from these studies are all over the map, providing empirical support for virtually any policy conclusion. For instance, in the current economic crisis, United States passed a $787 billion fiscal stimulus plan with the hope of boosting demand, limiting job losses and preventing deep recessions. Yet, there was a lack of consensus among economists indicating where each dollar should be spent in order to minimize the adverse effects of the crisis.

In fact, the diversity of findings highlights the difficulties in obtaining reliable estimates of fiscal effects. This is mainly because responses of economic variables to government spending shocks depend on many factors; type of spending, how the spending is financed and how monetary policy acts in response. Thus, there is a need for systematic analysis that confronts all these fiscal policy complexities. In line with this, the objective of this paper is to shed light on the single effects of these factors in the context of a micro-founded medium-scale dynamic stochastic general equilibrium (DSGE) model. The model embeds specific features for different types of government spending and analyses the role of monetary policy.

The rest of the paper is organized as follows: Section 2 reviews the literature; Section 3 describes the model and provides the first order conditions whereas its linearized counterparts are given in Section 4. Section 5 explains the Bayesian estimation procedure employed. Section 6 presents the results together with a sensitivity analysis for particular

parameters and Section 7 extends the model by adding habit persistency and sticky wages. Finally Section 8 concludes.

2.2 Literature Review

Most of the recent theoretical literature on fiscal policy in DSGE models has been motivated by the empirical evidence. From an empirical point of view, identification of government spending shocks is problematic and has been the subject of a lively debate in recent years[13]. However, theoretical models mainly attempt to capture the results of the VAR approach as this approach is considered as a means to account for the effects of government spending shocks in "normal" times, as opposed to extraordinary episodes like war or military build-up eras. Studies employing VAR approach typically find that a rise in total government spending (a positive spending shock) raises not only GDP, but also (private) consumption (e.g. Blanchard and Perotti (2002), Fatás and Mihov (2001), Gali et al (2007), Monacelli and Perotti (2008)). Regarding the response of private investment, it is found to be insignificant in Fatás and Mihov (2001) and Gali et al (2007), but negative (and significant) in Blanchard and Perotti (2002).

The theoretical literature, driven by DSGE models, begins with studies that employ a standard neoclassical framework such as Aiyagari, Christiano and Eichenbaum (1992) and Baxter and King (1993)[14]. These studies suggest that an increase in government spending creates a negative wealth effect for the households as they anticipate an increase in taxes to finance the increase of government spending[15]. Households optimally respond to this by

[13] See Perotti (2007) and Ramey (2009) for a summary of the issues.
[14] Infinitely-lived forward-looking agents, flexible prices, complete asset markets, and lump-sum taxation
[15] Assuming they are financed by non-distortionary taxes

decreasing their consumption and increasing their labor supply. The increased labor supply lowers the real wage but raises output. In the new steady-state, consumption is lower and working hours are higher[16].

Following Neoclassical models, New Keynesian models featuring a sticky price and monopolistically competitive environment were commonly used. The idea of introducing imperfect competition and sticky prices embedded in the New Keynesian models was promising for at least two reasons. First, imperfect competition generates an aggregate demand externality according to which an increase in output leads to a rise in profits and income. Higher profits and income in turn may help to offset the negative wealth effect. Secondly, sticky prices raise the possibility that labor demand reacts stronger than labor supply, with real wages increasing alongside labor supply[17]. Hence, in New Keynesian models, the wealth effect is accompanied by a demand effect due to price stickiness, whereby both effects increase output. Yet, the wealth effect has a negative impact on consumption while the demand effect has a positive impact. Accordingly, the net response of consumption depends on the relative strength of the two effects where wealth effect still dominates under plausible parameters.

As the standard New Keynesian model cannot replicate the response of increasing consumption under plausible parameters, it has been modified in order to attain increasing consumption. This was achieved by limiting the ability of the private sector to smooth consumption via asset markets, as in the model by Gali et al (2007). These authors have

[16] Response of investment depends on the persistence. If the shock is sufficiently persistent, the rise in the marginal product of capital leads to more investment and capital accumulation.
[17] To meet increasing demand stemming from increasing government expenditure, some firms will increase production as only a fraction of them can adjust their prices.

extended the standard New-Keynesian sticky-price model by allowing for the co-existence of "non-Ricardian" and "Ricardian" households, with the former simply consuming their after-tax disposable income each period and the latter optimizing in a forward-looking manner and thereby smoothing consumption over time. Accordingly, Ricardian agents are more sophisticated in the model because they can hold bonds and receive profits deriving from firms' ownership. On the other hand, non-Ricardian households, also referred to as rule of thumb households, only consume their current disposable income each period and do not have the ability to borrow or save. As a result, they cannot smooth their consumption path in the face of fluctuations. Since this is a simple means of breaking Ricardian equivalence, presence of rule of thumb households contributes to the New Keynesian models in producing positive co-movement between government spending and consumption. Nevertheless, this analysis has been criticized as relying on a large percentage of rule of thumb households. For example, Coenen and Straub (2005) conclude that the estimated share of the non-Ricardian households in the euro area is not sufficiently large to deliver a positive response of consumption. Similarly, Iwata (2009) showed that the estimated mean value of non-Ricardian share is one fourth for Japan, which is half of what Gali et al (2007) are relying upon.

An alternative modification to the standard New Keynesian models is to allow consumer preferences to depend on government spending. Under such a modification, government spending gains an additional role in the economy. First studies assume that government expenditures and private consumption directly enter the utility function of the representative agent linearly such as Barro (1981), Aschauer (1985), Christiano and Eichenbaum (1992) and Finn (1998). Some of the recent studies exploit government spending through the concept of effective consumption, which is a constant elasticity of

substitution (CES) aggregate of private consumption and government spending. Linnemann and Schabert (2004) and Bouakez and Rebei (2007) are examples of this kind. This work has similar a set up to these studies in the sense that household preferences depend on government spending in association with private consumption. However, I argue in the next section that such a structure is not applicable directly to government spending. Instead, it works indirectly through government production.

2.3 The Model

This section describes a dynamic general equilibrium model that consists of a representative household, a continuum of firms (indexed by *j*) producing differentiated intermediate goods, a perfectly competitive firm producing a final good, a central bank in charge of monetary policy, and government as a fiscal authority. All of the agents are infinitely lived and time is divided into periods and each period is indexed by the subscript *t*. The baseline model such as nominal rigidities in the form of price stickiness and real rigidities in the form of investment adjustment cost are standard to the literature. This framework serves as a starting point since it has been shown to fit the US data. Furthermore, habit persistence which is also commonly used in the literature is added to the baseline model individually as a next step.

The model differs from other studies and the standard New Keynesian framework in two dimensions. First, government spending is disaggregated into three parts: government investment, government wage component consumption (government wage bill) and government non-wage component consumption (government purchases of intermediate good and services). This classification is in line with the National Income and Product

(NIPA) tables of US Bureau of Economic Analysis (BEA) as shown in Table 2.1. According to this table, the wage component of government consumption constitutes roughly one half of the total government spending. The other half is shared between *intermediate goods and services*, *consumption of government fixed capital* and *government investment expenditure*.

Second, government has a productive role in the economy even though this production differs from the production of private sector in some aspects. Item of "Value Added" in NIPA tables displayed in Table 2.1 corresponds to the government production described in the paper. In the next subsections, the objectives (together with the constraints) of the agents are presented and transmission mechanism of shocks is explained.

2.3.1 Households

The economy is populated by a single, infinitely lived, representative household. Households derive utility from leisure ($1-N$) and effective consumption ($\tilde{C}_t$). In this representation, N_t, is the sum of hours worked for government (public employment; N^G) and hours worked for private sector (private employment; N^P): $N_t = N^G{}_t + N^P{}_t$. Likewise, effective consumption is defined as a CES index of private consumption (C) and government production (Y^G) following Bouakez and Rebei (2007):[18]

$$\tilde{C}_t = \left[a C_t^{\nu-1/\nu} + (1-a)(Y_t^G)^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}}$$

[18] The CES specification captures the idea of diminishing marginal returns to public spending in order to achieve a given level of effective consumption, ceteris paribus.

In the above representation, a is the weight of private consumption in the effective consumption index and $\nu \succ 0$ is the elasticity of substitution between private consumption and government production. As $\nu \to \infty$, private consumption and government production become perfect substitutes. This is the case when government competes with private sector by producing rival goods. Providing free lunches is an example of government producing rival goods. In contrast, C_t and $Y^G{}_t$ become perfect complements when $\nu = 0$ and government produces non-rival public goods. In this case, government production increases the marginal utility of consumption, providing an additional motive for households to work more. This, in turn, mitigates the negative wealth effect. Education services, knowledge generated by R&D, legislative services are examples of government production. A critical question at this point is whether private consumption and public spending are complements or substitutes. This has been examined by several studies such as those by Aschauer (1985), Karras (1994), Ni (1995), Amano and Wirjanto (1998), and Okubo (2003). The empirical results, however, are mixed and inconclusive.

In the model, households have preferences described by the following utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(\tilde{C}_t, N_t) \quad \text{where} \quad U(\tilde{C}_t, N_t) = \left[\frac{(\tilde{C}_t)^{1-\sigma}}{1-\sigma} - \kappa \frac{N_t{}^{1+\psi}}{1+\psi} \right]$$

In the above representation; $\beta \in (0,1)$ is the discount factor, E_t is the time t conditional expectation operator and $N_t = N^G{}_t + N^P{}_t$ as previously defined.

The budget constraint faced by the household is as below:

$$P_t(C_t + I_t) + \frac{B_{t+1}}{R_t} = P_t W^G{}_t N^G{}_t + P_t W^P{}_t N^P{}_t + P_t R^k{}_t K_t + B_t - P_t T_t$$

In this representation, P_t is the price level, $W^P{}_t$ is the private sector real wage, and $W^G{}_t$ is the public sector real wage. As indicated by the budget constraint, households receive labor income of $P_t W_t^P N_t^P$ from private sector and $P_t W_t^G N_t^G$ from public sector as compensation to working.

Capital accumulation (K_t) evolves according to the law of motion (as in Christiano et al. 2005);

$K_{t+1} = (1-\delta)K_t + I_t - I_t\phi_t$ where $\phi_t = \frac{\xi}{2}[\frac{I_t}{I_{t-1}} - 1]^2$ and function ϕ_t satisfies $\phi = \phi' = 0$ and $\phi'' > 0$ in steady-state. With such specification, adjustment costs are proportional to the rate of change in investment and it is costly to change the flow of investment. Thus, investment is inertial; it is unresponsive in the short run, but starts to build up its response gradually over time.

Following Cordoba, Perez and Torres (2009), an important assumption is that there is a positive wage premium received by public sector employees relative to private sector employees. This is the case for countries having a small share of public employment in the labor market. The existence of such a positive premium is a well documented empirical fact of developed economies, as shown in the surveys of Ehrenberg and Schwarz (1986), Bender (1998), and Gregory and Borland (1999). While there is little research on the determinants of the public wage premium, the literature on public sector labor markets reveals that the influence of public sector labor unions and the ”vote producing” activities by civil servants are the potential reasons for the existence of the earnings differential. In the US, for instance, the most prominent unions are among public sector employees such as teachers and police.

In conjunction with this assumption, the public wage in the model is deemed as the upper limit of the private wage. Such a set up is consistent with the varying public wage premium shown in Figure 2.1. This figure illustrates how the private and public sector are associated in the labor market by exploiting OECD Economic Outlook Database. The upper panel of the figure shows how this premium has changed over time in the US and in Euro Area. The ratio of public wages over private wages has fluctuated between 1 and 1.2 in the US whereas this ratio has risen as high as 1.4 in Euro Area. Lower panel of the same figure displays the ratio of public employees over private employees during the same period. Accordingly, the public/private wage premium has had a somewhat parallel reflection in the evolution of the ratio of government sector employees to private sector employees. For instance, the ratio of public to private employees in the Euro Area reached a maximum in the second half of the 1980s. This corresponds to the period in which the wage premium reached its minimum.

According to the budget constraint presented above, households receive income from renting their capital holdings (K_t) to intermediate firms and purchasing nominally riskless one-period bonds (B_t). The (real) rental cost of capital is R^k_t and the gross nominal return on bonds is R_t. Lastly, I_t and D_t respectively denote investment expenditures and dividends from ownership of firms while T_t is lump-sum taxes (or transfers, if negative) paid by these consumers.

The first order conditions (with respect to C_t, N^P_t, K_{t+1},B_{t+1} and I_t) for the household maximization problem are given below. Note that the household maximizes only with respect to private labor as government employment is exogenously given to the households and the representative household initially meets the government labor demand as she earns

a higher wage for working the government (This is due to the positive public wage premium). After meeting government labor demand which is a small portion of her total employment, she optimally chooses her labor supply for private sector.

$$\tilde{C}^{-\sigma+\frac{1}{\nu}} a C^{\frac{-1}{\nu}} = \lambda_t \quad \textbf{(1)}$$

$$N_t^{\psi} = \lambda_t W^P{}_t \quad \textbf{(2)}$$

$$\beta\left[\lambda_{t+1} R_{t+1}{}^{k} + \lambda_{t+1} Q_{t+1}(1-\delta)\right] = \lambda_t Q_t \quad \textbf{(3)}$$

$$\beta\left[\lambda_{t+1} R_t\right] = \lambda_t (1+\pi_{t+1}) \quad \textbf{(4)}$$

$$\lambda_t Q_t + 2\xi \frac{I_t}{I_{t-1}} \lambda_t Q_t + \beta \lambda_{t+1} Q_{t+1} \xi \frac{I^3{}_{t+1}}{I^3{}_t} = \lambda_t + \lambda_t Q_t \xi \frac{3I^2{}_t}{2I^2{}_{t-1}} + \lambda_t Q_t \frac{\xi}{2} + \beta \lambda_{t+1} Q_{t+1} \xi \frac{I^2{}_{t+1}}{I^2{}_t} \quad \textbf{(5)}$$

In these equations, Q_t represents the shadow price of additional unit of capital and is equal to one at its steady state. Similarly, λ_t represents the Lagrange multiplier of the budget constraint. Again note that the above expressions imply that the households choose the supply of private labor, given that public labor is determined inelastically by the government.

2.3.2 Firms

I assume that a continuum of monopolistically competitive firms produce differentiated intermediate goods that are used as inputs by a (perfectly competitive) firm producing a single final good.

Final Goods Firm

The final good is produced by a representative, perfectly competitive firm with a constant returns technology: $Y^P{}_t = \left(\int_0^1 X_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}$ where $X_t(j)$ is the quantity of intermediate good used as an input and $\varepsilon>1$. Profit maximization, taking as given the final goods price

P_t and the prices for the intermediate goods $P_t(j)$, all $j \in [0, 1]$, yields the set of demand schedules:

$X_t(j) = (\frac{P_t(j)}{P_t})^{-\varepsilon} Y^P{}_t$. Hence, the zero profit condition: $P_t = (\int_0^1 P_t(j)^{1-\varepsilon} dj)^{\frac{1}{1-\varepsilon}}$

Intermediate Goods Firm

The production function for an intermediate goods firm is given by: $Y^P{}_t(j) = K_t(j)^{\alpha_1} N_t^P(j)^{(1-\alpha_1)}$ where $K_t(j)$ and $N_t(j)$ represent the capital and labor services hired by firm.

Cost minimization, taking the wage and the rental cost of capital as given, implies the optimality condition: $\frac{W^P{}_t}{R^k{}_t} = \frac{(1-\alpha_1)}{\alpha_1} \frac{K_t(j)}{N^P{}_t(j)}$ **(6)**

Real marginal cost is common to all firms:

$MC_t = \frac{(1-\alpha_1)^{\alpha_1 - 1}}{\alpha_1^{\alpha_1}} \frac{(W_t^P)^{1-\alpha_1}}{(R_t^k)^{-\alpha_1}}$ **(7)**

Price Setting

Intermediate firms are assumed to set nominal prices in a staggered fashion, according to the rule proposed by Calvo (1983). Each firm resets its price with probability 1-θ of each period, independent of the time elapsed since the last adjustment. Thus, each period a measure 1-θ of producers reset their prices, while a fraction θ keep their prices unchanged. A firm resetting its price in period *t* will seek to solve:

$\text{Max}_{(P^*)} \sum_{k=0}^{\infty} \theta^k E_t \{\frac{C_t}{C_{t+k}} \beta^k Y^P{}_{t+k}(j)[(P^*{}_t / P_{t+k}) - MC_{t+k}]\}$

subject to the sequence of demand constraints: $Y^P{}_{t+k}(j) = X_{t+k}(j) = (P^*{}_t / P_{t+k})^{-\varepsilon} Y^P{}_{t+k}$

First order conditions can be obtained from the maximization as;

$$E_t \sum_{k=0}^{\infty} \theta^k E_t \{ \frac{C_t}{C_{t+k}} \beta^k Y^{P}{}_{t+k}(j)((P^*{}_t / P_{t+k}) - \mu MC_{t+k}) \} = 0 \quad \textbf{(8)}$$

where $\mu \equiv \varepsilon / (\varepsilon - 1)$ is the gross "frictionless" price markup at zero inflation steady state.

Hence, at steady state: MC≡$1 / \mu \equiv (\varepsilon\text{-}1) / \varepsilon$

Finally, the equation describing the dynamics for the aggregate price level is given by:

$$P_t = \left[\theta P_{t-1}{}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \quad \textbf{(9)}$$

2.3.3. Monetary Policy

The stance of monetary authority is important in determining the movements of the real interest rate, which plays a role in how macroeconomic variables react to spending shocks. For instance, recent work by Cogan, Cwik, Taylor, and Wieland (2009) and Christiano, Eichenbaum, and Rebelo (2009) have pointed out that when the monetary policy is completely unresponsive or the nominal interest is at the zero bound, the monetary-fiscal interactions have significant effects on the size of fiscal multipliers.

On the other hand, I consider the case of active monetary policy where the central bank is assumed to set the nominal interest rate $r_t \equiv R_t - 1$ every period according to a standard Taylor type rule:

$$r_t = r + \varphi_{\Pi} \pi_t + \varphi_y \hat{y}_t + \varepsilon_t \quad \textbf{(10)}$$

where r is the steady state nominal interest rate and both parameters are positive. In this equation, and henceforth, lower-case letters with hats denote log-deviations with respect to the corresponding steady state values. Thus, this rule implies that the nominal interest rate should respond to divergences of actual inflation rates from *target* inflation rates and of actual Gross Domestic Product (GDP) from *potential* GDP. Such representation is

sufficient to reflect the variations in the Federal Funds rate over the Greenspan era which corresponds to the second half of our sample period. Nevertheless, in Section 6.4, I analyze how a shock to nominal interest rate affects the macroeconomic variable of output.

2.3.4. Fiscal Policy

The government's budget is constraint is defined as below:

$$P_t T_t + \frac{B_{t+1}}{R_t} = B_t + P_t(GI)_t + P_t(GW)_t + P_t(GNW)_t$$

where (*GI)*, (*GW)* and (*GNW)* respectively represent government investment, government wage consumption and government non-wage consumption. According to the budget equation, government can finance its spending either by borrowing (debt, B_t) or taxing households (T_t).

Regarding the government's fiscal rule, unlike monetary policy, there isn't any widely accepted specification. Leeper (1991) initially mentions a fiscal rule with taxes responding to the level of real outstanding government debt. Then, McGrattan (1994) introduces reduced form fiscal rules with a VAR representation of exogenous state variables, government spending and tax rates and Schmitt-Grohe and Uribe (2007) show that such rules can approximate optimal policy rules. Following these studies, I assume below fiscal rule for the government:

$$\hat{t}_t = \varphi_b \hat{b}_t + \varphi_g \hat{g}_t \qquad \textbf{(12)}$$

where parameters are again positive constants.[19]

[19] As parameters of fiscal rule (φ_b, φ_g) can differ from each other, I keep debt (B_t) in the budget equation even though taxes are lump-sum.

On the spending side, all types of government spending (in deviations from steady state, and normalized by steady state values) are assumed to evolve exogenously according to some autoregressive process of AR(1):

$$(g\hat{w})_t = \rho_{gw}(g\hat{w})_{t-1} + e_t \qquad (gn\hat{w})_t = \rho_{gnw}(gn\hat{w})_{t-1} + e_t \qquad (g\hat{i})_t = \rho_{gi}(g\hat{i})_{t-1} + e_t$$

where $0 < \rho < 1$, and e_t represents an i.i.d. government spending shock with constant variance.

For government wage expenditure, which is the multiplication of government employment and public wage, the shock stems from the government employment according to the model. This is because I have already assumed public wage is constant and defined as the maximum amount that private wage can reach.

In addition to its standard tasks, I assign a production role to the government. Thus, the government is assumed not only to spend and collect lump-sum taxes (T_t) from households but also to produce. From this aspect, this study is similar to Cavallo (2005) in which government produces output by using a fraction of its purchases of goods in combination with the labor hired from households. On the other hand, unlike Cavallo (2005), an important feature of government production in this study is that government production is not sold in the market; hence it is not a component of total output.

The government produces government output, Y^G, from government capital, (GK), and public employment, (N^G), according to the following production function:

$$Y^G{}_t = (GK_t)^{\gamma_1}(N^G{}_t)^{1-\gamma_1} \qquad \textbf{(11)}$$

According to (11), I assume that the government combines hours and its capital to assemble what I refer to as government output. This is consistent with the NIPA tables as

shown in Table 2.1. According to this table, added value of government corresponds to the sum of compensation of government employees and government consumption of fixed capital. BEA categorizes both items as government consumption expenditures. For purposes of the model, however, I classify government consumption of fixed capital in the context of government investment, as it is merely a measure of the services of general government fixed assets and represents depreciation of capital goods.

As before government's capital accumulation of government evolves as below;

$$(GK)_{t+1} = (1-\delta)(GK)_t + (GI)_t - (GI)_t \phi_t \qquad \text{where } \phi_t = \frac{\xi}{2}[\frac{I_t}{I_{t-1}} - 1]^2$$

As described in Section 3.1, government production has a role in the formation of effective consumption together with private consumption. Hence, depending on the data, government production might possess either complementary or substitute characteristics to private consumption. For instance, while government spending used for building a highway is complementary to car consumption, it becomes a substitute if the government gives the same car itself as subvention.

2.3.5. Market Clearing:

The clearing of factor and good markets requires that the following conditions are satisfied:

$$K_t = \int_0^1 K_t(j)dj$$

$$Y_t = Y^P{}_t = X_t(j)$$

$$G_t = (GI)_t + (GW)_t + (GNW)_t \quad Y_t = C_t + I_t + G_t$$

$$N_t = N^P{}_t + N^G{}_t = \int_0^1 N_t(j)dj + N^G{}_t$$

2.4 Linearized Equilibrium Conditions

In the present section, I derive log-linear versions of the key optimality and market-clearing conditions that will be used in the analysis of the model's equilibrium dynamics. Some of these conditions hold exactly, whereas others represent first order approximations around a zero-inflation steady state. As a reminder, lower-case letters with hats denote log-deviations with respect to the corresponding steady state values.

2.4.1. Households

Next I list the log-linearized versions of the defined households' optimality conditions, expressed in terms of the aggregate variables. Log linearizations of the first order equations from **(1)** to **(5)** are respectively presented below:

$$\hat{\lambda}_t = (-\sigma + \frac{1}{\nu})(\hat{\tilde{c}})_t - \frac{1}{\hat{\nu}}\hat{c}_t \quad \textbf{(13)}$$

$$\hat{\lambda}_t + \hat{w}^p{}_t = \psi \hat{n}_t \quad \textbf{(14)}$$

$$\beta \overline{R}^k (\hat{\lambda}_{t+1} + r^k{}_{t+1}) + \beta(1-\delta)(\hat{\lambda}_{t+1} + \hat{q}_{t+1}) = \hat{\lambda}_t + \hat{q}_t \quad \textbf{(15)}$$

$$\hat{\lambda}_{t+1} + r_t = \hat{\lambda}_t + \pi_{t+1} \quad \textbf{(16)}$$

$$\hat{q}_t + \xi(\hat{i}_{t-1} - \hat{i}_t) + \beta\xi(\hat{i}_{t+1} - \hat{i}_t) = 0 \quad \textbf{(17)}$$

Lastly, the log-linearized capital accumulation equations are as follows:

$\hat{k}_{t+1} = (1-\delta)\hat{k}_t + \delta\hat{i}_t$ and

$(g\hat{k})_{t+1} = (1-\delta)(g\hat{k})_t + \delta(g\hat{i})_t$

Also, note that private wage can be obtained from **(13)** and **(14)** as:

$$\hat{w}^p{}_t = \psi\hat{n}_t - \left[(-\sigma + \frac{1}{\nu})(\hat{\tilde{c}})_t - \frac{1}{\nu}\hat{c}_t\right]$$

2.4.2. Firms

Starting with the firms' production function (which is also equal to total production in the economy as government production is not sold), the log-linearized of it is presented below:

$$\hat{y}^{p}{}_{t} = \alpha_1 \hat{k}_t + (1-\alpha_1)\hat{n}^{p}{}_{t} \qquad \textbf{(18)}$$

Moreover, log-linearization of **(8)** and **(9)** around the zero inflation steady state yields the familiar equation describing the dynamics of inflation as a function of the log deviations of the real marginal cost from its steady-state level:

$$\pi_t = \beta\pi_{t+1} + \zeta(m\hat{c})_t \qquad \text{where } \zeta = \frac{(1-\theta)(1-\beta\theta)}{\theta} \qquad \textbf{(19)}$$

Ignoring constant terms; $\hat{w}^{p}{}_{t} = \hat{y}^{p}{}_{t} - \hat{n}^{p}{}_{t} + (m\hat{c})_t$ and $r^{k}{}_{t} = \hat{y}^{p}{}_{t} - \hat{k}_t + (m\hat{c})_t$**.**

Equivalently, defining the average mark up in the economy as $\hat{\mu}_t = -(m\hat{c})_t$, equations given above can be written as a function of average mark up.

2.4.3 Fiscal Policy

Linearization of the government production function is given by:

$$\hat{y}^{g}{}_{t} = \gamma_1(g\hat{k})_t + (1-\gamma_1)\hat{n}^{g}{}_{t} \qquad \textbf{(20)}$$

And $(g\hat{k})_{t+1} = (1-\delta)(g\hat{k})_t + \delta(g\hat{i})_t$

Furthermore, linearization of the government budget constraint around a steady state with zero debt and a balanced primary budget yields

$$\frac{\overline{T}}{\overline{B}}\hat{t}_t + \frac{(\hat{b}_{t+1} - r_t + \hat{\pi}_{t+1})}{\overline{R}} = \hat{b}_t + \frac{\overline{G}}{\overline{B}}\hat{g}_t \qquad \textbf{(21)}$$

2.4.4. Market Clearing

$$\hat{y}_t = \hat{y}^{p}{}_t$$

$$\hat{y}_t = \frac{\overline{C}}{\overline{Y}}\hat{c}_t + \frac{\overline{I}}{\overline{Y}}\hat{i}_t + \frac{\overline{G}}{\overline{Y}}\hat{g}_t$$

$$\hat{g}_t = (g\hat{i})_t \frac{(\overline{G}\overline{I})}{\overline{G}} + (g\hat{w})_t \frac{(\overline{G}\overline{W})}{\overline{G}} + (gn\hat{w})_t \frac{(\overline{G}\overline{N}\overline{W})}{\overline{G}}$$

$$\hat{n}_t = \frac{\overline{N}^{P}}{\overline{N}}\hat{n}^{p}{}_t + \frac{\overline{N}^{G}}{\overline{N}}\hat{n}^{g}{}_t$$

2.5 Bayesian Estimation of the Model

I adopt the empirical approach outlined in Smets and Wouters (2003) and estimate the model employing Bayesian inference methods. This involves obtaining the posterior distribution of the parameters of the model based on its log-linear state space representation. In the following, I briefly describe the data, estimation strategy and the prior distributions used in its implementation.

2.5.1 Data and Estimation Strategy

I estimate the model using quarterly data of US covering the period 1960Q1 through 2007Q4.[20] Since the focus of this paper is government spending, I also include government spending variables as observables. Accordingly, I employ the data series of government investment, wage and non-wage component government consumption in addition to macroeconomic variables of GDP, consumption, personal taxes, inflation rate and nominal interest rate.[21] Government spending definition covers Federal, State and Local authorities'

[20] Average annual inflation in this period is around 4 percent although first order approximations are performed around a zero-inflation. However, typical annual inflation rates (up to 10%) can be thought as sufficiently close to zero. Furthermore, model responses display only limited variations with regard to changes in parameters (such as price stickiness) as shown in the sensitivity analysis.

[21] Data is obtained from the NIPA Tables of Bureau of Economic Analysis, available at the address: http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=N. For government production data, see Table 1.

spending. As states are required to balance their budgets, some might think that this restriction is problematic in the analysis. However, balanced-budget rules are valid only for operating budgets not capital budgets. Besides, this restriction is not rigid in practice as it does not forbid new borrowing. The last two variables of inflation and interest rates are simply GDP deflator and Federal Funds rate.

As the variance-covariance matrix of the residuals becomes singular, a crucial requirement of this method is that the number of observable variables used in the estimation does not exceed the number of shocks in the model. This is, in fact, the case for the described model: the number of shocks (government spending shocks, monetary policy shock and a tax shock) imposed to the system is less than the number of the variables whose data is used. To circumvent this problem, following Schorfheide (2000), I add measurement errors to those variables expressed in logarithms and detrended by removing linear trends. [22]

The priors for the parameters being estimated are given in the next subsection and the likelihood is computed using the Kalman filter. The Metropolis-Hastings algorithm is used to sample from the posterior distribution, given by a multivariate normal distribution. The algorithm is initialized using the maximized posterior mode from the Monte-Carlo based optimization routine.

2.5.2. Calibration and Prior distributions

Some of the parameters which are difficult to identify in steady state and commonly used in the literature are calibrated following Smets and Wouters(2003). Main results are robust to changes in these parameters. This includes setting the subjective discount factor β to

[22] Except for the Federal Fund rate.

0.99 (so that the annual steady state real return on financial assets is 4 %), the depreciation rate δ to 0.025 (implying a 10% annual depreciation rate of capital), the production function parameters of firms (α_1) to 0.33 and of government (γ_1) to 0.85 (which makes the steady state labor share in income approximately equal to 67% and 15% respectively). I take weight of disutility from working (κ) in the utility function as 1. These values are roughly consistent with the data as discussed by Gali et al (2007). Furthermore, the capital adjustment cost parameter of ξ is assigned a value equal to 3 as estimated by Christiano et al. (2005) and Schmitt-Grohé and Uribe (2008).

Regarding the ratios employed in the paper, US data is examined. Some of the steady state variables are also calibrated based on averages over the sample period considered in the paper. In this perspective, steady-state ratios of debt to GDP and total government spending to GDP are set as 0.33 and 20 percent respectively. Shares of government wage expenditure, non-wage consumption and government investment are calibrated as 50, 25 and 25 percent of total government spending respectively reflecting their average shares for the US over the sample. Additionally, the share of government working hours in total working hours is set as 1/6. Figure 2.2 and 2.3 illustrate the data associated with the stated ratios.

Regarding the parameters obtained from the US data, Table 2.2 below shows the prior distributions for these parameters being estimated. These are in line with the literature and the means of the distribution were set based on the estimates of pre-existing studies of Forni (2009), Coenen and Straub (2006) and Smets and Wouters(2003). For the critical parameter of v that defines the relation between private consumption and government production, I choose the uniform distribution in order to impose the minimum.

Lastly, a steady state price markup (μ-*1*) of 0.2 is chosen by setting ε equal to 6. The fraction of firms that keep their prices unchanged (θ) is given a baseline value of 0.75 implying to average price duration of one year. These baseline values are employed in the Bayesian estimation but I also perform a sensitivity analysis for these parameters in order to demonstrate the effects of price stickiness and price mark-ups.

2.6 Results

2.6.1 Parameter Estimates

Given priors, I estimate the posterior distributions of the parameters using the Metropolis–Hastings algorithm with one million iterations, a number which seems to be sufficient to achieve convergence. Figure 2.4 plots prior and posterior distributions for a selection of parameters where red and black lines represent prior and posterior distributions in Metropolis-Hastings procedure. Green line is the mode of posterior distributions.

Posterior means, standard deviations and distributions are all presented in Table 2.2. According to this table, the most persistent shock is government wage expenditure having an autoregressive parameter of 0.98. This shock also has the smallest standard deviation. In contrast, government investment shocks are the least persistent (with an autoregressive parameter of 0.89) while holding the largest standard deviation. Table 2.2 also indicates that weight of government production (a) is limited with 9 percent in the effective consumption. Hence, the rest 91 percent is private consumption. Furthermore, government production shows strong complementary features to private consumption with elasticity of substitution between C and Y^G of 0.27. Regarding the policy parameters taking place in the monetary rule, responses of nominal interest rate to output and inflation are obtained as

0.08 and 1.71 respectively. Similarly, tax response to debt and government spending are attained as 0.27 and 0.37.

2.6.2 Responses of the Model

Figures 2.5, 2.6 and 2.7 display the response functions of total government spending, output and (private) consumption given one percentage point shock to each type of government spending. The x-axis shows quarters after the shock hits the economy and the y-axis shows deviations from the steady state in response to a unit shock in government spending.

Upper graphs on the left panel of Figure 2.5, 2.6 and 2.7 show the output responses to an increase in each type of government spending. Output rises on impact in all graphs which is a common finding in the empirical literature. Apart from this, these graphs indicate that size of output responses differ among the spending types. Regarding private consumption, it increases in response to a shock in government wage expenditure but decreases in response to a government non-wage consumption shock. However, the latter negative effect is mostly insignificant. Similarly, responses of private consumption are again insignificant in the case of government investment shocks.

Regarding the positive effects of government spending shocks on output and consumption, government production plays a role in offsetting the negative wealth effect in addition to price stickiness and imperfect competition. Typically, given a government spending shock, households foresee to be taxed later. In order to compensate this negative effect, they optimally choose to increase their labor supply which in turn lowers their real wage. As a result, output rises with increasing labor but consumption shrinks due to the negative

wealth effect. However, adding government production into the mechanism mitigates the negative wealth effect as government production serves as a complement to private consumption in the formation of effective consumption. Hence, a government spending shock increases the marginal utility of consumption providing an additional motive for households to consume.

Lastly, the responses of private investment, all types of spending shocks have negative effects this time. Yet, these negative effects are mostly insignificant for this economic variable. This partially explains why some empirical studies (e,.g. Fatás and Mihov (2001) and Gali et al (2007)) obtain negative, and others (e.g. Blanchard and Perotti (2002)) obtain insignificant responses of private investment given a spending shock.

2.6.3 Multipliers

Following Blanchard and Perotti (2002), studies generally summarize the effects of government spending by the impact multiplier, which is the increase in the level of output *k* periods ahead in response to a change in the fiscal variable of interest given by ΔG_t at time *t*[23].

Impact multiplier *k* periods ahead = $\frac{\Delta Y_{t+k}}{\Delta G_t}$

Figure 2.8 shows how output multipliers vary over time for each type of spending. Among all types of government spending, government wage expenditure shock has the largest output multipliers whereas government non-wage component consumption shock has the smallest. Same consequence holds if we consider the effects of government spending on

[23] For instance the government spending multiplier is computed as follows, $\frac{\Delta Y_{t+k}}{\Delta G_t} = \frac{\%\Delta Y_{t+k}}{\%\Delta G_t}\frac{Y}{G}$, where Y and G are the steady state values of output and government spending respectively.

private employment. The model indicates that private sector working hours also go up for all types of government spending shocks. This is a standard result in empirical literature and explained with the negative wealth effect as discussed earlier. Nevertheless, the size of increases in private employment again varies for each type of government spending shock, in which government wage expenditure shocks have the most impact. This indicates that a fiscal stimulus plan should primarily include government wage expenditure if it aims to decrease unemployment.

2.6.4 Role of Monetary Policy

In the present section I analyze the effect of monetary policy by imposing a one percentage point shock to the Taylor rule described in Section 3.3. The shock itself disappears after one period and Figure 2.9 displays the effect of this shock over the five year forecast horizon. Accordingly, such shock has a sizable negative impact on all economic variables; namely, output, private consumption, private investment and private employment. This negative is the strongest on impact, and quickly dies out. Hence, its negative effects are statistically significant only during the first few quarters.

By imposing the shock, nominal and real interest rates go up. This in turn leads to a fall in aggregate demand and results a decrease in output. This suggests that if the monetary authority reacts strongly to the state of the economy, it then limits the stimulative effects of increased government spending. Alternatively, in the presence of a relatively accommodative monetary policy, government spending has a higher stimulative effect on aggregate demand, which is the case of zero bound interest rates.

2.6.6 Sensitivity to Price Mark-Up

The effect of the price mark-up on output is analyzed by assigning different parameter values of ε. Baseline value of ε is 6 and this indicates to a mark-up of 0.2. This time, I compare this baseline value of 0.2 with only no mark up case (0). Figure 2.10 shows the responses of output for both values of ε. Output responses exhibit a decline for all types of spending when the markup decreases from 0.2 to 0. However, this fall is significantly higher only in the case of wage component government consumption as displayed in Figure 2.10. In sum, increases in mark-ups have again positive effects on output. This is in line with the Gali et al (2007) who performed the same analysis with total government spending. In fact, imperfect competition, which leads to such mark-ups, generates a rise in profits and income. And higher profits and income in turn help to offset the negative wealth effect.

2.6.5 Sensitivity to Price Stickiness

In this sub-section, I analyze the effects of price stickiness with altered baseline parameters. The graphs in Figure 2.11 illustrate the response of output with changing parameters of price stickiness (Θ) given one percentage point government spending shock. Level of price stickiness is described with the figures; 0 and 0.75. Stickiness value of 0 describes flexible prices and value of 0.75 describes is the baseline figure corresponding to average price duration of one year.

The figures indicate that price stickiness has varied effects on different types of spending. In the case of non-wage government consumption and government investment shocks, responses of output decays as the price stickiness increases in the first two years. Such

results are again in line with the findings of Gali et al (2007). Intuitively, the wealth effect is offset as sticky prices raise the possibility that labor demand reacts stronger than labor supply. For the case of government wage expenditure shock, price stickiness has no significant effect on output responses hence output responses have the same figures.

2.7 Extension to the Baseline Model

In this section, I present an extension of the baseline model with habit persistence. This extension is commonly used in the literature. As an example, Monacelli and Perotti (2008) argue that habit persistence helps dynamic general equilibrium models capture the gradual buildup of many (real) variables in response to shocks as in VAR-based impulse responses.

In order to incorporate habit persistence into the model, I assume that last period's effective consumption also enters the utility function as below:

$$U(\tilde{\tilde{C}}_t, N_t) = \left[\frac{(\tilde{\tilde{C}})_t^{1-\sigma}}{1-\sigma} - \kappa \frac{N_t^{1+\psi}}{1+\psi} \right] \text{ where } (\tilde{\tilde{C}})_t = \tilde{C}_t - h\tilde{C}_{t-1}$$

In the above representation, *h* is the parameter of habit persistence. Rest of the model remains the same. Figure 2.12 presents how the output responses vary for different values of *h* where h=0 describes our baseline model. For all types of spending, output responses from two scenarios are similar and converge later. Only difference is observed only on impact whereas the output response of the model with habit persistence is sluggish. This result is also valid responses of private consumption. Indeed, researchers usually employ habit persistence with the claim that it enables the model to generate a persistent and non-monotonic consumption response similar to that obtained from the VAR.

2.8 Conclusion

In the paper, total government spending has been disaggregated in the context of a theoretical model which assigns different roles to each type of government spending. The model is able to capture empirical findings and incorporates a transmission mechanism regarding the effects of various types of government spending on economic variables. The government wage component of consumption has the largest effect on economic variables affecting the economy through the public sector employees necessary for government production. Government investment has a similar transmission mechanism but its effects are limited. Additionally, all types of spending shocks influence the output directly as they are components of the total government spending.

Figure 2.5, 2.6 and 2.7 demonstrate the contemporaneous responses in output, private consumption and private investment to each type of government spending shocks. Accordingly a government wage expenditure shock has positive effects both on private consumption and output. As this spending type constitutes half of the total spending, total government spending usually reflects the responses to government wage expenditure shocks. Other two government spending types have also positive effects on output whereas their responses on private consumption are mostly insignificant. Likewise, regarding responses of private investment, these responses are again insignificant.

Consequently, these results provide an explanation for the wide range of multipliers existing in the literature. An equal amount of total government spending might have different multipliers depending on its composition as different types of government spending have different effects on output and private consumption. With this set up, I bring

an alternative explanation to the empirical puzzle of increasing consumption given a government spending shock in addition to Gali et al (2007). These authors decompose the standard representative household into two types by introducing rule of thumb household and emphasizing their consumption behavior difference. And this study similarly features a disaggregating approach but in total government spending and assigns different roles to each type.

Table 2-1 Government Consumption Expenditures and Gross Investment

Government consumption expenditures and gross investment	**2,878.3**
Government Investment	495.5
Government Consumption Expenditures	2,382.8
Intermediate goods and services purchased (Net)	685.2
Value Added by Government	1,697.6
Compensation of general government employees	*1,436.9*
Consumption of general government fixed capital	*260.7*

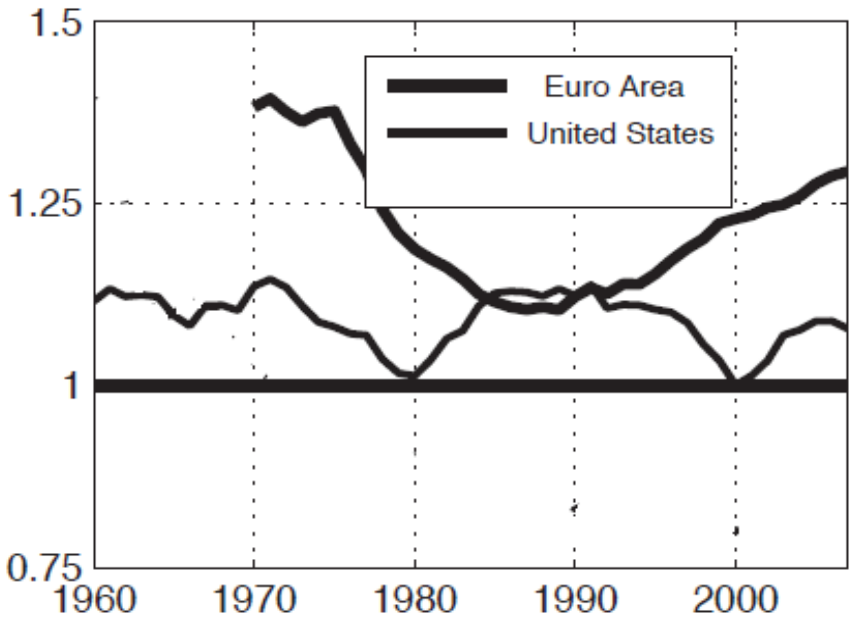
Source: (National Income and Product Accounts Table: 3.9.5 and 3.10.5 for the year 2008)

Table 2-2 Prior and Posterior Means

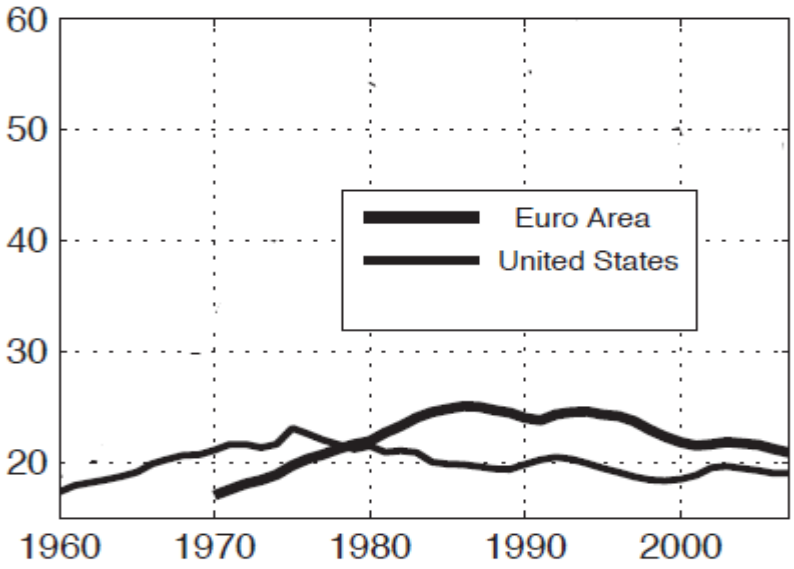
	Description	Distribution	Prior Mean	Prior St. Dev.	Posterior Mean	Posterior Interval
ψ	Elasticity of wages wrt to hours	Normal	1.00	0.3	1.04	[1.02-1.07]
σ	Inverse of elasticity of intertemporal substitute	Gamma	1.5	0.4	1.71	[1.67-1.74]
a	Weight of private consumption	Beta	0.70	0.3	0.91	[0.89-0.92]
ν	Elasticity of substitution between C and Y^G	Uniform	0.50	0.5	0.27	[0.25-0.29]
ρ_{gi}	Autoregressive parameter of GI shock	Beta	0.80	0.2	0.89	[0.88-0.91]
ρ_{gw}	Autoregressive parameter of GW shock	Beta	0.90	0.1	0.98	[0.975-0.99]
ρ_{gnw}	Autoregressive parameter of GNW shock	Beta	0.80	0.2	0.91	[0.90-0.93]
σ_{gi}	Std. deviation of GI shock	Inverse Gamma	0.01	Infinite	0.61	[0.59-0.62]
σ_{gw}	Std. deviation of GW shock	Inverse Gamma	0.01	Infinite	0.003	
σ_{gnw}	Std. deviation of GNW shock	Inverse Gamma	0.01	Infinite	0.60	[0.59-.061]
γ_y	Response of nominal interest rate to output	Gamma	0.1	0.05	0.08	[0.07-0.1]
γ_π	Response of nominal interest rate to inflation	Normal	1.5	0.2	1.71	[1.70-1.73]
ϕ_b	Response of tax to debt	Gamma	0.35	0.2	0.27	[0.24-0.29]
ϕ_g	Response of tax to gov. spending	Gamma	0.35	0.2	0.37	[0.34-0.39]

Figure 2-1 Public/Private Sector Interaction

Ratio of Public/Private Sector Wages Per Employee



Ratio of Public/Private Sector Employee



Source: Labor force surveys (OECD).

Figure 2-2 Share of Total Government Spending in GDP (%)

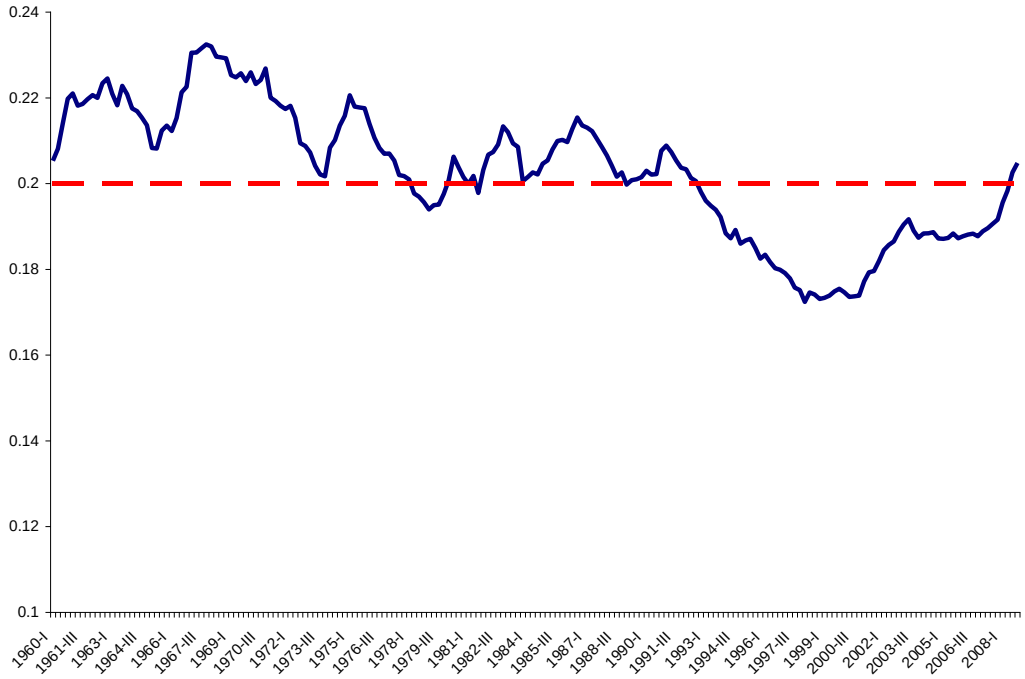


Figure 2-3 Ratio of Net Federal Debt to Output

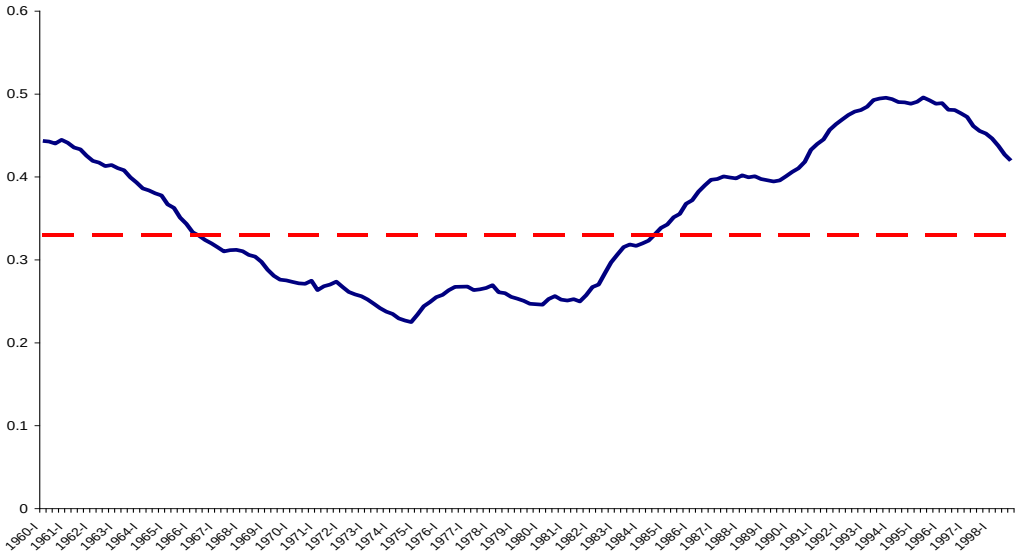


Figure 2-4 Prior and Posterior Distributions of Selected Parameters

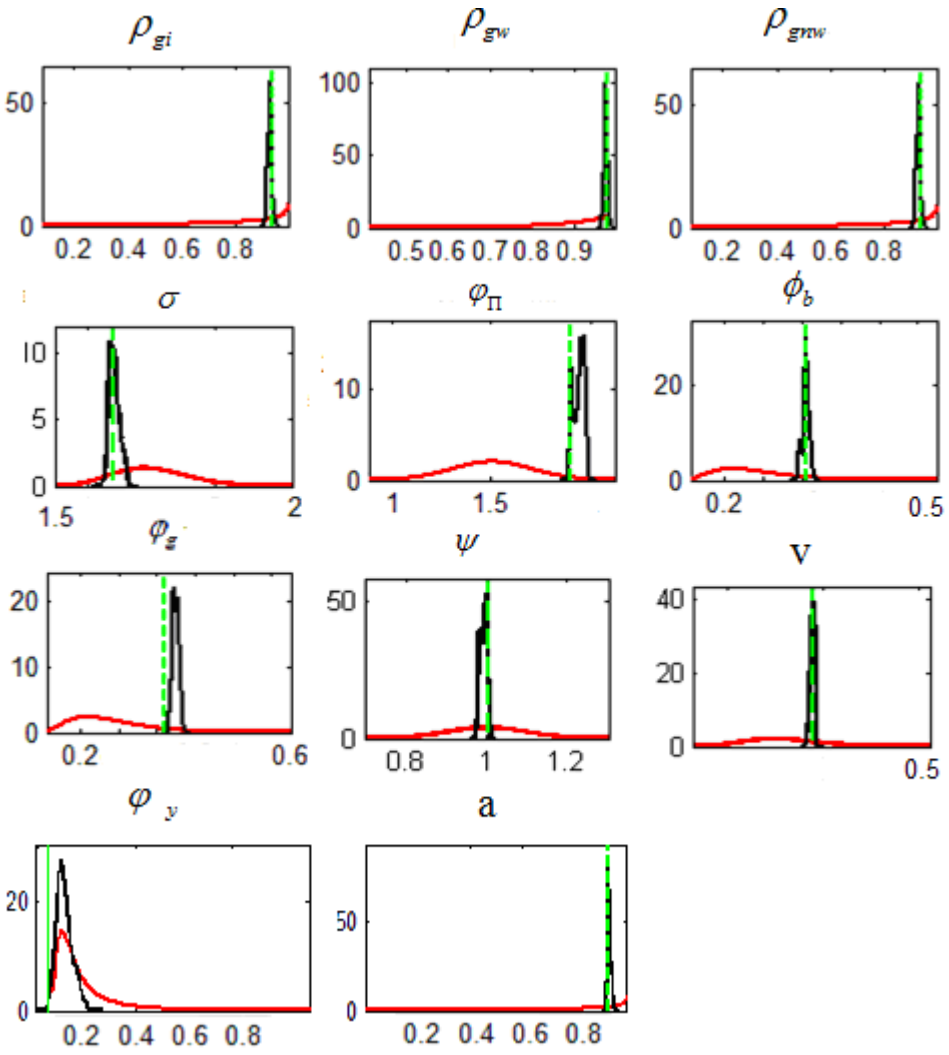


Figure 2-5 Model Responses; Shock to Government Wage Expenditure

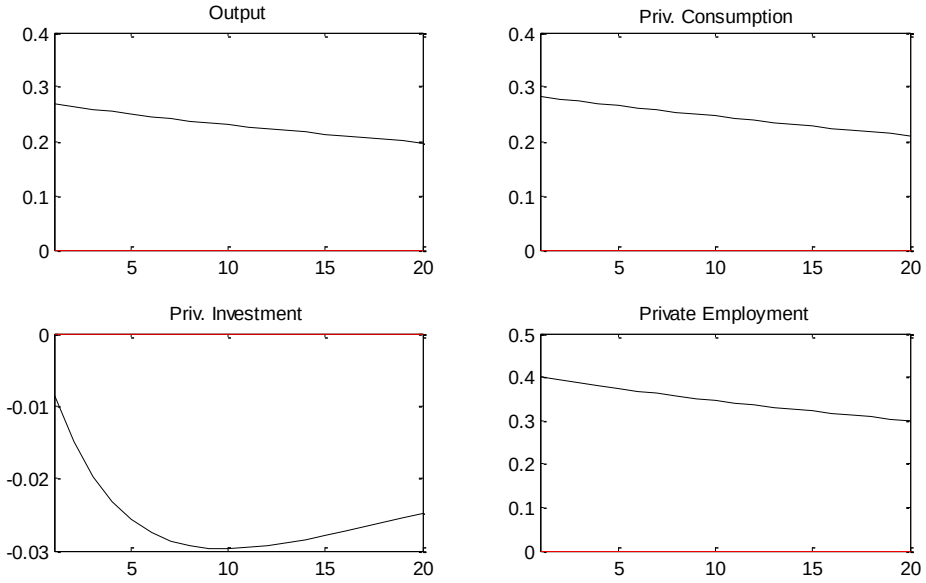


Figure 2-6 Model Responses; Shock to Government Non-Wage Consumption

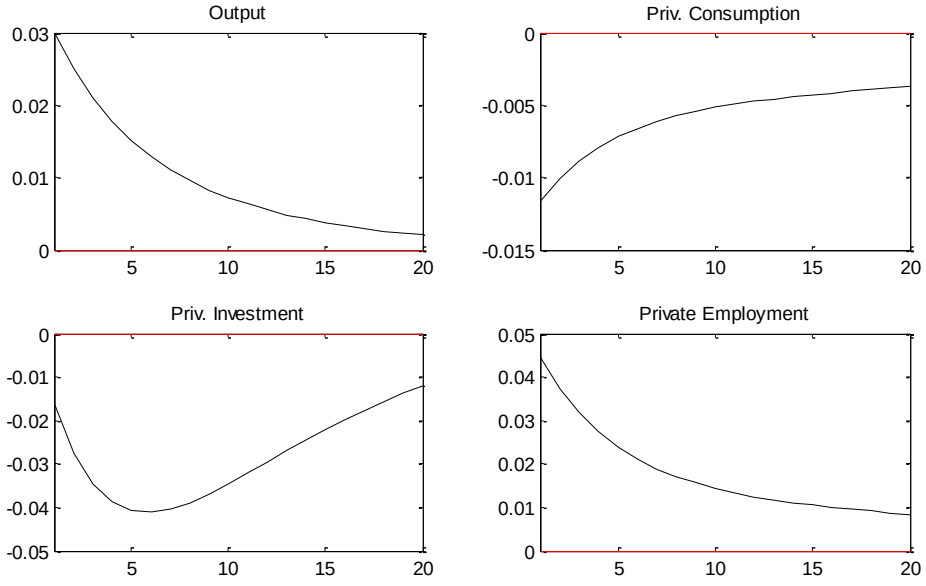


Figure 2-7 Model Responses; Shock to Government Investment

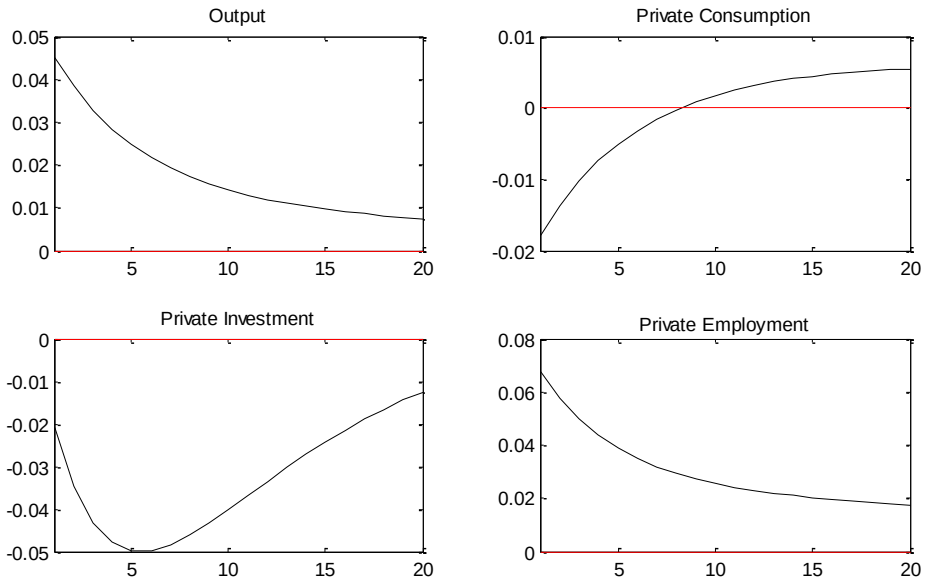


Figure 2-8 Output Multipliers

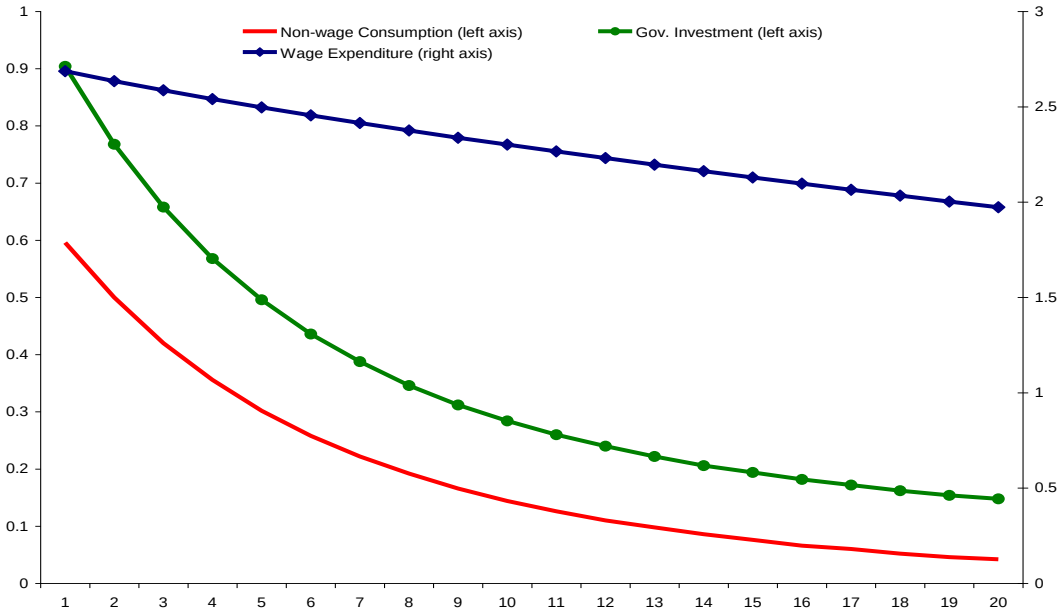


Figure 2-9 Output Responses of the Model Given a Monetary Policy Shock

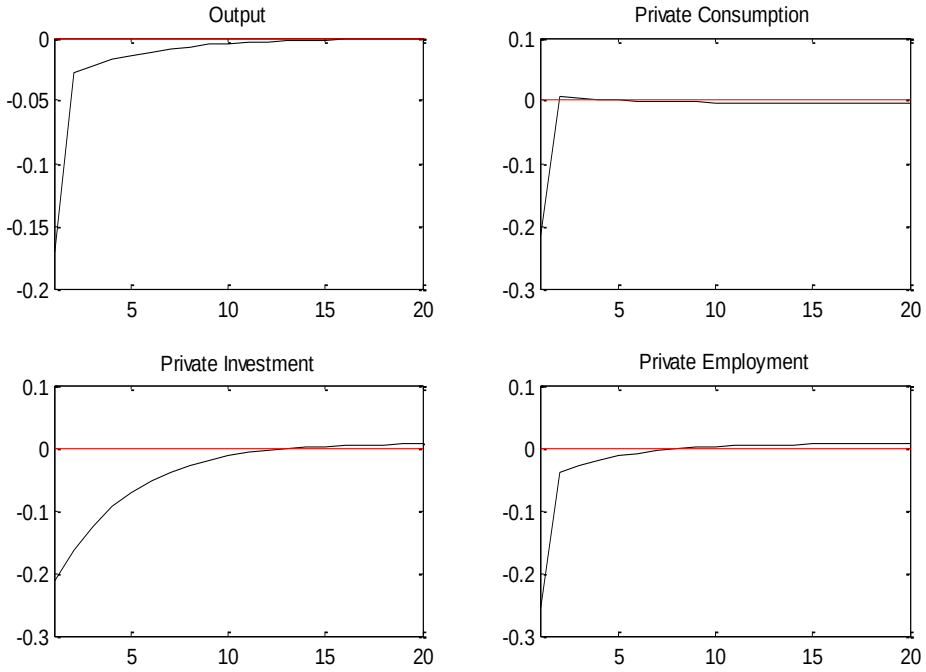


Figure 2-10 Sensitivity to Price Mark Up

Shock to Wage Component Government Consumption

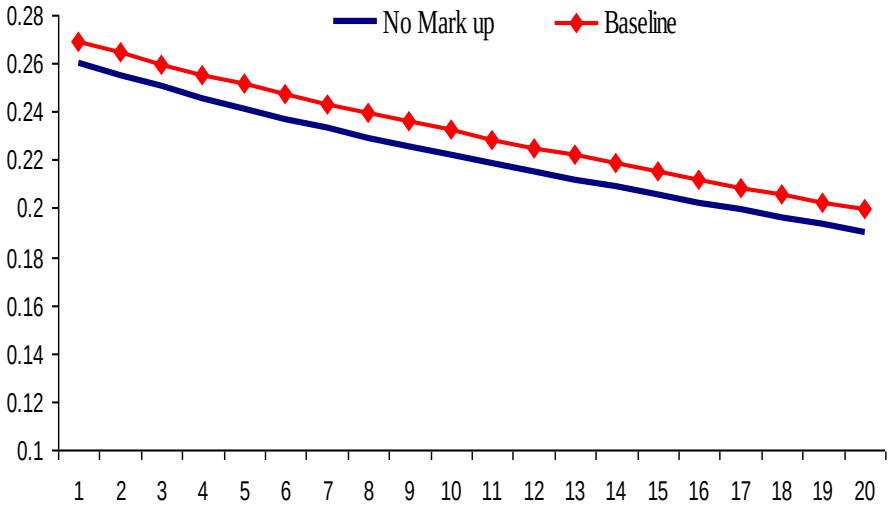
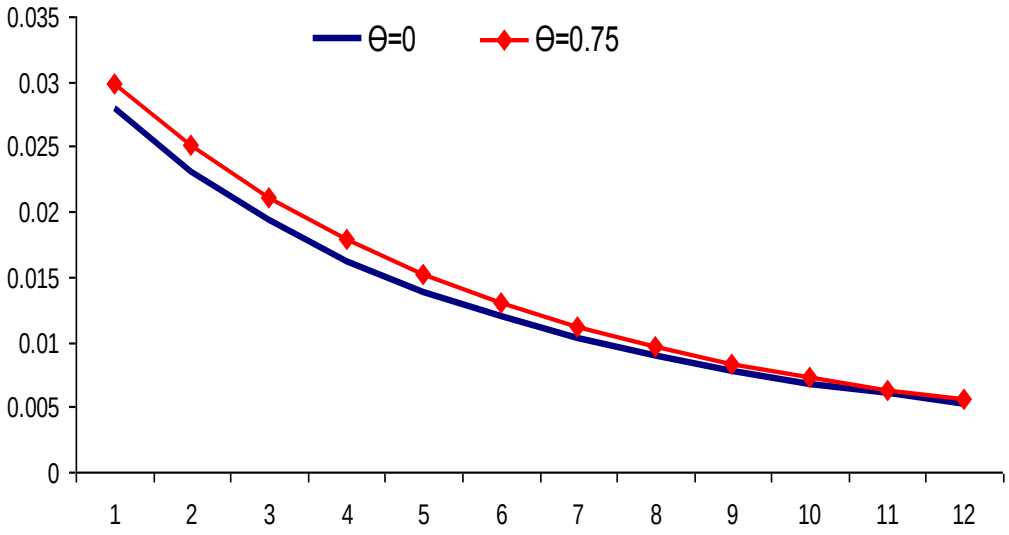


Figure 2-11 Sensitivity to Price Stickiness

Shock to Non-Wage Component Government Consumption



Shock to Government Investment

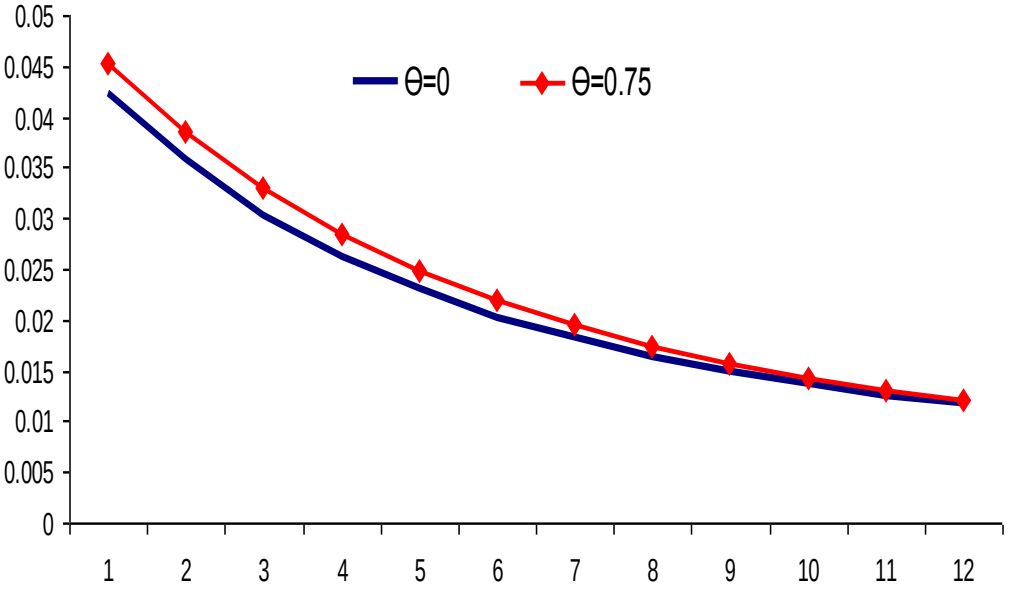
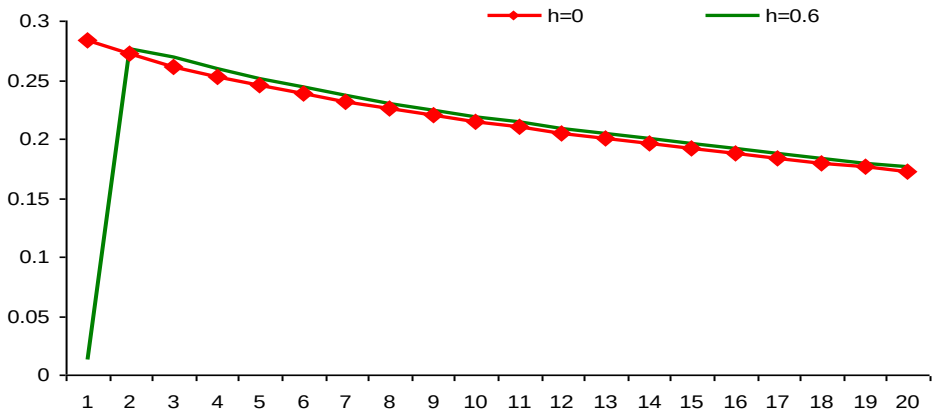
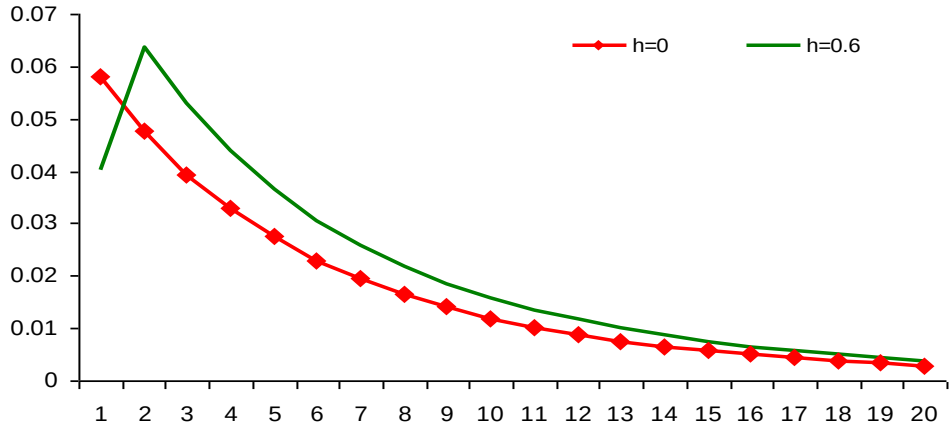


Figure 2-12 Sensitivity to Habit Persistence

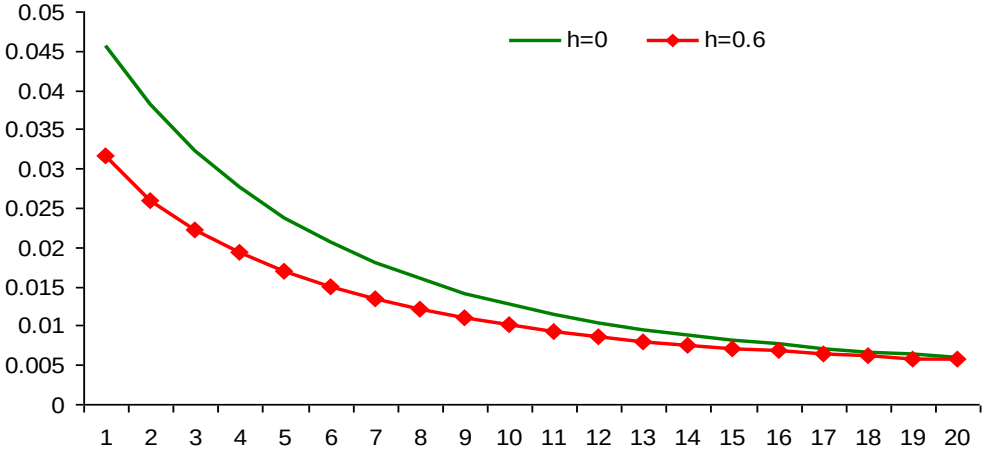
Shock to Government Wage Expenditure



Shock to Government Non-Wage Expenditure



Shock to Government Investment



Chapter 3 Turkey's Trilemma Trade-offs: Is There a Role for Reserves?

3.1. Introduction

The macroeconomic policy "trilemma" for open economies, also known as the impossible trinity, states that a country simultaneously may choose at most two of the following three goals: monetary independence(MI), exchange rate stability (ES) and capital account openness (KO). The trilemma policy trade-offs are conveniently represented via a triangle, where each side of the triangle in Figure 3.1 represents full attainment of one of the three goals. Therefore, as shown, being at any vertex of the triangle represents full attainment of two of the three goals, at the expense of abandonment of the third.

Clearly, an economy cannot be positioned on all three sides of the Figure 3.1 triangle at once. However, since each of the three goals is potentially desirable, it is conceivable that policy makers would attempt to meet all three partially, which is captured in Figure 3.1 as being at a point somewhere in the interior of the triangle.[24] For example, a country might have a managed float and some capital controls, sacrificing some monetary independence as well in the face of international capital flows.

In fact, the partial attainment of all three policy goals has seemed to characterize policy-making in practice, and has perhaps even been the dominant global policy stance, especially for emerging market economies. This "mixed" approach to the trilemma has been characterized by continual adjustment of policies in response to a rapidly changing

[24] See Aizenman (2010), for example, for a more detailed discussion of the trilemma framework.

global environment, as well as attempts to implement market-oriented economic reforms. At the same time, government policy makers have not always had clear guidance on how precisely to manage the trade-offs: in terms of Figure 3.1, what is the optimal position in the triangle at any given time? Or, even more fundamentally, what are the joint implications of a complex set of macroeconomic policy decisions for the policy stance of an economy, viewed from the lens of trilemma trade-offs? Can a country's policy-makers even know where they are positioned in the triangle?

Therefore, it is important to have a better understanding of how to characterize and measure various different mixtures of trilemma policy stances, and the present paper contributes to an emerging literature in this area. The underlying theoretical framework of the trilemma, namely the Mundell-Fleming model, is not very easily adapted to analyzing the partial attainment of all three goals in formal theoretical modeling. However, Aizenman, Chinn and Ito (ACI) recently developed a new methodology to empirically characterize the mixed approach to the trilemma in practical policy-making. In their approach, ACI (2008, 2010) initially measure each policy dimension via an empirical index. A higher value of one index represents greater closeness to that policy goal. In this case, the question of how trilemma-based policy trade-offs are managed becomes an empirical exercise.

The theoretical constraint of trade-offs between the three policy goals is then captured by estimating a regression equation in which the dependent variable is a constant (in their case, one), and the independent variables are the three trilemma indices (with the constant term excluded on the right hand side, of course). However, in this regression, the estimated coefficients alone will not provide sufficient information about "how much of" the policy

choice countries have actually implemented even though they should give us some approximate estimates of the weights countries put on the three policy goals. Hence, following ACI, looking into the contributions using the estimated coefficients and the actual values for the variables (such as a*MI , b*ES , and c*KO) will be more informative. The coefficients multiplied by the values of the indices therefore indicate the ***relative contributions*** of the three variables to the overall trilemma policy stance.

The ACI methodology is applied by them to large cross-sections and time-averaged panels of countries, in order to discern patterns of trilemma policy stances in different groups of countries, and at different points in time. That particular data analysis reveals how, for example, emerging market economies have adjusted to managing the trilemma as they have opened their economies while facing potentially severe global shocks. The ACI methodology provides an important new empirical approach to understanding the evolution of the global financial architecture and policy responses.

Cross-country analysis can also be useful for individual country policy-makers, if they believe that they can draw lessons from "average" experience across a relevant comparison group, but it will typically not be sufficient for understanding a single country's past policy choices and future policy options. Our focus in this paper is therefore on applying the ACI methodology to a single country, Turkey, with the objective of more specifically understanding the detailed evolution of the policy stance toward the trilemma trade-offs. Our analysis can provide policy-makers with a summary view of their past choices, including unintended consequences or unappreciated trade-offs, as well as serve as an input into analysis of future policy options.

Our focus on Turkey is driven by its relatively challenging experiences as an emerging market economy, including struggles with inflation, exchange rate management, and policies of financial liberalization. Besides, Turkey is a candidate country for European Union membership, and hence has to fulfill the Maastricht criteria. With this perspective, the resulting potential future impacts on macroeconomic policy making can be informed by a better understanding of how it has managed the trilemma trade-offs in the recent past.

Our single-country paper is similar to Hutchison, Sengupta and Singh (2010) who have applied the ACI methodology to India. However, we differ from them by testing the ACI methodology in terms of checking specification errors and searching for consistent contribution figures. This is because, potentially, running a regression with a constant on the left hand side; the independent variables may become correlated with the residuals as we force the residuals and the weighted sum of the variables to add up to a constant. Such correlation causes OLS coefficient estimates biased and inconsistent. In this context, we initially perform a specification test i.e. the Ramsey RESET test, to check the specification of the regression. Next, we attempt to eliminate such a misspecification found in the OLS analysis by employing different techniques; two stage least squares (TSLS), general method of moments (GMM), Kalman filtering etc. While no single estimation method can be considered definitive, our approach here allows us to examine the robustness of the estimated contributions across different estimation methods, each with its own assumptions about the underlying structure of the relationship between the trilemma indices and associated policy stances. Nonetheless, results obtained from Kalman filter analysis are the most consistent with the actual economy.

An important additional feature of the ACI analysis has been to apply their empirical approach to assessing the role of foreign exchange reserves in softening (at least in the short run) the trade-offs inherent in the trilemma. Thus, this paper, following ACI again, specifically assesses the empirical role of reserves in modifying the trilemma trade-offs in practice for Turkey. The role of international reserves has also been discussed widely both in the literature and by central bankers. Central bankers of emerging markets usually assign reserves a buffer role against risks after experiencing several crises in a financially integrated environment. The reserves to GDP ratios in many emerging market economies increased dramatically after the East Asian crisis of 1997-98. Similarly, Turkey's reserve accumulation presented in Figure 3.2 indicates a substantial increase in international reserves over the last decade. Regarding empirical studies, several of them (e.g., Cheung and Ito, 2007; Obstfeld, et al. 2008) suggest structural changes in the patterns of reserves hoarding. Obstfeld, et al. (2008) also find that financial openness, the ability to access foreign currency through debt markets, and exchange rate policy are all significant predictors of international reserve stocks.

The paper proceeds as follows: Section 2 gives a brief description of Turkish macroeconomic policies during 1998-2010. Section 3 describes the methodology and the dataset used in this study. Section 4 and 5 conduct the econometric analysis and report the results. Section 6 investigates macroeconomic impacts of trilemma policy configuration. Lastly, Section 7 presents the conclusions.

3.2 Dealing with the Trilemma Trade-offs after Liberalization: Turkish Case

Liberalization of the Turkish economy started in the early 1980s with economic policies designed to encourage exports. This was followed by the liberalization of foreign exchange regime early in 1984, allowing commercial banks to accept foreign currency deposits. In parallel to those changes, an interbank money market for short term borrowing facilities was enacted in 1986 and the Turkish Central Bank started its open market operations in 1987. Additionally, the Turkish Capital Market Board was established which later on initiated the opening of Istanbul Stock Exchange during the same period. Finally, with the recognition of full convertibility of the Turkish Lira and full liberalization of the capital account, financial liberalization was effectively completed in 1989.

Two decades of experience after liberalization have provided a basis for examination of Turkish economic policies with regards to the trilemma trade-offs. Since 1989 when Turkey became financially liberalized, the Turkish economy could not manage to achieve a solid economic performance at all times. In fact, two serious exchange rate crises hit the economy in 1994 and 2001 due to the vulnerability caused by financial liberalization and accompanying high current account and budget deficits. In the first crises of 1994, the Turkish currency devalued by nearly 40 percent. With the later one, devaluation rate reached 100 percent and the Turkish economy has changed its strategy in dealing with the trilemma trade-offs. Before 2001, exchange rate stabilization (via pegged exchange rate regimes) was crucial for the Turkish economy. However, after 2001, monetary independence took this place as the exchange rate was allowed to float freely. Hence, we next examine macroeconomic policy implementations of Turkey in two main periods: the pre-2001 period and the period from 2001 till today.

3.2.1. Pre-2001 Period

In terms of macroeconomic policies, the pre-2001 period can be further categorized into three sub-periods: pre-1980s, 1980-1988 and 1989-2001. In the pre-1980 period, international capital movements were restricted. Thus there were not any policy trade-offs yet, as Turkey could control both the exchange rates and interest rates in the absence of financial integration.

The decade of 1980s (more specifically, the 1980-1988 period) was the transition period for the liberalization of Turkish economy. In this period, the controls over foreign exchange transactions were removed in a gradual manner. However, there were still some restrictions on capital transactions in this decade; hence it was possible for the Turkey to implement a pegged exchange rate regime and also to control interest rates simultaneously.

Finally, with the recognition of full convertibility of the Turkish Lira in 1989, Turkey removed all controls over foreign exchange transactions. Thus, it initially faced the trilemma trade-offs in 1989 after having fully liberalized its capital account movements. Subsequently, Turkey made its choice and continued to implement the pegged exchange rate regime and (slowly) gave up controlling interest rates till 2001.

After the completion of capital account liberalization in 1989, there has been a relatively massive short term capital inflow -- rather than long term -- to Turkey whereas long term inflows including direct investment remained limited[25]. Given the lack of deep domestic financial markets, the productive sectors of the economy were harmed in an environment

[25] The level of FDI inflows remained stable in Turkey in the 1990s, while FDI surged over the world. For Turkey, FDI increased in the 1980s following the liberalization measures implemented at the beginning of the decade, but growth in FDI stopped in the 1990s, with inflows averaging less than 0.5% of GDP. In the same time, Central European countries, which are considered as Turkey's main competitor in the region for attracting foreign investment, scored much higher inflows (OECD reviews of Regularity Reform in Turkey, 2002).

dominated by large movements of short-term capital, high interest rates, overvalued currency and a stagnant export market. The situation was worsened because the Turkish government was not 'fiscally disciplined' enough and unable to meet its budget and had to borrow from the domestic market with high interest rates. As a result, Turkey's macroeconomic performance soon became dependent on short-term capital inflows and Turkey had lived through chronic fiscal imbalances and a high and chronic inflation. In order to overcome inflation and to achieve macroeconomic stability, Turkey has launched many stabilization programs, at the center of which lay the pegged exchange rate regime. However, as most of the exchange rate based stabilization programs were either interrupted or stopped, Turkey could achieve neither price stability nor high and sustainable growth rates. Therefore, the economy remained vulnerable to a vicious circle of bad macroeconomic performance causing costly capital inflows generating, in turn, higher public deficits (Central Bank of the Republic of Turkey, 2004).

On account of this risky position, Turkey experienced two severe crises, in 1994 and 2001, each of which ended with large devaluations, higher inflation rates and economic recessions. Besides, contagion effects of the Asian and Russian crises in 1997 and in 1998 have increased the vulnerability of the economy. Living with such weaknesses for such a long period of time has created a strong inertia in inflation dynamics and high volatility in growth rates. As a consequence, Turkey's inflation averaged over 70 percent in the period 1989 to 2001 while growth rates remained at a level of 3 percent on average.

As the economy has been trapped into high real interest rates together with an overvalued domestic currency, the monetary authority was bound to a passive role in this period. Hence, the Central Bank of the Republic of Turkey (CBRT) has been forced to hold

significant foreign exchange reserves in order to accommodate to this process (Balkan and Yeldan, 2002). In line with this, Central Bank reserves reached 25 billion USD at the end of the 1990s starting from 5 billion USD in the beginning of the decade. In spite of this hoarding, Central Bank's reserves were not sufficient to defend the Turkish Lira in the crisis of 2001. Even though Central Bank reserves spent 25 percent of its reserves in this crisis, the Turkish Lira depreciated by 40 percent due to the huge short term capital outflows. In fact, net portfolio capital outflows exceed 5 billion USD in just one quarter before this crisis. This is a huge outflow for Turkey as net portfolio investment flows stayed positive throughout the decade attaining an average of 1.5 billion USD per year[26].

3.2.2. Post 2001 Period

The 2001 crisis was an important watershed for the Turkish economy as it made clear that the pegged exchange rate regime was impossible to carry out due to the loss of confidence of economic agents in the sustainability of such a regime. Hence, on 22nd February of 2001, the Turkish Lira was allowed to float freely in order to prevent further damage to the economy. Accordingly, the Central Bank would intervene in the market only to compensate for the short-term excess volatility in the exchange rates in either direction. In practice, Central Bank carried out several interventions in the period of 2002–2006 amounting to a total of 27.5 billion USD. As presented in Table 3.1, a big portion of these interventions (around 25.5 billion USD) was in the form of foreign exchange purchases. As a result of this, Central Bank reserves rose from 20 billion USD to the level of 60 billion USD in just 5 years.

[26] Only exception is the year of 1998 when there was net portfolio investment outflow 6.7 billion USD. This was mainly a contagious effect of the Russian crisis.

By implementing a floating exchange rate regime, Turkish Central Bank has gained an active role after 2001 in achieving price stability, thus a new monetary policy strategy, namely an inflation targeting (IT) regime, was designed. This regime was implemented implicitly during the period between 2002-2005 and explicitly thereafter. Under the inflation targeting regime, the Central Bank began to use its interest rate instrument, effectively indicating a significant move in positioning within the trilemma triangle. Thus, during this period, the CBRT faced the traditional trilemma problem of maintaining an independent monetary policy in the face of international capital inflows and a desire to stabilize the exchange rate.

With these new policies, the Turkish economy has entered into a structural transformation process through which macro economic performance has improved considerably. In the period of 2002 - 2005, all inflation targets have been attained for four years in a row and the inflation rate was brought down to single digits, where it stayed thereafter. This performance in disinflation positively affected economic growth. Not only positive but also high growth rates were attained. Total cumulative economic growth in real terms surpassed 30 percent from 2002 to 2006.

In parallel to these macroeconomic improvements, the economy started witnessing sharp increases in capital inflows, especially in the years prior to the recent global financial crisis. Both net foreign direct (FDI) investment and net portfolio investment inflows rose to a larger extent. Between 2002 and 2007, net FDI inflows grew constantly and peaked at 20 billion USD level. On the other hand, net portfolio inflows continued to fluctuate even tough these inflows attained an average over 5 billion USD each year during the same period.

Lately, with the beginning of the global financial crisis, the outlook of the economy changed somewhat as Turkey suffered from its spillover effects like most emerging market economies. Nevertheless, the Turkish economy has been one of the first to recover from the crisis in 2010. In the meantime, the inflation rate was kept in single digits despite the external shocks experienced during 2008-2010. On the other hand, keeping inflation low had some contractionary effects on economic growth during 2008-2009. Turkish GDP initially stabilized in 2008 and shrank later in 2009. The slowdown of the economy did not long last and Turkish economy recovered starting from the last quarter of 2009 and achieved a high growth of around 9 percent in 2010.

These growth prospects have been accompanied by fluctuating capital flows. While FDI continued to remain strong with 15.7 billion USD in 2008 and 6.7 billion USD in 2009, net portfolio outflows amounted to roughly US$10 billion just in three quarters of 2008 Q3-2009Q1. This led to depreciation pressures and higher volatility in the foreign exchange market. However, even in the event of such large capital outflows, CBRT did not undertake foreign exchange intervention measures to limit pressures on domestic liquidity. As a result, the rapid reserve accumulation of 2002- 2006 has slowed down after 2006 and Central Bank reserves reached a total of 70 billion USD in 2009 by increasing 10 billion USD since 2006. In contrast, capital inflows and net portfolio investments have gone up by US $15 billion just in 2010, boosting foreign exchange reserves another 10 billion USD during the year.

3.3 Data

Our approach to of constructing the trilemma indices mainly follows Aizenman, Chinn and Ito (2008, 2010) in terms. Hence, we initially construct indices for each of the three policy objectives of the trilemma: monetary independence, exchange rate stability and capital account openness (or financial integration). Nevertheless, our study has two departures from Aizenman, Chinn and Ito (ACI). First of all, instead of using cross-country data and time-averages of annual data, we use data for a single country, Turkey. Secondly, we use a different measure of capital account openness than the preceding authors, this last departure being dictated by the needs of a time series analysis of trilemma policy stances. In this respect, our study follows Hutchison, Sengupta and Singh (2010).

The data we employ, being quarterly, is higher in frequency than employed by ACI, and subject to substantial time variation. Indeed, we find that there is variation in the results across three sub-periods into which we divide our sample. The division into sub-periods is determined by changes in the institutional regime that was in force in the different sub-periods.

The main data constraint in this work is related with the capital openness. Firstly, quarterly data for capital flows is available starting from 1992. Nevertheless, since we describe capital openness as a ratio over GDP in the next subsection, our data extends from 1998Q1 to 2010Q4, covering 52 quarters. The reason for losing the period of 1992 to 1998 is mainly because the up-to-date GDP series for Turkey starts from 1998. However, the previous series covering the period of 1987 to 2007 is also used for robustness and cross checks.

For composing the trilemma indices, we obtain quarterly data on GDP, exchange rate, interest rates and capital flows from the CBRT website. We use the nominal Lira-to-US dollar exchange rate series to construct a quarterly index of exchange rate stability, as described in the next subsection. For calculating the monetary independence index, we use interbank overnight interest rates for Turkey and for the US. For the latter, we use Federal fund rates which we obtain from Federal Reserve System database. The correlations between these two are used to create a quarterly index of monetary independence, again as described in the next subsection. To examine the impact of international reserves, we again use data from the CBRT website where the data is weekly. We average reserves figures for each quarter to construct a quarterly series for international reserves of Turkey[27].

The policy outcomes we examine are growth volatility, inflation and inflation volatility. For growth volatility, we employ the industrial production index (IPI) as output data is not available for sufficiently high frequencies to allow construction of a quarterly growth volatility series[28]. For two other measures, we use the monthly CPI index, again from the CBRT database. The inflation series is quarterly averages of monthly inflation figures. For inflation and growth volatility series, the standard deviation of two sequential quarter's inflation and IPI series are calculated.

[27]Since reserves are a stock, and GDP is a flow, one can calculate the reserves-to-GDP ratio using quarterly data after annualizing the GDP figure by multiplying it by four. However, this will not change any of our results in our analysis.

[28] Two different industrial production series are used in our regressions to cover the whole period of 1998-2010. The first series lies between 1997-2008 while second one starts from 2005 and continues to up to date.

3.3.2 Construction of Indices

The key constructs for examining the policy configuration with respect to the trilemma are indices of monetary independence (MI), exchange rate stability (ES) and capital account openness (KO). These indices are constructed as follows.

ES Index

Following ACI (2008), we construct this index by calculating the quarterly standard deviations of the change in the log of the Lira-US dollar exchange rate, and the index is then constructed according to the formula below:

$$\frac{0.01}{0.01 + stdev(\Delta(\log(exch\_rate))}$$

Again, the scaling ensures that the index lies between 0 and 1, with the highest value indicating the greatest degree of exchange rate stability. In the calculation of this index, we depart from ACI (2008) by employing daily series in order to be more precise. The evolution of this index for the sample period is shown in Figure 3.3.

MI Index

We again follow Aizenman, Chinn and Ito (2008) in measuring MI as the reciprocal of the correlation of interest rates in the home country (here Turkey) and the base country (here the United States). Quarterly correlations are calculated using daily interest rate data whereas ACI (2008) used monthly interest rates. As mentioned earlier, the interest rates are overnight interbank rates. The formula used for constructing this index is:

$$MI = 1 - \frac{corr(i_H, i_B) - (-1)}{1 - (-1)}$$

The scaling ensures that the index lies between 0 and 1, with the highest value indicating the greatest degree of monetary independence. The plot of the MI index is shown in Figure 3.4.

KO Index

For construction of the KO index, we use simple de facto measure of capital account openness, using the ratio of the sum of inward and outward foreign investment flows to GDP following Huthcison, Sengupta and Singh (2010)[29]. However, a critical point should be noted at this stage is that the KO index is not theoretically constrained to lie between 0 and 1 – the upper bound cannot be imposed. However, for the sample period, it is easily met as shown in Figure 3.5.

3.3.3 Dividing into Sub-periods

We divide the entire period into sub-periods as the period under consideration covers dramatic changes in external conditions and policy stances. Doing so will allow us to see how policy differences affected the trilemma configuration in different sub-periods.

While dividing the whole sample into sub periods, our main focus is the exchange rate policies of Turkey. As described earlier, Turkey switched from the pegged exchange rate regime to floating in the first quarter of 2001. After allowing Turkish currency to float freely after 2001Q1, Turkey experienced the famous concept of fear of floating as Turkey continued to intervene to the foreign exchange markets. This continued till 2006Q2 as shown in Table 3.1. Hence, in the period of 2001Q2 to 2006Q2, CBRT has intervened to the foreign exchange market from time to time. After 2006Q2, Turkey

[29] Aizenman, Chinn and Ito use the Chinn-Ito index.

has not performed any interventions in the foreign exchange market. Accordingly, we choose 2001Q2 and 2006Q2 as critical episodes in splitting the whole period into three.

3.4 In Search of Consistent Contribution Estimates

Our methodology to analyzing Turkey's macroeconomic policies in the context of trilemma trade-offs again follows Aizenman, Chinn and Ito (2008, 2010) but with cross-checks by employing other econometric techniques, to explore the robustness of particular estimation methods. We initially estimate a model for the trilemma configuration that is revealed by the data, by regressing a constant on the three indices. We replicate this with other techniques in order to reach a method in which specification is attained correctly. Thus, apart from OLS, we employ different techniques, both linear and non-linear, in order to obtain consistent index contribution figures. Finally, we also examine the role of international reserves accumulation in affecting policy outcomes, through the interaction of reserves with the trilemma configuration.

3.4.1 Methodology

Following ACI (2008), we initially test the validity of this possible trilemma in a linear tradeoff for each sub-period. This reduces to examining the goodness of fit of this linear regression[30]:

$$2 = aMI_t + bES_t + cKO_t + \varepsilon_t \qquad \textbf{(1)}$$

[30] For this regression, we detect heteroskedasticity and autocorrelation in our robustness checks in several cases, even though the significance of our coefficients is affected only in a limited manner. Hence, we employ Newey-West standard errors in our regressions in order to be more precise and consistent in the presence of both heteroskedasticity and autocorrelation.

The contributions obtained from equation (1) for the subsamples are reported in Table 3.2. This table reports the means, coefficients and contributions of the three indices for all three periods and R-squared figures. The overall fit is extremely good, reflected in the very high R-squared numbers.

Furthermore, we also cross-examine the robustness of the contribution estimates as this analysis may possess specification problems. This is because Ramsey and Alexander (1984) showed that the **Ramsey Regression Equation Specification Error Test (**RESET) test could detect specification error in an equation which nonetheless gave satisfactory values for traditional test criteria (goodness of fit, high t-ratios etc). Thus, as a next step in our analysis, we test our OLS analysis by performing the Ramsey RESET test, in order to see whether specification errors exist or not.

3.4.2 Testing the Specification: Ramsey RESET Test

The Ramsey RESET test developed by Ramsey (1969) is a general specification test for the linear regression models. More specifically, it tests whether non-linear combinations of the explanatory variables have any power in explaining the endogenous variable. Technically, Ramsey (1969) proposed to fit the initial regression and generate new regressors that are functions of fitted values $\mathbf{y=x\beta}$, such as $\mathbf{w= (x\beta)^2, (x\beta)^3\ldots (x\beta)^n}$. The next step in the test is to estimate the model $\mathbf{y=x\beta+w\gamma+u}$ and the test the nonlinearity as the Wald test of *n* restrictions, H_o: $\gamma=0$ against H_a: $\gamma\neq0$. Typically a low value of 2 (or 3) is used.

In our trilemma regression, Ramsey RESET test indicates the possibility of specification error despite the attractive results. Accordingly, the OLS analysis may have at least one of the following types of specification errors:

- Omitted variables
- Incorrect functional form
- Endogeneity problem.

In all these cases, the OLS estimates become both biased and inconsistent. Below, we discuss and attempt to overcome those different types of specification errors.

3.4.3 First Potential Problem: Omitted Variables

This problem occurs if the OLS analysis does not include all relevant variables. However, as we are constrained with three indices theoretically, we can not add any other variables into our regression. On the other hand, we can still *add* quadratic and/or cubic (or even higher power) terms of the same indices into our regression equation. This modification is therefore a special case of the incorrect functional form issue. Adding these new terms does not violate linearity in the parameters, although the expression on the right hand side becomes non-linear in the independent variables. In the rest of the paper, we name this new OLS regression obtained by adding new terms to our standard OLS as "***enhanced OLS***".

3.4.4 Second Potential Problem: Incorrect Functional Form

Regarding the incorrect functional form problem, the linearity assumption of OLS might have caused the specification error. To address this issue, some or all of the variables should be transformed to logs, powers, reciprocals, or in some other way. Hence, there is a wide range of alternatives in the form of ***non-linear least squares***. However, as none of the

non-linear specifications we attempt give reasonable results, we do not report these analyses performed in the context of non-linear least squares.

3.4.5 Third Potential Problem: Endogeneity

Endogeneity, correlation between the disturbance and explanatory variables, can arise as a result of omitted variables and measurement error.[31] Given that we deal with the omitted variables case in the previous section, here we focus on measurement error. Next, we also allow our regressions contain autocorrelated errors in order to eliminate inefficiency, if any.

Measurement Error:

Measurement error occurs when the variable that theory tells us belongs in the relationship cannot be precisely measured in the available data. We are faced, therefore, with using an approximate measure, including some error of measurement. The standard approach to deal with measurement error is to estimate the equation using *instrumental variables* regression. The idea behind this approach is to find a set of variables, termed *instruments*, that are both correlated with the explanatory variables in the equation, and uncorrelated with the disturbances. These instruments are used to eliminate the correlation between right-hand side variables and the disturbances.

In our analysis, we treat the capital openness index as the variable that is measured with error. This is due to the fact that we cannot observe capital openness precisely.[32] "Net

[31] Simultaneity and sample selection errors and autoregression with autocorrelated errors are other problems that give rise to endogeneity.

[32] Regarding other two indices, we assume no measurement errors as exact values of both interest rates and exchange rates are observable.

errors and omissions" item in Turkey's balance of payments amounts to non-negligible figures. Furthermore, for our time series data, we can not calculate capital openness according to the commonly used measures. Hence, our capital openness definition (of the ratio of the sum of inward and outward foreign investment flows to GDP) is likely to depart from its true value and we need to use an instrumental variable instead of the capital openness index.

As measurement error of capital openness has no structure in our case meaning that it is independent of the true capital openness (named as "classical measurement error"), use of lagged variables as instruments becomes legitimate. In line with this, we employ lagged capital openness index as the instrumental variable in a two stage least squares (TSLS) analysis, which is a special case of instrumental variables regression.

Autocorrelated Errors:

A common finding in time series regressions is that the residuals are correlated with their own lagged values as in our case. Unless there are also lagged dependent variables on the RHS of the regressions, autocorrelation itself does not bias the OLS coefficient estimates but they become inefficient as the standard errors tend to be underestimated. Hence, in order to attain efficiency, we replicate all our analyses with auto correlated errors of first-order lags, AR(1), as it is the simplest type of serial correlation.

3.5 Findings

In this section we assess different techniques discussed so far; OLS, enhanced OLS, TSLS, enhanced TSLS and same models with autocorrelated errors. In our assessment, our guide

is the Ramsey RESET test. We employ this test in order to evaluate specifications of each model for different sub-periods in which we determine our confidence level as 95 percent.

First, we start with OLS and its autocorrelated error version. We find out that Ramsey RESET test rejects both of these specifications for any sub-periods. As they are misspecified, our contribution figures are biased and inconsistent. This is a crucial finding as it indicates that it is misleading to apply the ACI approach for Turkey.

Next, we investigate TSLS and its autocorrelated error version. TSLS regression itself is confirmed by Ramsey RESET test for the first period of 1998Q1-2001Q1 while its first-order autocorrelated error version is confirmed for the last period of 2006Q3-2010Q4. For the middle period of 2001Q2-2006Q2 and for the whole period of 1998Q1-2010Q4, Ramsey RESET test still indicates a specification error.

As none of these specifications are verified by Ramsey RESET test, these specifications do not constitute a common ground for making comparisons. In line with this, we enhance our trilemma regression in two dimensions in order to obtain a common specification of all sub-periods that is suitable for the Ramsey RESET test. First, we add extra terms to the trilemma regression. Secondly, we examine higher degree of autocorrelation in our regressions. Below; we discuss these two dimensions in more detail.

3.5.1 Obtaining Enhanced Models

In the context of the first dimension mentioned above, our search over possible specifications results in a specification which contains both squared and cubic terms of the trilemma indices. With such a specification, we follow the same steps as before and obtain more satisfactory results in terms of suitability of their specifications. Hence, results of Ramsey RESET test obtained from enhanced models differ from the previous models. In

fact, we are able to obtain the verification of Ramsey RESET test for all three sub-periods for the regression of enhanced TSLS with AR(1) errors. Similarly, enhanced OLS with AR(1) errors regression is verified for the first and third periods.[33] Regarding the regressions without autocorrelated errors, namely enhanced OLS and enhanced TSLS, our specifications are again rejected by the Ramsey RESET test.[34]

3.5.2 Higher order autocorrelation

With this second dimension, we allow model errors to be higher order autocorrelated and compare such specifications with our first order autocorrelated model. As autocorrelated errors do not lead to bias, only to inefficiency, this step is only to check robustness of our results and it is supportive to our earlier analysis. In this context, we run our basic OLS and TSLS regressions including AR(2), AR(3), etc. terms. An important point here is that allowing higher order autocorrelation decreases the reliability of the regressions given the low degrees of freedom especially for the enhanced models. Additionally, in most cases, regressions with first-order autocorrelation have the most suitable results with regard to the Ramsey RESET test. From this perspective, the only worthy specification is the TSLS regression that includes both first and second order autocorrelated errors. For this regression, the Ramsey RESET test does not reject its specification at the 95 percent level for periods of 1998Q1-2001Q1 and 2006Q3-2010Q4 and at the 99 percent level for 2001Q2-2006Q2.

[33] For 2001Q2-2006Q2, Ramsey RESET test rejects this specification at 95 percent confidence level but does not reject it at 99 percent confidence level.

[34] Third period of 2006Q2 -2010Q4 for enhanced TSLS regression is the only exception.

3.5.3 Assessment

In Table 3.3 and 3.4, we report contributions calculated from all the regressions mentioned earlier. According to these contribution figures, we have 3 groups of results. The first group consists of OLS and OLS with first-order autocorrelated errors which are misspecified in general according to Ramsey RESET test. According to the contributions of this group, exchange rate stability is the highest contributor among the three trilemma indices. Thus, stabilizing the exchange rate has been crucial for policy makers throughout the entire period. On the other hand, the contribution of exchange rate stability has decreased in the last period, which was compensated by increased monetary independence and capital openness reflecting the trilemma trade-off. However, contributions of monetary independence and capital openness are still limited in comparison to the contribution of exchange rate stability.

In the second group of results, we mention contributions obtained from the regressions of TSLS, TSLS with AR(1) and TSLS with both AR(1) and AR(2) errors. For the period of 1998Q1-2001Q1, this group of results is similar to the results of the first group confirming the high contribution of exchange rate stability. During the subsequent periods, this group of results indicates a very high contribution level of capital openness whereas in some cases it surpasses even the contribution of exchange rate stability. However, this finding should be considered with caution as estimates of TSLS might be imprecise because of instrumenting which makes the outcome highly sensitive to the chosen instrumental variable.

In the last group, we mention enhanced OLS, enhanced OLS with AR(1) errors and enhanced TSLS with AR(1) errors. These regressions indicate that in the first two periods,

during 1998Q1-2006Q2, Turkey's macroeconomic policies are driven only by exchange rate stability while capital openness and monetary independence have no contribution at all. In the last period of 2006Q3-2010Q4, capital openness and monetary independence gain very limited roles although exchange rate stability still continues to dominate. In line with this, changes in contributions of the indices between periods are very small for these regressions and differences between sub-periods are negligible. This is in fact a disadvantage of adding too many extra terms into the regression as some of the coefficients become insignificant and contribution figures become imprecise.

According to the results of all three groups, exchange rate stability being the highest contributor among the three trilemma indices especially in the first and second periods is in line with the Turkish macroeconomic policies experiencing a pegged exchange rate regime and the concept of fear of floating respectively. Nonetheless, apart from this common finding, the regression techniques considered in this section differ from each other with regard to their contribution figures. Hence, we continue our examination of trilemma contributions with alternative and more general techniques.

3.6. Introducing Alternative Techniques

In this section, we employ alternative techniques in order to check how consistent our results are in comparison to the alternative techniques. These new techniques we employ are Generalized Method of Moments (GMM) and State Space Modeling i.e. Kalman filter. In choosing these techniques, we aim to eliminate potential misspecification problems by taking our methodology into a more general framework in which OLS remains as a particular case in the analysis.

3.6.1. General Method of Moments (GMM)

We carry out a GMM analysis as the first alternative method in which we use MI, ES and KO indices themselves linearly and we employ their lagged values as instruments. This method requires that a certain number of moment conditions were specified for the model. These moment conditions are functions of the model parameters and the data, such that their expectation is zero at the true values of the parameters. The GMM method then minimizes a certain norm of the sample averages of the moment conditions. The main advantage of employing GMM is that it is based on minimal assumptions; requires only a partial specification of the model with fewer restrictions on the error structure. Thus, the GMM estimators don't use any extra information aside from that contained in the moment conditions and they are known to be consistent, asymptotically normal, and efficient in the class of all estimators.

The starting point of GMM estimation is a theoretical relation that the parameters should satisfy. These theoretical relationships are usually orthogonality conditions between some function of the parameters and a set of instrumental variables. The GMM estimator selects parameter estimates so that the sample correlations between the instrument and the function are as close to zero as possible. Accordingly, the ordinary least squares estimator can be viewed as a GMM estimator based upon the conditions that each of the right-hand variables is uncorrelated with the residual.

We perform our GMM analysis with *Time series (HAC)* and *Prewhitening* options. The former option enables GMM estimates to become robust to heteroskedasticity and autocorrelation of unknown form. With the second option, we "soak up" the correlation in the moment conditions by running a preliminary VAR(1) prior to estimation.

3.6.2 State Space Modelling: The Kalman Filter

State space modeling is a general and powerful representation. A wide range of time series models, including the classical linear regression model and ARIMA models, can be written and estimated as special cases of a state space specification. One of the main benefits of representing a dynamic system in state space form is that it allows unobserved variables to be incorporated into, and estimated along with, the observable model. Second advantage of employing state space models is its flexibility. They allow for known changes in the structure of the system.

In the context of state-space specifications; we specify our measurement and transition equations as below. The measurement equation shows the evolution of the observed variables described as a function of the unobserved variables. The transition equation shows how the unobserved variables evolve.

Measurement equation:

$$2 = C(1)_t * MI_t + C(2)_t * ES_t + C(3)_t * KO_t$$

According to this measurement equation, we treat the trilemma regression holds exactly as predicted by the theory. By eliminating the error term from the regression in such a way, we do not need to concern about the theoretical predictions regarding the error structure.

Transition equations:

$C(1)_t = \rho_1 C(1)_{t-1} + v_t$,

$C(2)_t = \rho_2 C(2)_{t-1} + \eta_t$ and $C(3)_t = \rho_3 C(3)_{t-1} + \varepsilon_t$ where v, η, ε are assumed to drawn from zero mean and normal distribution.

Regarding the transition equations, we treat the parameters of the trilemma indices as unobserved and allow them to vary over time, evolving based on the transition of the economic state. This general representation constitutes our main Kalman filter approach. However, as a second version of the same representation, we follow Athans (1974) by specifying coefficients, ρ_1, ρ_2, ρ_3, all equal to one. Main characteristic of this second version is that eliminating error terms from the transition equations produces the standard OLS estimates. By keeping these error terms in the equations but restricting the coefficients to one, we expect the second version to produce estimates between OLS and first version estimates.

Next, we analyze this model by using the Kalman filter first developed by Kalman (1960). In Statistics and Economics, a filter is simply a term used to describe an algorithm that allows recursive estimation of unobserved, time varying parameters or variables in the system. Nevertheless, the Kalman filter is different from forecasting in that forecasts are made for future, whereas filtering obtains estimates of unobservables for the same time period. The basic idea behind this filter is to arrive at a conditional density function of the unobservables using Bayes' Theorem together with the functional form of its relationship with observables and an equation of motion. The filter uses the current observation to predict the next period's value of unobservable and then uses the realisation of next period to update that forecast. Similarly, all available data can also be used over the forecast sample by Kalman filtering through the entire data set, called as *smoothed estimate*.

The linear Kalman filter is optimal, i.e. Minimum Mean Squared Error estimator if the observed variable and the noise are jointly Gaussian. Additionally, as Watson (1983)

argues Kalman filter can always provide optimal estimates whenever OLS does and is also capable of doing so even OLS does not.

3.6.3 Results

Table 3.5 presents the contributions obtained from GMM and Kalman filter analyses. These contribution figures, on one hand, have similarities with contribution figures of previous techniques. They all agree that stabilizing exchange rate plays a crucial role for policy makers throughout the entire period although its contribution has diminished. On the other hand, contributions of GMM and Kalman filter differ from the contributions of the previous techniques with regard to the intensity of this reduction in the contribution of exchange rate stability and how this reduction is compensated.

Starting with GMM, this approach is different from others mainly because it assigns no role for capital openness (i.e. assigns negative figures) especially in the second and third sub-periods. This is exactly opposite to what TSLS implies. Instead, the GMM approach implies that monetary independence has an increasing contribution in Turkey's macroeconomic policies. Hence, it indicates that the trade off is between monetary independence and capital openness rather than monetary independence and exchange rate stability during 2001Q2-2010Q4. In fact, such high negative contribution figures of capital openness are suspicious hence related findings of GMM are somewhat contrary to what happened in Turkey. Nevertheless, more general methods such as GMM may be again introducing other problems such as imprecise estimates due to instrumenting. Similarly, we experience such high negative contribution figures in the TSLS analysis which also uses instrumental variables for analyzing.

As the second alternative, Kalman filter contributions of both versions exhibit balanced trade-offs between the trilemma indices. The leading role of exchange rate stability observed in the first period declines in the next sub-periods. This decreasing tendency of exchange rate stability is compensated by mainly increasing tendency of monetary independence whereas capital openness has a stable contribution path according to the first version. In the second version, capital openness fluctuates in a similar fashion to OLS as expected.

Hence, there are a lot of different estimates obtained from different techniques and they give different contribution figures. Among all these results, behavior of the Turkish economy is most consistent with the contributions of Kalman filter approach in particular to the first version which imposes fewer restrictions.

3.7. Macroeconomic Impacts of Trilemma Policy Configuration

In this section, we analyze how the trilemma policy configuration and its interaction with the level of reserves affect macroeconomic variables, namely growth volatility, inflation and inflation volatility. Hence, following ACI (2008), the basic model we estimate is given by:

$$y_t = \alpha_0 + \alpha_1 TLM_t + \alpha_2 TR_t + \alpha_3 (TLM_t x TR_t) + \varepsilon_t \qquad \textbf{(2)}$$

y_t is the measure for macro economic variables, TLM_t is the trilemma index, namely, *MI*, *ES*, and *KO*, included individually and TR_t is the level of international reserves (excluding gold) as a ratio to GDP. (TLM_t x TR_t) is an interaction term between the trilemma index and the level of international reserves. Regressions were estimated using two indices at a

time, given the collinearity between the three trilemma indices. Additionally, we do not include any other controls given the limited degrees of freedom in the subsamples.

3.7.1 Findings

Results of all regressions are presented in Table 3.6-3.14. Clearly, effects of the trilemma indices examined below differ with regards to each sub-period. Besides, in several cases, it is not feasible to reach a conclusion as coefficients of the trilemma indices are insignificant and change direction. However, we can still sum up the effects of these indices for the sub-periods where they are statistically significant and robust. These results are analyzed in detail in the next subsections.

Regarding the impact of reserve accumulation, its direct effect on these economic variables is usually insignificant and somewhat mixed. On the other hand, it is common for all sub-periods that; when reserves are introduced into the regressions as interaction terms with indices, the interaction terms of the trilemma indices with the reserves-GDP ratio are of the opposite signs.[35] As we suspect that international reserves may complement or substitute for other policy stances, we are particularly interested in the effect of those interaction terms. Thus, we can conclude for Turkey that *the reserve accumulation relaxes the impact of the Turkish trilemma policy stance for all macroeconomic variables***.** Besides, adding the interaction terms to our regressions, have impacts on the effects of the trilemma indices either by changing their direction or statistically losing their power.

[35] Only in one case at Table 10, coefficients of the trilemma index and its related interaction term have same sign. However, in this case, both terms are highly insignificant.

Growth Volatility:

Outcomes of our analysis for growth volatility are demonstrated in Table 3.6, 3.7 and 3.8 for each sub-period. Starting with the period of 1998Q1-2001Q1, we obtain the most significant results in the middle section of Table 3.6 where we regress growth volatility on the ES and KO indices. In this section, the adjusted R square statistics ranges from 40 percent to 55 percent. Table 3.6 indicates that ES index is highly significant with a diminishing effect on growth volatility. Other trilemma indices, namely KO and MI indices are statistically insignificant in this time span.[36]

For the period of 2001Q2-2006Q2, none of the trilemma indices seem to matter for the volatility of growth whereas the adjusted R square takes negative values in most cases. The only significant variable (except the intercept) in these tables is the ratio of reserves to GDP having a positive sign as shown in Table 3.7. This result implies a positive association between reserves and growth volatility for this period.

For 2006Q3-2010Q4, most significant results are obtained in the last section of Table 3.8 where we regress growth volatility on the MI and KO indices. Both KO and MI indices have significant lowering effects on growth volatility whereas the effect of former index is stronger. Likewise, the ES index is weakly but again negatively associated with growth volatility, as shown in other sections of the same table.

Change in Inflation:

Table 3.9, 3.10 and 3.11 present regression results of inflation in which change in inflation is employed as a dependent variable. This is mainly due to the stationary problems of

[36] Excluding the case where KO index is significant and has a negative effect on growth volatility. However, this negative effect fades away in other cases.

inflation data.[37] In the period of 1998Q1-2001Q1 and 2001Q2-2006Q2; all indices have insignificant effects on inflation change and adjusted R square statistics are mostly negative as shown in Table 3.9 and 3.10.

Among all three trilemma indices, the ES index having no significant effects on the change of inflation is critical as this result implies that disinflation programme based on exchange rate stabilization implemented in the period of 1998Q1-2001Q1 has in fact no significant contribution[38].

On the other hand, ES index becomes highly significant during 2006Q3-2010Q4 with a negative effect on the change of inflation. Similarly, MI index also gains a significant and negative role while KO index remains to be insignificant in the same period. Regression outcomes of this period are provided in Table 3.11.

Inflation Volatility:

Results regarding regressions employing inflation volatility as a dependent variable are reported in Table 3.12, 3.13 and 3.14. For the first period of 1998Q1-2001Q1, significant results are attained only in the sections where KO index is employed. These results indicate that KO index has an increasing effect on inflation volatility. Effect of ES index on inflation volatility is again insignificant although it appears to have a negative effect. This slight and insignificant effect of ES index on inflation volatility is consistent with the earlier result of the same index having insignificant influence on the change of inflation. The patterns with respect to monetary independence are also highly insignificant.

[37] All variables are tested for stationary with both ADF and KPSS techniques except the indices taking values between zero and one. Inflation series is the only variable found to be non-stationary at the level.

[38] When same regression is performed with the level of inflation (hence, neglecting the stationary issues), ES index becomes highly significant.

During 2001Q2-2006Q2, the effect of KO index on inflation volatility interchanges from the previous period. It acquires a diminishing impact on inflation volatility in this period. Additionally, MI and ES indices become significant during this period with negative and positive effects respectively on inflation volatility. Results for this period are shown in Table 3.13.

Lastly, Table 3.14 presents the findings of the regressions for the last period of 2006Q3-2010Q4. As the table indicates, the most significant variable for the term is reserves to GDP ratio. This variable has a positive impact on inflation volatility in this period. Apart from reserves, capital openness is the most noteworthy trilemma index among others taking somewhat significant values. Similar to the second period, this index has a declining effect on inflation volatility but it is stronger in this period[39]. Thus, effect of KO index on inflation volatility turns negative in 2001 Q2-2010Q4 while it was positive in the period of 1998Q1 -2001Q1.

3.8 Conclusion

In this paper we investigate Turkey's macroeconomic policies of the last two decades in the context of trilemma trade-offs. In this investigation, we also try to get an answer to the question whether there is a role for accumulating international reserves for Turkey. In line with this aim, we start with searching the point Turkey stands with respect to the trilemma triangle.

[39] When regressed with the interaction term, the coefficient of MI index becomes positive whereas the coefficient of interaction term is negative. Yet, the net effect is still negative.

Our methodology starts with following ACI (2008) approach. Using quarterly data from 1998Q1 to 2010Q4, we construct trilemma indices for each of the three policy objectives: monetary independence, exchange rate stability and capital account openness. Considering Turkish macroeconomic policies, we split the whole period into three sub-periods to explore: 1998Q1-2001Q1, 2001Q2-2006Q2 and 2006Q3 -2010Q4.

Next, we employ different regression techniques (TSLS, GMM, Kalman filtering and adding higher power terms into the regressions) to examine trilemma trade-offs in addition to ACI approach of OLS estimation. At first cut, the results of our empirical analysis indicate that trilemma trade-offs are binding for Turkey and Turkish macroeconomic policies have been in a transformation with respect to trilemma trade-offs in particular from 1998Q1-2001Q1 to 2001Q2-2006Q2. The most remarkable change is the decrease of exchange rate stability contribution although it dominates others in the trilemma configuration throughout the entire period. Naturally, this reduction on exchange rate stability has accompanied by the increases in other two indices, namely monetary policy independence and capital openness. Thus, monetary policy independence and capital openness become a part of the Turkish macroeconomic policies starting from 2001Q2-2006Q2.

Nevertheless, there is no consensus among different techniques with regard to how monetary policy independence and capital openness contribute to the economy in the later periods. While TSLS favors capital openness and attributes all the compensation to this index, GMM does the same for monetary independence. OLS and Kalman filter exhibit balanced increases in these two indices. Regarding the specifications that employ higher power terms of indices, the decrease in exchange rate stability is so limited that neither

capital openness nor monetary independence demonstrates significant increases in the trilemma configuration. Among all, the Kalman filter approach has the most consistent contribution figures with the behaviour of the economy. According to this approach, reduction on exchange rate stability is compensated mainly by monetary independence especially in the third sub-period.

We also show that this transformation among the trilemma indices has influenced the economic outcomes of growth volatility, inflation and inflation volatility. Obviously, these effects of the trilemma indices and their significance levels on economic variables differ with regards to each sub-period. Yet, one can summarize effects of each trilemma indices on examined economic variables that are common in all sub-periods. Accordingly, monetary independence has a diminishing effect both on inflation change and inflation volatility throughout 1998-2010 while exchange rate stability has the same decreasing effect on growth volatility. Regarding capital openness, the patterns of this index are less straightforward for all economic variables as they differ from period to period.

Finally, we investigate the role played by international reserves in mitigating the intensity of the trilemma trade-offs faced by Turkey. Our examination verify that indeed there is a significant role for international reserves in softening Turkey's trilemma trade-offs. Such reserve management not only contributes to actively managing the exchange rate and limiting its volatility but also helps to regain control over monetary policy even in the face of capital inflows.

Table 3-1 Direct Foreign Exchange Interventions under the Floating Exchange Rate Regime

Date	Amount Purchased	Amount Sold
July 2002		3
December 2002	16	9
May 2003	579	
June 2003	566	
July 2003	938	
September 2003	2.146	
February 2004	1.283	
May 2004		9
January 2005	1.347	
March 2005	2.361	
June 2005	2.056	
July 2005	2.366	
October 2005	3.271	
November 2005	3.164	
February 2006	5.441	
June 2006		2.105
TOTAL	**25.534**	**2.126**

Table 3-2 Trilemma Indices, OLS Coefficients and Contribution Estimates

		1998Q1-2001Q1	2001Q2-06Q2	2006Q3-10Q4
	MI	0.492	0.529	0.473
MEANS	**ES**	0.885	0.599	0.641
	KO	0.064	0.062	0.068
	MI	0.061	0.0592*	0.813**
COEFF.	**ES**	2.034***	2.190***	2.262***
	KO	2.596**	4.790	1.760
	MI	0.030	0.313	0.385
CONTRIB.	**ES**	1.800	1.311	1.450
	KO	0.166	0.298	0.120
Adj. R Square		**0.997**	**0.955**	**0.971**

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

Table 3-3 Contribution Estimates of OLS and TSLS

		OLS	OLS; AR(1)	TSLS	TSLS; AR(1)	TSLS; AR(1)&AR(2)
	MI	0.030	0.026	0.051	0.048	0.070
1998Q1-	**ES**	1.800	2.126	1.561	1.609	1.859
2001Q1	**KO**	0.166	0.016	0.383	0.340	0.085
	MI	0.313	0.313	-0.150	0.130	0.027
2001Q2-	**ES**	1.311	1.370	0.382	0.961	0.629
2006Q2	**KO**	0.298	0.272	1.733	0.871	1.306
	MI	0.385	0.362	0.366	0.175	0.252
2006Q3-	**ES**	1.450	1.415	1.179	-0.345	0.545
2010Q4	**KO**	0.120	0.160	0.412	2.217	1.128

Table 3-4 Contribution Estimates of Enhanced OLS and TSLS

		Enhanced OLS	Enhanced OLS;AR(1) errors	Enhanced TSLS	Enhanced TSLS; AR(1) errors
	MI	0.000	0.000	-0.027	-0.011
1998Q1-	**ES**	2.001	2.000	2.028	2.011
2001Q1	**KO**	-0.001	0.000	0.000	0.000
	MI	-0.115	-0.126	-0.232	-0.102
2001Q2-	**ES**	2.061	2.164	1.544	2.165
2006Q2	**KO**	0.075	-0.007	0.778	-0.035
	MI	0.051	0.044	-0.041	0.036
2006Q3-	**ES**	1.871	1.917	1.160	1.918
2010Q4	**KO**	0.071	0.026	0.864	0.030

Table 3-5 Contribution Estimates of GMM and Kalman Filter

		GMM	Kalman Filter 1st Version	Kalman Filter 2nd Version
	MI	0.175	-0.046	-0.097
1998Q1-	**ES**	1.515	1.611	1.981
2001Q1	**KO**	0.318	0.434	0.116
	MI	1.116	0.068	0.282
2001Q2-	**ES**	1.462	1.504	1.340
2006Q2	**KO**	-0.557	0.428	0.377
	MI	0.705	0.409	0.318
2006Q3-	**ES**	1.627	1.150	1.435
2010Q4	**KO**	-0.326	0.441	0.246

Table 3-6 Growth Volatility, 1998Q1-2001Q1

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	29.71***	4.83	32.00***	7.08	72.92***	10.92	73.53	117.01	67.82	93.40
MI	6.06	3.51	4.74	3.10	-76.35**	23.76	3.72	5.06	-76.76**	30.08
ES	-30.90***	5.08	-30.06***	4.91	-30.45***	4.97	-74.51	123.77	-24.69	110.04
Res/GDP			-6.72	11.58	-120.28***	34.96	-124.01	332.84	-105.85	267.52
MI*Res					228.71**	77.09			230.25*	100.60
ES*Res							127.14	358.22	-16.47	320.79
Adj. R^2	**0.41**		**0.36**		**0.48**		**0.29**		**0.41**	**0.41**
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	37.38***	6.48	49.61***	9.48	39.67	10.11	114.70	76.74	68.23	83.94
KO	-21.95	16.52	-37.14**	15.74	232.63	119.74	-36.85	15.94	216.26	136.66
ES	-34.62***	6.79	-39.24***	6.59	-47.21	7.39	-110.43	82.09	-77.29	88.30
Res/GDP			-20.16	14.25	29.33	28.72	-204.24	211.75	-52.73	252.03
KO*Res					-798.58	351.33			-749.74	401.45
ES*Res							201.23	228.36	86.39	264.47
Adj. R^2	**0.40**		**0.49**		**0.55**		**0.45**		**0.49**	**0.40**
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	3.30	3.41	7.97	13.54	14.20	23.74	47.58	25.85	74.52	44.00
KO	17.75	24.91	11.43	35.98	-74.08	326.64	4.23	40.98	-220.11	414.88
MI	1.85	5.04	-0.23	6.92	-0.86	6.79	-76.46*	35.77	-98.75*	44.74
Res/GDP			-9.10	26.03	-25.57	64.09	-117.12*	59.55	-189.20	122.61
KO*Res					241.44	979.54			627.97	1214.89
MI*Res							211.77**	89.61	269.14*	126.06
Adj. R^2	**-0.14**		**-0.24**		**-0.38**		**-0.23**		**-0.32**	**-0.14**

Table 3-7 Growth Volatility, 2001Q2-2006Q2

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	6.00***	1.16	-2.60	4.72	13.10	11.10	-1.85	9.28	10.49	14.13
MI	1.10	2.02	2.365	1.67	-25.52	20.95	2.34	1.74	-26.17	20.75
ES	-3.11	2.78	-2.29	1.90	-4.66	2.86	-3.70	22.20	0.91	20.43
Res/GDP			19.25	12.43	-18.33	27.06	17.30	23.91	-11.51	36.27
MI*Res					74.78	58.21			-14.83	54.72
ES*Res							3.70	59.21	76.77	57.22
Adj. R^2	**-0.06**		**0.00**		**0.00**		**-0.06**		**-0.07**	**-0.06**
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std .Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	5.37***	1.80	0.60	4.69	-3.38	12.41	3.33	8.12	0.70	12.40
KO	22.72	28.06	19.51	27.48	84.71	255.50	19.00	26.86	107.15	279.08
ES	-3.45	3.00	-2.92	2.68	-2.88	2.72	-8.22	22.40	-13.57	19.39
Res/GDP			12.04	9.78	22.18	33.49	4.89	23.02	11.41	33.69
KO*Res					-165.94	671.65			-225.66	730.01
ES*Res							14.03	57.83	28.32	47.30
Adj. R^2	**0.00**		**-0.01**		**-0.07**		**-0.07**		**-0.13**	**0.00**
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std .Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	3.09	1.85	-4.27	4.75	-4.12	12.73	3.52	11.98	5.76	21.17
KO	20.14	29.42	13.12	28.06	10.35	259.58	15.79	29.44	-19.16	278.48
MI	0.71	2.12	2.05	1.86	2.06	1.77	-13.71	22.53	-14.24	24.73
Res/GDP			18.35*	9.92	17.95	33.83	-2.57	31.03	-8.50	56.65
KO*Res					6.97	693.73			88.29	739.58
MI*Res							42.21	60.70	44.01	67.71
Adj. R^2	**-0.04**		**0.00**		**-0.06**		**-0.04**		**-0.10**	

Table 3-8 Growth Volatility, 2006Q3-2010Q4

	(1)		(2)		(3)		(4)		(5)	
	Coefficients	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*
Intercept	11.69***	2.91	11.82***	4.84	24.04	22.50	34.23	25.87	45.99	31.42
MI	-3.42	2.24	-3.40	2.15	-24.70	33.35	-3.71	2.47	-24.66	32.67
ES	-7.43*	4.11	-7.39	4.57	-7.72	4.89	-43.00	40.66	-42.94	41.03
Res/GDP			-0.42	10.93	-29.42	53.54	-56.83	70.44	-84.73	81.17
MI*Res					51.08	77.68			50.22	75.60
ES*Res							89.72	111.04	88.74	112.86
Adj. R^2	**0.00**		**-0.09**		**-0.19**		**-0.18**		**-0.29**	
	Coefficients	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*
Intercept	12.62***	3.02	12.34*	6.78	56.55**	27.63	17.18	25.69	52.87*	27.12
KO	-116.51	85.29	-117.04	88.17	-854.23	488.09	-115.81	95.32	-1416.03	1289.88
ES	-0.90	5.13	-0.95	5.42	2.09	5.22	-8.67	51.69	63.11	104.32
Res/GDP			0.82	15.26	-111.78	66.26	-11.59	70.83	-101.82	65.70
KO*Res					1790.74	1091.76			3132.65	2955.21
ES*Res							19.42	128.49	-147.63	242.52
Adj. R^2	**0.14**		**0.06**		**0.03**		**-0.03**		**-0.04**	
	Coefficients	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*	*Coefficients*	*Std. Error*
Intercept	15.89***	4.33	12.22*	5.94	50.83**	21.00	22.58	26.67	70.22	39.96
KO	-143.57**	55.07	-157.17**	58.93	-783.16**	339.95	-158.12**	61.02	-857.81**	363.81
MI	-4.85*	2.40	-5.49*	3.07	-5.54**	3.13	-23.61	40.87	-31.55	41.99
Res/GDP			11.44	18.25	-84.35	55.38	-13.50	61.39	-131.34	95.73
KO*Res					1548.68	850.52			62.41	98.60
MI*Res							43.50	95.97	1729.99*	899.20
Adj. R^2	**0.28**		**0.24**		**0.22**		**0.17**		**0.16**	

Table 3-9 Change in Inflation, 1998Q1-2001Q2

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	-14.16	28.07	-33.44	32.68	-15.97	49.95	-272.77	331.01	-279.84	366.11
MI	0.89	11.48	11.527	11.10	-24.62	58.51	17.44	17.19	-48.85	92.22
ES	9.57	30.91	6.54	29.94	6.93	32.70	262.67	347.86	305.76	430.82
Res/GDP			47.56	29.21	-2.87	85.99	723.36	979.38	741.25	1080.73
MI*Res					103.31	176.38			192.25	304.58
ES*Res							-732.48	1051.91	-853.61	1288.47
Adj. R^2	-0.21		-0.19		-0.35		-0.29		-0.47	-0.21
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	-8.54	37.78	-32.58	37.78	11.71	43.79	-152.23	205.97	77.62	243.49
KO	-16.54	57.91	11.82	76.19	-1189.41**	486.81	11.55	81.51	-1227.43*	517.98
ES	4.93	40.22	14.57	44.20	50.01*	22.82	145.43	224.93	-19.40	256.49
Res/GDP			38.67	36.33	-181.70	101.48	378.04	641.30	-371.64	726.66
KO*Res					3555.96**	1292.70			3668.92**	1367.61
ES*Res							-371.21	704.01	200.11	772.24
Adj. R^2	-0.20		-0.23		0.14		-0.38		0.00	-0.20
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	-4.39	5.04	-31.69	19.72	31.85	38.22	-17.19	47.83	98.03	124.66
KO	-20.87	39.49	12.45	60.30	-832.15	588.74	9.33	66.44	-976.28	778.14
MI	0.97	11.60	14.21	12.22	5.91	12.90	-14.01	74.11	-104.84	151.57
Res/GDP			52.87	39.81	-113.20	102.99	12.91	122.81	-294.15	331.45
KO*Res					2390.43	1714.04			2764.16	2231.11
MI*Res							79.60	209.57	308.74	400.14
Adj. R^2	-0.20		-0.19		-0.07		-0.35		-0.18	

Table 3-10 Change in Inflation, 2001Q2-2006Q2

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	-2.73	5.74	19.09	19.08	48.41	46.60	-14.53	47.44	12.36	51.49
MI	-5.52	7.65	-8.71	7.76	-60.80	69.56	-7.64	7.03	-69.76	78.25
ES	7.36	10.32	5.28	8.88	0.86	8.37	67.87	97.76	77.90	108.67
Res/GDP			-48.84	42.95	-119.01	107.98	38.13	132.26	-24.64	134.84
MI*Res					139.66	173.48			167.30	202.91
ES*Res							-164.95	266.30	-205.33	298.88
Adj. R^2	**-0.05**		**-0.03**		**-0.08**		**-0.08**		**-0.12**	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	-8.00	5.12	5.90	10.96	65.63	50.23	-52.54	62.62	-10.53	56.74
KO	41.32	62.87	62.87	65.52	-927.47	684.84	61.58	67.48	-1345.76*	751.13
ES	7.00	12.33	5.45	11.95	4.85	10.65	118.85	131.22	204.21	144.09
Res/GDP			-35.08	33.61	-187.26	135.97	117.65	159.76	13.56	157.82
KO*Res					2489.30	1788.56			3602.64	1957.25
ES*Res							-299.96	338.97	-528.09*	381.58
Adj. R^2	**-0.06**		**-0.08**		**-0.02**		**-0.09**		**0.08**	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	-1.15	7.68	25.02	22.49	62.32	47.80	62.19	46.01	117.51*	56.51
KO	56.26	50.56	81.21	57.75	-604.16	581.32	93.97	68.24	-768.92	552.18
MI	-6.80	8.92	-11.57	9.53	-8.64	9.70	-86.76	74.38	-99.66	63.43
Res/GDP			-65.17	51.97	-163.54	124.78	-164.94	115.51	-311.20**	141.73
KO*Res					1725.78	1541.98			2179.88	1437.65
MI*Res							201.32	183.61	245.75	153.41
Adj. R^2	**-0.03**		**0.04**		**0.04**		**0.05**		**0.07**	

Table 3-11 Change in Inflation, 2006Q3-2010Q4

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	6.79***	1.57	9.01***	2.74	-3.97	8.27	-26.68***	5.98	-37.72***	6.61
MI	-2.66**	1.24	-2.34**	0.94	21.02	13.00	-1.76**	0.72	19.65*	9.83
ES	-8.70***	2.10	-8.12**	2.82	-7.64**	2.79	49.45***	10.70	48.50***	10.66
Res/GDP			-6.55	7.22	23.98	20.64	82.87***	15.22	108.72***	16.57
MI*Res					-55.90*	30.58			-51.28**	22.25
ES*Res							-144.51***	26.54	-141.03***	26.85
Adj. R^2	**0.39**		**0.38**		**0.38**		**0.51**		**0.52**	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	4.85***	1.64	9.56***	3.17	5.48	10.67	-27.59***	8.07	-28.93***	8.27
KO	7.68	6.91	13.39	10.08	75.45	158.28	10.02	8.35	37.27	95.41
ES	-8.45***	2.84	-7.82**	3.47	-8.48**	3.77	51.78***	13.64	50.81***	15.27
Res/GDP			-13.16	8.64	-2.69	27.34	81.23***	21.46	84.73***	21.62
KO*Res					-141.91	350.89			-62.23	203.49
ES*Res							-149.82***	34.83	-148.09***	37.59
Adj. R^2	**0.29**		**0.34**		**0.30**		**0.49**		**0.45**	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	0.95	0.96	6.57	3.90	16.03**	6.93	-11.24	11.84	-2.35	16.42
KO	-2.06	6.99	5.76	10.44	-128.59	74.23	2.99	10.25	-89.62	92.70
MI	-1.81	1.96	-1.10	1.56	-1.17	1.40	30.95*	17.06	26.69	18.22
Res/GDP			-15.50	10.14	-37.53**	16.88	28.01	30.07	7.05	40.58
KO*Res					309.72*	174.88			214.32	216.88
MI*Res							-77.06*	41.77	-66.92	44.05
Adj. R^2	**-0.07**		**-0.02**		**-0.04**		**0.01**		**-0.04**	**-0.07**

Table 3-12 Inflation Volatility, 1998Q1-2001Q1

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	20.74	11.97	28.10	17.70	12.73	18.12	305.23**	132.96	309.59	113.61
MI	-1.61	8.14	-5.82	5.41	24.64	21.41	-12.627***	3.78	48.78	42.01
ES	-17.59	14.26	-14.91	15.12	-14.76	16.73	-311.53*	143.03	-349.53	116.57
Res/GDP			-21.58	16.89	21.09	30.35	-804.27*	375.09	-818.12	315.93
MI*Res					-85.92	68.84			-175.65	117.22
ES*Res							848.43*	404.65	957.98	320.22
Adj. R^2	**-0.01**		**0.02**		**-0.08**		**0.22**		**0.21**	**-0.01**
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	4.06	10.18	7.46	18.35	-8.31	16.73	193.44	111.32	129.43	126.47
KO	47.60*	22.81	43.36	25.35	471.76*	224.74	44.19	25.34	392.77	233.61
ES	-3.07	10.86	-4.36	14.23	-17.02*	8.90	-207.72	123.35	-162.08	126.88
Res/GDP			-5.62	15.73	72.96	46.91	-531.49	347.94	-322.84	386.49
KO*Res					-1268.12*	646.84			-1032.53	697.80
ES*Res							574.86	381.91	416.71	388.72
Adj. R^2	**0.22**		**0.15**		**0.28**		**0.22**		**0.28**	**0.22**
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	1.53	4.46	5.37	12.30	-17.77	21.96	-26.51	20.74	-82.88	46.89
KO	50.36*	24.74	45.14	29.58	362.74	240.11	50.94	29.94	520.39**	204.16
MI	-0.74	5.92	-2.46	9.14	-0.12	10.20	58.91	32.47	105.55	60.16
Res/GDP			-7.51	20.49	53.65	50.61	79.45	47.09	230.30*	115.34
KO*Res					-896.82	654.59			-1314.10**	532.68
MI*Res							-170.49*	87.43	-290.55*	151.56
Adj. R^2	**0.22**		**0.15**		**0.19**		**0.12**		**0.31**	**0.22**

Table 3-13 Inflation Volatility, 2001Q2-2006Q2

	(1)		(2)		(3)		(4)		(5)	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	0.53	1.94	-3.40	6.58	9.00	11.23	17.34	19.12	24.88	21.40
MI	-3.85***	1.08	-3.273***	1.08	-25.31	15.88	-3.94***	0.82	-21.36	21.71
ES	7.23*	4.02	7.60*	4.38	5.73	4.63	-31.01	43.68	-28.20	45.11
Res/GDP			8.80	13.62	-20.89	26.02	-44.86	53.46	-62.46	59.22
MI*Res					59.08	43.24			46.91	59.68
ES*Res							101.77	123.41	90.44	129.36
Adj. R^2	**0.15**		**0.11**		**0.08**		**0.10**		**0.06**	**0.15**
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	-0.58	2.34	-7.87	5.62	-13.06	8.92	7.67	20.21	2.49	19.92
KO	-18.50	12.09	-23.41**	10.58	61.62	106.85	-26.30**	11.43	147.06	151.18
ES	7.59*	4.01	8.40*	4.13	8.46*	4.25	-21.74	43.67	-32.26	52.07
Res/GDP			18.41	12.10	31.64	21.87	-22.20	58.15	-9.38	57.81
KO*Res					-216.40	271.00			-443.79	379.43
ES*Res							79.75	124.11	107.86	146.52
Adj. R^2	**0.06**		**0.09**		**0.04**		**0.06**		**0.02**	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*	*Coefficient*	*Standard Error*
Intercept	5.35***	0.90	2.74	5.32	-9.25	8.03	22.64**	9.71	13.26	10.78
KO	-8.87	16.54	-11.35	14.99	209.02*	102.01	-4.52	11.26	141.83*	81.04
MI	-3.74**	1.58	-3.26**	1.48	-4.21**	1.79	-43.51**	19.26	-41.32**	20.05
Res/GDP			6.48	13.77	38.11*	21.48	-46.91*	24.68	-22.10	27.50
KO*Res					-554.89**	246.33			-369.72*	207.84
MI*Res							107.75**	52.26	100.21*	54.18
Adj. R^2	**0.02**		**-0.03**		**-0.06**		**0.02**		**-0.03**	

Table 3-14 Inflation Volatility, 2006Q3-2010Q4

	(1)		(2)		(3)		(4)		(5)	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	1.27**	0.59	-0.25	1.09	-4.96*	2.51	1.80	4.46	-2.64	5.65
MI	-0.07	0.48	-0.29	0.59	8.19*	4.61	-0.33	0.63	8.29	4.68
ES	-0.35	0.81	-0.75	0.87	-0.58	0.77	-4.07	7.40	-4.45	6.74
Res/GDP			4.50	3.35	15.58**	6.38	-0.65	11.85	9.75	14.56
MI*Res					-20.31*	10.98			-20.63*	11.04
ES*Res							8.32	18.89	9.72	17.40
Adj. R^2	**-0.13**		**-0.09**		**-0.10**		**-0.17**		**-0.19**	**-0.13**
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	1.40**	0.52	-0.88	0.85	0.26	2.67	-1.59	4.28	-0.67	4.41
KO	-6.26**	2.73	-9.02**	3.12	-26.28	35.69	-9.08***	3.02	-27.32	39.95
ES	0.06	0.87	-0.24	0.79	-0.06	0.93	0.90	7.28	1.55	7.70
Res/GDP			6.34***	1.75	3.43	6.60	8.14	11.68	5.80	11.92
KO*Res					39.49	77.91			41.65	87.67
ES*Res							-2.87	19.82	-4.02	20.34
Adj. R^2	**0.01**		**0.16**		**0.10**		**0.10**		**0.03**	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	1.48***	0.34	-0.98	0.73	0.40	2.36	-7.91***	2.19	-7.79**	2.94
KO	-6.23**	2.60	-9.66***	2.49	-29.34	29.38	-10.74***	2.30	-11.97	25.74
MI	-0.09	0.52	-0.40	0.59	-0.41	0.59	12.06**	4.39	12.00**	4.49
Res/GDP			6.80***	1.69	3.57	5.32	23.71***	5.55	23.44***	6.90
KO*Res					45.37	65.35			2.85	55.69
MI*Res							-29.96**	10.86	-29.83**	11.05
Adj. R^2	**0.01**		**0.18**		**0.13**		**0.27**		**0.21**	

Figure 3-1 The Trilemma Framework

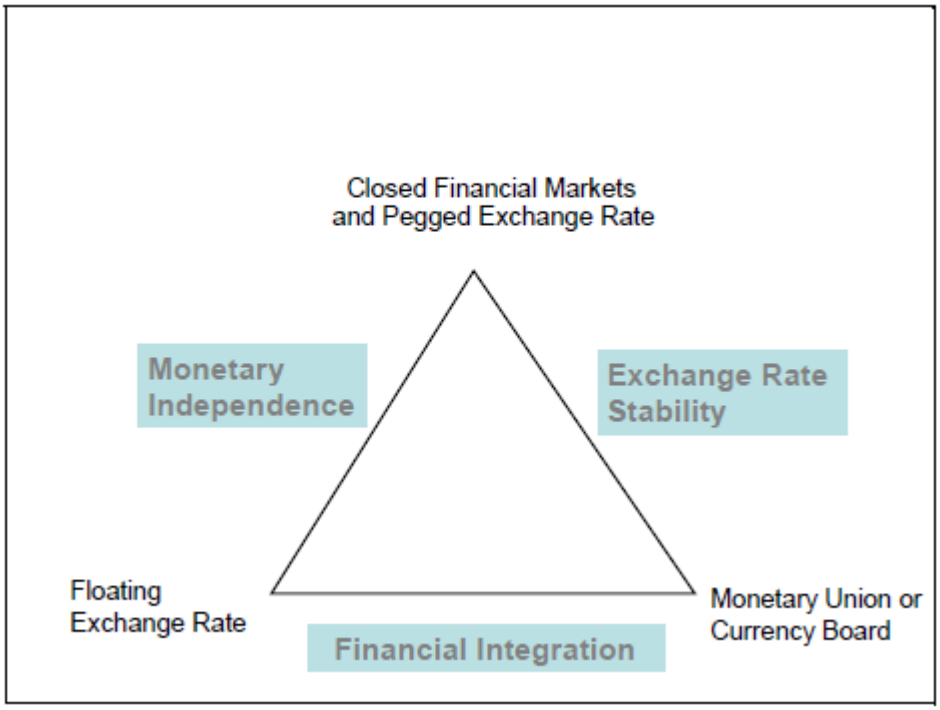


Figure 3-2 Reserves-GDP Ratio

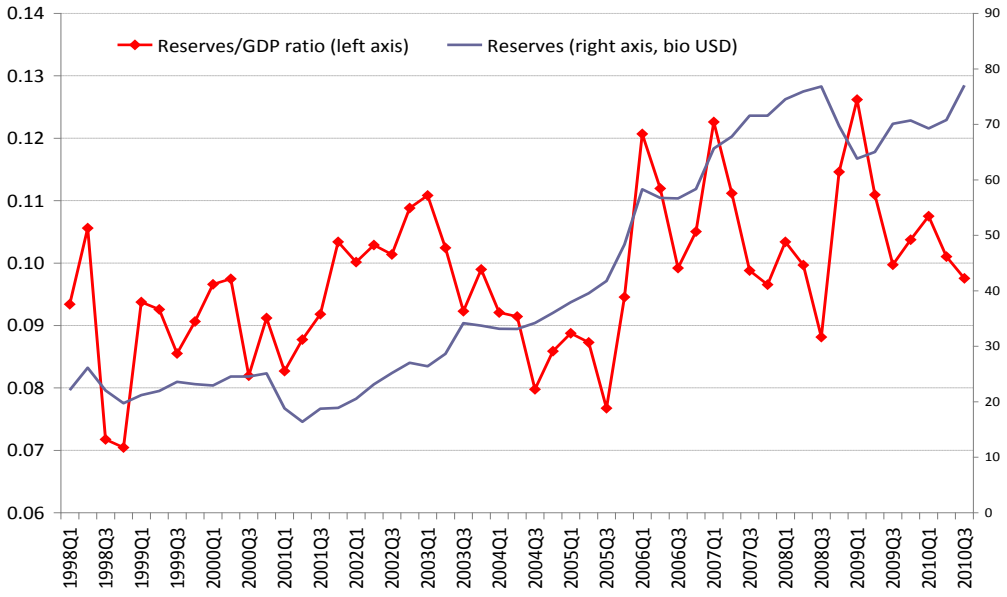


Figure 3-3 Exchange Rate Stability (ES) Index

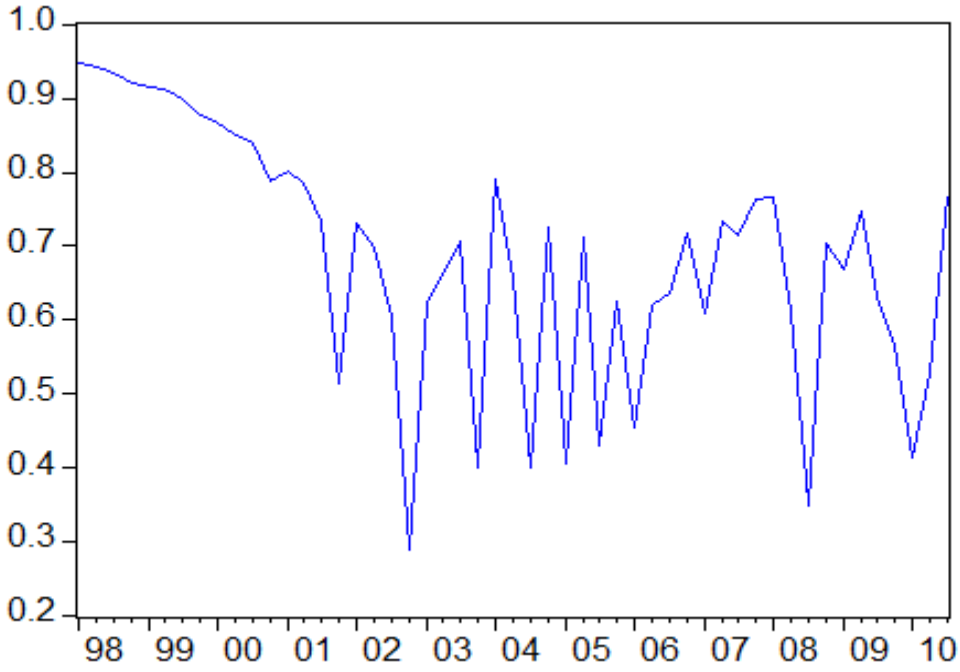


Figure 3-4 Capital Openness (KO) Index

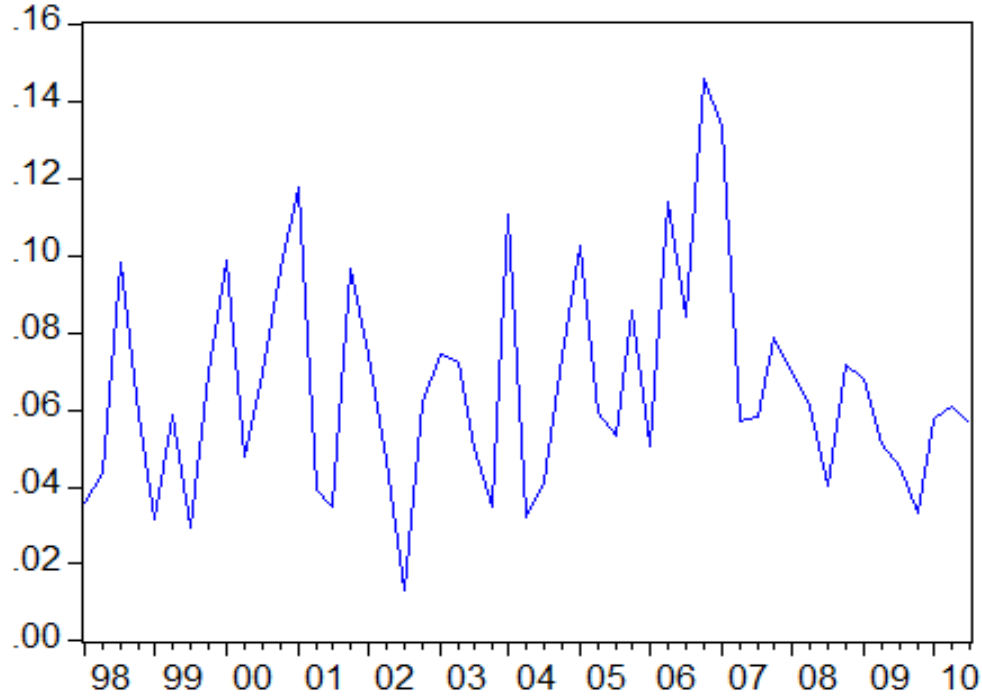
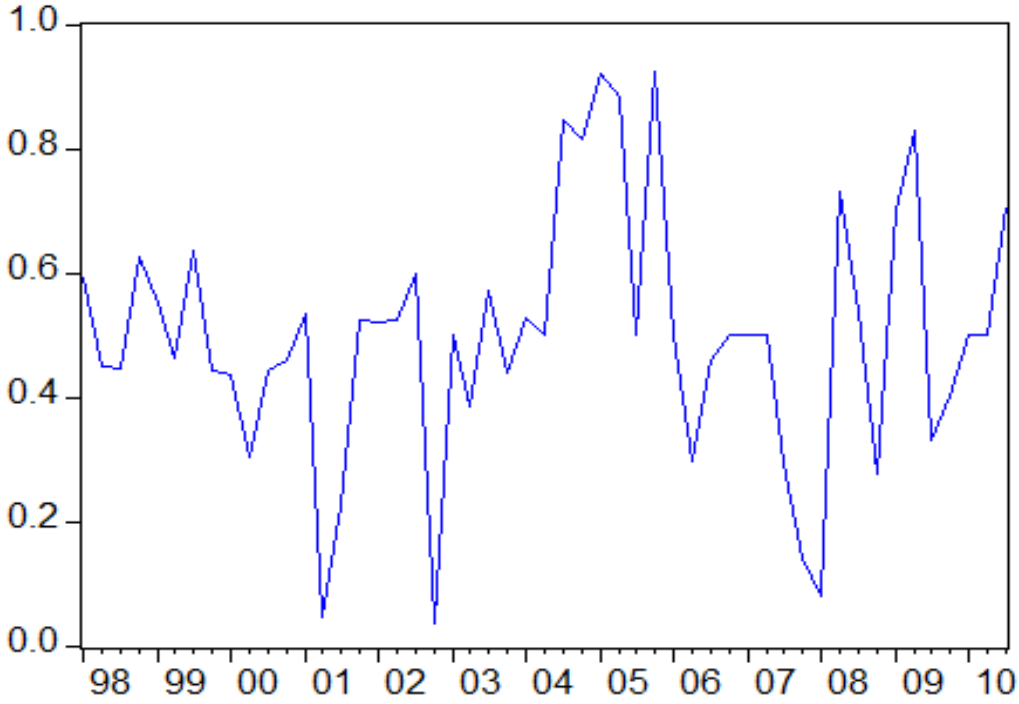


Figure 3-5 Monetary Independence (MI) Index



APPENDIX

Data Sources of Chapter 1 and Chapter 2

Data can be obtained from the NIPA Tables of Bureau of Economic Analysis, available at the address:
http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=N

Total Government Spending:
Government consumption expenditures and gross investment, Table 3.9.5, Line 1

Government Investment:
Gross investment, Table 3.9.5, Line 3

Government Wage Component Consumption:
Compensation of general government employees, Table 3.10.5, Line 4

Government Non-Wage Component Consumption:
Intermediate goods and services purchased, Table 3.10.5, Line 6

Output:
Gross Domestic Product, Table1.1.5, Line 1

Consumption:
Personal consumption expenditures, Table1.1.5, Line 2

Data Sources of Chapter 3

Turkish data obtained from the CBRT website, available at the address:
http://evds.tcmb.gov.tr/yeni/cbt-uk.html

US data obtained from the Federal Reserve System database, available at:
http://research.stlouisfed.org/fred2/categories

Bibliography

Aiyagari, R., Christiano, L. and Eichenbaum, M. (1992). "Output, Employment and Interest Rate Effects of Government Consumption", *Journal of Monetary Economics*, 30, 73–86.

Amano, R.A., and T.S. Wirjanto (1998). "Government expenditures and the permanent income model", *Review of Economic Dynamics* 1, 719–30

Aschauer, D. (1985). "Fiscal policy and aggregate demand", *American Economic Review.* 75, 117–27

Aizenman, J. (2010). "The Impossible Trinity (aka The Policy Trilemma)", forthcoming in Encyclopedia of Financial Globalization (May).

Aizenman, J., M. Chinn and H. Ito, (2008), Assessing the Emerging Global Financial Architecture: Measuring the Trilemma's Configurations over Time," NBER Working Paper No. 14533 (December).

Aizenman, J., Chinn M. and Ito H. (2010). "Surfing the Waves of Globalization: Asian and Financial Globalization in the Context of the Trilemma," *NBER Working Paper* No. 15876 (April).

Athans, M. (1974) "The Importance of Kalman Filtering Methods for Economic Systems", *Annals of Economic and Social Measurement*, 2, 1974, 49-64.

Balkan, E., and Yeldan, E. (2002) "Peripheral Development Under Financial Liberalization: The Turkish Experience", in N. Balkan and S. Savran (ed) The Ravages of Neo-Liberalism: Economy, Society and Gender in Turkey, New York: Nova Science Publication

Barro, R. (1981). "Output Effects of Government Purchases", *Journal of Political Economy* 89, 1086–21

Baxter, M. and King R. (1993). "Fiscal Policy in General Equilibrium", *American Economic Review*, 83, 315–334.

Bender, K. (1998). "The Central Government-Private Sector Wage Differential", *Journal of Economic Surveys*, 12, 177-220.

Benetrix, A. S. and Lane, P. R. (2009). "Fiscal Shocks and the Real Exchange Rate", *The Institute for International Integration Studies Discussion Paper Series*, 286.

Blanchard, O. and Roberto, P. (2002). "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *Quarterly Journal of Economics*, 117, 1329–1368.

Bouakez, H. and Rebei, N. (2007). "Why does Private Consumption Rise After a Government Spending Shock?" *Canadian Journal of Economics*, 40 (3), 954-979.

Burnside, C., Eichenbaum, M. and Fisher M. (2004). "Fiscal Shocks and Their Consequences", *Journal of Economic Theory*, 115(1), 89-117.

Caldara, D. and Kamps, C. (2006). "What do We Know About the Effects of Fiscal Policy Shocks? A Comparative Analysis", mimeo, Stockholm University.

Calvo, G. (1983). "Staggered Prices in a Utility Maximizing Framework", *Journal of Monetary Economics*, 12, 383–398.

Cavallo, M. (2005). "Government Employment Expenditure and the Effects of Fiscal Policy Shocks", Working Paper 16, Federal Reserve Bank of San Francisco.

Central Bank of the Republic of Turkey, (2004). "Remarks by Governor", www.tcmb.gov.tr, Access: December 2010

Cheung, Y-W. and Ito, H. (2007). "Cross-sectional Analysis on the Determinants of International Reserves Accumulation," mimeo, UC, Santa Cruz.

Christiano, L.J., Eichenbaum, M. and Rebelo, S. (2009)."When is the Governmet Spending Multiplier Large", mimeo, Northwestern University.

Christiano, L.J., Eichenbaum, M. and Evans, C. (2005). "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy" *Journal of Political Economy*, 113(1), 1-45.

Cogan, J. F., Cwik, T., Taylor, J.B. and Wieland, V. (2009): New Keynesian versus Old Keynesian Government Spending Multipliers," NBER Working Papers 14782, National Bureau of Economic Research, Inc.

Coenen, G. and Straub, R. (2005). "Does Government Spending Crowd in Private

Consumption? Theory and Empirical Evidence for the Euro Area." *International Finance,* 8, 436-470.

Cordoba, G.D., Perez, J.J. and Torres, J.L. (2009), "Public and Private Sector Wages Interactions in a General Equilibrium Model", ECB Working Paper Series, 1099.

Ehrenberg, R.D. and Schwarz, J.L. (1986). Public Sector Labor Markets, in Ashenfelter, O. and Leyard, R. (eds.), *Handbook of Labor Economics*, Vol. 2, North-Holland.

Fatás, A. and Mihov, I. (2001). "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", Working paper, INSEAD.

Fernald, J. (1993). "Roads to Prosperity? Assessing the Link between Public Capital and Productivity", American Economic Review, 89(3), pp. 619-38

Finn, M. G. (1998). "Cyclical Effects of Government's Employment and Goods Purchases", *International Economic Review* 39, 635–657

Forni, L., Monteforte, L. and Sessa, L. (2009). "The General Equilibrium Effects of Fiscal Policy: Estimates for the Euro Area," Journal of Public Economics, 93(3-4), 559-585.

Gali, J., López-Salido, J.D. and Vallés, J. (2007). "Understanding the Effects of Government Spending on Consumption", *Journal of the European Economic Association*, 5(1), 227-270.

Giordano, R., Momigliano, S., Neri, S. and Perotti, R. (2007). The Effects of Fiscal Policy in Italy: Evidence from a VAR model", *European Journal of Political Economy*, 23(3): 707–733.

Gregory, R. and Borland, J. (1999). Recent Developments in Public Sector Labor Markets, in O. Ashenfelter & D. Card (ed.), *Handbook of Labor Economics*, edition 1, volume 3, chapter 53, pages 3573-3630 Elsevier.

Hutchison, M., Sengupta, R. and Singh, N. (2010). "India's Trilemma: Financial Liberalization, Exchange Rates and Monetary Policy", mimeo, University of California, Santa Cruz.

Ilzeztki, E., Enrique, G.M., and Vegh, C.A. (2010). "How Big (Small) Are Fiscal Multipliers?", Centre for Economic Performance Discussion Paper No.1016, October.

Iwata, Y. (2009). “Fiscal Policy in an Estimated DSGE Model of the Japanese Economy: Do Non-Ricardian Households Explain All?”, 15th International Conference on Computing in Economics and Finance.

Kalman, R.E. (1960). “A New Approach to Linear Filtering and Problems”, *Journal of Basic Engineering*, 82, 35-45.

Karras, G. (1994). “Government Spending and Private Consumption: Some International Evidence”, *Journal of Money, Credit and Banking* 26, 9–22

Leeper, E. M. (1991). “Equilibria Under 'Active' and 'Passive' Monetary and Fiscal Policies", *Journal of Monetary Economics*, 27(1), 129-147.

Leeper, E. M. (2010). “Monetary Science, Fiscal Alchemy”, NBER Working Paper No: 16510, National Bureau of Economic Research.

Linnemann, L. and Schabert, A. (2004). “Can Fiscal Spending Stimulate Private Consumption?” *Economics Letters* 82, 173–79

McGrattan, E. R. (1994). “The Macroeconomic Effects of Distortionary Taxation," *Journal of Monetary Economics*, 33(3), 573-601.

Monacelli, T. and Perotti, R. (2008). “Fiscal Policy, Wealth Effects, and Markups”, NBER Working Paper No. 14584, National Bureau of Economic Research, December.

Mountford, A. and Uhlig, H. (2002). “What are the Effects of Fiscal Policy Shocks?", CEPR Discussion Papers 3338.

Mountford, A. and Uhlig, H. (2008). “What are the Effects of Fiscal Policy Shocks?", NBER Working Paper 14551, December.

Ni, S. (1995). “An Empirical Analysis on the Substitutability between Private Consumption and Government Purchases,’ *Journal of Monetary Economics* 36, 593–605.

Obstfeld, M., Shambaugh, J. C. and Taylor, A. M. (2008). “Financial Stability, the Trilemma, and International Reserves”, NBER Working Paper 14217 (August).

OECD Reviews of Regulatory Reform in Turkey, 2002, “Enhancing Market Openness”, Report No. 40/9

Okubo, M. (2003) 'Intratemporal Substitution between Private and Government Consumption: The Case of Japan,' *Economics Letters* 79, 75–81

Pappa, E. (2005). "New-Keynesian or RBC transmission? The Effects of Fiscal Policy in Labor Markets", Working Papers 5313, CEPR Discussion Paper.

Perotti, R. (2004). "Public Investment: Another (different) Look. mimeo, Bocconi University.

Perotti, R. (2007). "In Search of the Transmission Mechanism of Fiscal Policy", NBER Macroeconomics Annual.

Ramey, V. A. (2009). "Identifying Government Spending Shocks: It's All in the Timing", NBER Working Paper Series, 15464.

Ramey, V.A. and Shapiro, M. (1998). "Costly Capital Reallocation and the Effect of Government Spending." *Carnegie-Rochester Conference Series on Public Policy*, 48, 145–194.

Ramsey, J.B. (1969). "Tests for Specification Errors in Classical Linear Least Squares Regression Analysis," *Journal of the Royal Statistical Society*, Series B, 31, 350-371.

Ramsey, J.B. and Alexander A. (1984). "The Econometric Approach to Business-Cycle Analysis Reconsidered," *Journal of Macroeconomics*, 6, 347-356.

Schorfheide, F. (2000). "Loss function-based evaluation of DSGE models". Journal of Applied Econometrics, 15.

Schmitt-Grohé, S. and Uribe, M. (2007). "Optimal Simple and Implementable Monetary and Fiscal Rules", Journal of Monetary Economics, 54(6), 1702-1725.

Schmitt-Grohé, S. and Uribe, M. (2008): "What's News in Business Cycle", NBER Working Paper No. 14215

Smets, F. and Wouters, R. (2003). "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area", *Journal of the European Economic Association,* 1 (5).

Watson, P.K. (1983). "Kalman Filtering as an Alternative to Ordinary Least Squares: Some Theoretical Considerations and Empirical Results", *Empirical Economics,* Vol. 8, page 71-85.