Macroeconomic Effects of Fiscal Policy

A thesis submitted for the degree of Doctor of Philosophy

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Abstract

The interest in the use of fiscal policy as an effective economic policy tool has been revived recently, since the global recession of 2008 hit the world. In spite of a large empirical literature, there remains substantial uncertainty about the size and even the direction of the effects of discretionary fiscal policy. This thesis seeks to investigate the macroeconomic effects of discretionary fiscal policy in the short term, highlighting several methodologies for identifying discretionary fiscal policy.

In Chapters 2 and 3, we suggest a new instrument based on the narrative approach for identifying exogenous government spending shocks: natural disaster damages and the subsequent government emergency spending. While applying our methodology to the Korean and the U.S data, we find that our instrument is not only powerful but also superior to military build-ups used by most of the literature. The relief expenditure in the wake of natural disaster has several advantages such as the similarity in scope to general government activity and the easy applicability beyond the U.S. compared to military build-ups. In the analysis of Korean fiscal policy, using our narrative method and the Structural Vector Autoregression (SVAR) model, we find that government spending shocks increase GDP, consumption, and real wage, which is in line with the New Keynesian model. We also find that the timing is crucial in identifying government spending shocks due to the anticipation effects of fiscal policy. Furthermore, while analyzing the U.S. fiscal policy both at the state as well as national level, we estimate two kinds of non-defense spending multipliers: federal (1.4~1.7) and state (1.5~2.5), which exceed the defense spending multiplier obtained in the literature using military building-ups.

In Chapter 4, in regard to the study of effects of fiscal adjustment, we develop the approach based on changes in cyclically adjusted primary balance (CAPB) by including fluctuations of asset price in the CAPB measure and allowing for individual country heterogeneity in the definition of fiscal adjustment. Using our new CAPB in 20 OECD countries, we find that fiscal adjustments have contractionary effects on economic activity in the short term, which is consistent with the result based on the narrative approach. Nevertheless, our results suggest that fiscal adjustments that rely predominantly on spending cuts are less contractionary than those involving tax increases.

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Declaration

I hereby declare that this thesis has been written by me and has not previously been accepted for any degree, or qualification, by any other university or institution of academic learning, and is not concurrently submitted in candidature for any degree.

The final versions of Chapters 2 and 3 were edited by, and incorporate feedback from, my supervisors, Dr. Jan Fidrmuc and Prof. Sugata Ghosh. Thereafter, these two papers have been circulated as joint working papers with view to submitting them to academic journals.

Chapter 1

Introduction

During the global recession and financial crisis of 2008 and onwards, often referred to as the 'Great Recession', most advanced countries implemented a variety of active fiscal policies as large stimulus packages to mitigate this recession. In particular, since monetary policy options are restricted by the very low interest rates which were central features of this recession, most governments relied much more on fiscal policy. For example, the U.S. enacted unprecedented fiscal expansion including the American Recovery and Reinvestment Act (ARRA) of 2009 which was a combination of tax cuts, transfers to individuals and states, and government purchases equal to 5.5 % of GDP (Auerbach, 2012). In 2008, the EU adopted the European Economic Recovery Plan (EERP) equivalent to 1.5 % of the EU GDP (Beetsma and Giuliodori, 2011). These examples are just a subset of the stimulus packages by G20 governments. According to Gemmell (2011), much larger G20 stimulus packages worth $1~5 trillion over 2009-2010 were announced in 2009, expecting to stimulate GDP by 4% compared to the 'no stimulus' alternative. However, these large scale fiscal stimulus packages have triggered a lively debate about the effectiveness of fiscal policy.

Moreover, before the extent of fiscal stimulus was finalised and while the exit strategy started to be discussed in many countries, the Eurozone fiscal crisis followed the 'Great Recession' due to the rising fiscal deficit and public debts and there are still concerns that the chances of fiscal crisis will increase substantially. In response to the deteriorating fiscal balance, many European countries have undertaken fiscal adjustments even though unemployment has remained high and the GDP growth has been low (Auerbach, 2012). However, the launch of fiscal consolidation raises concerns about the possibility of stalling the recovery of their economies. Overall, this process shows that fiscal policy in many countries is trapped in a vicious circle. As a result, fiscal policy and its effects on economies have been at the centre of interest and debate, and the focus has recently been shifting from the fiscal stimulus to the fiscal austerity.

Until the early 1980s, fiscal policy was widely regarded as a useful tool for economic stabilization. However, its failure to boost economic growth in the wake of the oil shocks of the 1970s, and the associated increase in budget deficit and public debts, have led a lot of economists to be skeptical about the effectiveness of fiscal policy to smooth cyclical fluctuations (Beetsma and Giuliodori, 2011), and fiscal policy has received less attention

(Afonso and Sousa, 2012). While policymakers continued to rely heavily on active fiscal policy as a policy instrument, as demonstrated during the current global recession, academic researchers have not reached a consensus about the effects of fiscal policy on macroeconomic variables, or about the magnitude of such effects. This stands in stark contrast to monetary policy, where a substantial consensus has been established between academics and policymakers as regards current inflation-targeting strategies and its effects on the economy (Perotti, 2007; Beetsma, 2008; Fontana, 2009; and Auerbach, 2012). According to Arestis (2009), the new consensus on monetary policy has an implication that monetary policy is effective as a means of inflation control through changes in the interest rate via the Taylor Rule. Moreover, this new consensus model is based on the new Keynesian theory of nominal rigidities and long-run vertical Phillips curve as well as the neoclassical theory of rational expectation and explicit optimization behaviour. However, there is less agreement regarding fiscal policy in both the theoretical model and empirical approach.

Theoretical models on the effects of fiscal policy can be often distinguished by two main views developed with micro foundations: neoclassical theory and new Keynesian theory. For a fiscal expansion such as an increase in government spending or tax cut, both views predict rising output in the short term, but envisage different transmission mechanism. These different channels are attributed to different assumptions adopted by each theory and to the corresponding responses of private consumption and the labour market. Therefore, the key point of debate between the two theoretical views is about the effects of fiscal policy on private consumption and real wage in that predictions about the responses of these two variables to fiscal policy are consistent according to theoretical models in spite of various underlying assumptions. For example, the neoclassical model predicts that an expansionary fiscal policy decreases private consumption and increases labour supply due to negative wealth effects and consequently an increase of labour supply causes a decline in the real wage. On the other hand, the new Keynesian model predicts that after positive fiscal shocks, real wage increases because of an increase in labour demand due to nominal price rigidities and imperfect competition, and the rising real wage also raises private consumption because of 'rule-of-thumb' consumers (Galí et al., 2007) or 'deep habits' (Ravn et al., 2006). There is a similar disagreement about the effects of fiscal adjustments such as spending cuts or tax hikes: even the response of GDP is predicted differently to some degree. For instance, the

neoclassical model can predict that fiscal adjustment implemented during the periods of fiscal stress has expansionary effects on output because of wealth effects or credibility effects, which is often called 'Non-Keynesian effects', in conflict with the traditional Keynesian perspective (Bertola and Drazen, 1993; Sutherland, 1997).

As a consequence, the need for empirical evidence to elucidate the issues in two theoretical debates has spurred two strands of empirical literature. One focuses on the dynamic macroeconomic effects of discretionary fiscal expansion and on estimating the fiscal multipliers. The other focuses on the effects of large reductions in the budget deficit and tries to verify the existence of expansionary fiscal adjustment and its determinants. However, the results of empirical studies also reveal considerable disagreement, just like the theoretical literature, depending on alternative approaches used for identifying fiscal policy shocks. Two main approaches are used to identify the effects of fiscal expansion: the Structural Vector Autoregression (SVAR) approach and the narrative (event study) approach. The main difference between them concerns the responses of consumption and wages, which have different signs depending on the approach used to identify fiscal policy shocks. The results using the SVAR approach (Blanchard and Perotti, 2002; Perotti, 2005) are usually consistent with the New Keynesian theory, but those from the narrative approach (Ramey and Shapiro, 1998; Burnside et al., 2004) tend to be consistent with the neoclassical model. More recently, although a few papers (Perotti, 2007; Ramey, 2011a) try to reconcile the disparate empirical evidence under the two identification schemes, there is still no agreement on the qualitative effects of fiscal shocks. Nevertheless, the SVAR approach has been applied actively to the data of various countries in many studies due to its easy application in spite of some criticism concerning the high sensitivity of results to assumptions and information used and its failure to account for 'anticipation effects'. Since there is concern about the SVAR approach identifying fiscal shocks that are not truly exogenous, economists following the narrative approach look for major events that can be assumed to be exogenous and pin down the timing of fiscal shocks. However, the big hurdle is to find appropriate events identifying for fiscal shocks. Large military build-ups from wars or war threats (Ramey and Shapiro, 1998) have proven to be a popular instrument for unexpected government spending shocks in the U.S. However, these military build-ups also have some limitations such as their infrequency and unusual composition of the associated government spending. Moreover, it is very hard to

identify exogenous military build-ups for other countries other than the U.S., as the latter is exception in that it has primarily been involved in extra-territorial military conflicts. Similarly, for the identification of fiscal adjustment episodes, most of the literature (Alesina and Perotti, 1995; Alesina and Ardagna, 2010) relies on traditional approach based on changes in cyclically adjusted primary balance (CAPB). However, more recent evidence calls the CAPB-based approach and its results into question. The narrative approach, which uses historical records to identify fiscal adjustments episodes, fails to support the notion of expansionary fiscal adjustment in general and highlights the potential inaccuracy of using CAPB (IMF, 2010; Guajardo et al., 2011).

In this context, this thesis attempts to reconcile the two alternative approaches which show contrasting results in the existing empirical literature on the macroeconomic effects of fiscal policy. The main contributions of this thesis are as follows. First, we propose a new instrument for exogenous and unexpected government spending shocks instead of military build-ups: damages caused by natural disasters and the subsequent government emergency spending. As natural disasters are unexpected and unpredictable events, natural disaster relief expenditure constitute exogenous spending shocks. In particular, the relief expenditure has several advantages compared to military build-ups. It covers a broad range of sectors similar in nature to the general government activities and it can be easily extended to other countries unlike military build-ups used only for the U.S. Second, by improving the measure and criteria of fiscal adjustment in the CAPB-based approach, we demonstrate that the CAPB is a useful indicator of fiscal adjustment when compared with the narrative approach. Lastly, our empirical evidence suggests that the new Keynesian model provides a better description of reality than the neoclassical model regardless of the identification method used in both fiscal expansion and consolidation. We find that a positive government spending shock tends to increase GDP, private consumption, and real wage and a fiscal adjustment has contractionary effects on GDP in the short term.

This thesis collects three empirical chapters investigating the macroeconomic effects of fiscal policy. The second chapter attempts to develop a narrative approach to analyze the effects of government spending shocks without relying on the military build-ups and U.S. data. We propose the economic damages due to natural disasters as a new instrument. We find

that economic damages from natural disasters are a strong and relevant instrument for identifying government spending shocks. Having constructed the new exogenous series based on narrative records for Korea, we then use it to estimate the macroeconomic effects of government spending shocks and to compare results from the two approaches: narrative and SVAR. We find that private consumption and real wage, in addition to GDP, increase in response to an increase in government spending, under both approaches. Our results thus are in line with the New Keynesian model, regardless of the method used. This stands in contrast to the previous literature that obtains different results according to the identification method. Therefore, our findings indicate that what is important for the analysis is not the identification method but the instrument used. In addition, we find that the timing is very important in identifying government spending shocks due to the 'anticipation effects' of fiscal policy. The private sector can anticipate the increase of government spending in the wake of natural disasters and thus the effects can be observed already prior to the actual fiscal shock. This finding implies that failure to consider the 'anticipation effects' can lead to misleading conclusion about the effects of fiscal shocks.

The third chapter attempts to apply our new instrument to another country in order to confirm the general applicability of natural disasters and our findings in the second chapter. We select the natural disaster data of the U.S. because this allows us also to compare our results with those of other papers using military build-ups of the U.S. Therefore, the third chapter assesses the effects of government spending shocks in the U.S. Constructing a new dataset on damages due to natural disaster at the state level of the U.S. from historical records, we analyze its effects as fiscal shocks both at the state as well as national levels, confirming that natural disasters constitute a strong and relevant instrument for identifying fiscal shocks, especially nondefense spending shocks. We calculate two kinds of nondefense spending multiplier: federal nondefense spending (1.4~1.7) and state government spending (1.5~2.5), which fall within the range of multipliers obtained in the previous literature. In addition, we find that the nondefense multiplier is higher than the defense-spending multiplier estimated using military build-ups.

The fourth chapter explores the short-term effects of fiscal adjustment on economic activity in OECD countries and assesses the evidence regarding the expansionary fiscal

adjustment hypothesis. We seek to reconcile two alternative approaches for identifying fiscal adjustment: the traditional approach based on changes in the CAPB, and the narrative approach. We propose a new CAPB measure that incorporates several issues raised by Guajardo et al. (2011). The main improvement is to include the fluctuations in asset prices in the CAPB measure and to allow for individual country heterogeneity in the definition of fiscal adjustment. Using our new measure and criteria of fiscal adjustment, we find that fiscal adjustments have contractionary effects on economic activity in the short term and that the expansionary fiscal adjustment is unusual phenomenon. Our finding is therefore similar to the results of Guajardo et al. (2011) based on the narrative approach. We also find that fiscal adjustments relying on spending cuts have less contractionary effects than those relying on tax hikes.

Finally, the sixth chapter concludes and proposes several policy implications and future research issues.

Chapter 2

Macroeconomic effects of government spending shocks: New evidence using natural disaster damages in Korea

1. Introduction

The effect of fiscal policy in an economy is an issue that has always been high on the minds of academics and policymakers alike. This is especially so now, given the role that fiscal policy has played in the attempts to mitigate the economic downturn during the current global crisis, and also because of the fiscal tightening associated with the debt crises afflicting peripheral European economies. It has been widely recognized that fiscal stimulus can foster economic recovery, although the debate continues about the size of the effect and the transmission mechanisms at work. Likewise, the interest in the output effects of fiscal spending cuts has increased in line with the austerity measures imposed on Greece and other countries with excessive public debt. As a result, the debate about the effect of fiscal policies on the economy has been going on with renewed rigor.

Two main theoretical views prevail in this respect. In the neoclassical model, a fiscal stimulus translates into a negative wealth shock. The increased public spending needs to be financed by higher taxes, either in the present or in the future. Households, therefore, reduce their consumption, and increase their labour supply so that wages fall. In the New Keynesian model, by contrast, the stimulus boosts the aggregate demand and labour demand so that both consumption and wages rise. Both views thus predict rising output, either because of the aggregate demand effect or because of increased labour input. However, the responses of private consumption and wages envisaged by the two models are opposite.

It falls, therefore, upon empirical analysis to reconcile these two views. However, a particular fiscal policy intervention can have different effects depending on whether it is expected or unexpected. A fiscal stimulus announced well in advance will affect the behaviour of households even before it is implemented. The macroeconomic response observed at the time of implementation, correspondingly, fails to capture the true effect of the stimulus. Alternatively, fiscal policy may itself be responding to earlier macroeconomic events. Therefore, one needs to identify fiscal shocks that are both unexpected and exogenous in order to carry out a robust analysis of effects of fiscal policy.

To date, the most promising method relies on identifying fiscal shocks with military

build-ups (see Ramey and Shapiro, 1998; Ramey, 2011a; and Barro and Redlick, 2011). Wars are, at least to some extent, exogenous and unpredictable events. They are also associated with massive increases in government purchases. The U.S., the subject of most of these studies, has an additional advantage in that all of its recent wars were extra-territorial.[1] Therefore, the adverse supply side effects due to the destruction of assets and loss of life resulting from wars are limited.[2] Focusing on military build-ups has an added advantage that the timing of the shock can be identified relatively precisely.

Nevertheless, this approach also has a number of drawbacks. First, few other countries have been involved in primarily extra-territorial conflicts, so the application of this approach remains limited to the U.S. and possibly a few other cases. Second, participation in wars and the associated military build-ups are not entirely unexpected in that they are typically preceded by, often lengthy, periods of rising tensions and posturing.[3] Third, even when they are extra-territorial, wars often have non-negligible supply side effects: conscription removes a large number of men in prime age from the labour supply and government purchases and borrowing can have important spillover effects across the economy. Finally, the nature of government spending during a military build-up is substantially different from the general government purchases. It is therefore questionable whether one really learns much about the effect of fiscal shocks from the economy's response to military build-ups.

We propose an alternative approach for identifying government spending shocks and their effects: emergency response in the wake of natural disasters. By their very nature, natural disasters are unexpected: acts of God rather than man-made. The ensuing government response typically involves expenditure in a broad range of categories: direct transfers to households, wages of emergency services and health workers, capital purchases and others. In that, it more closely mimics the general nature of government spending than military build-ups.

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1. The literature typically considers the build-ups associated with the World War II, Korean and Vietnam wars and the Cold War-related build-up under President Reagan in the 1980s. Only World War II was in part fought on US territory, Hawaii, which accounts for a tiny fraction of the U.S. economy.

2. In particular, civilian deaths resulting from enemy action are modest or non-existent in such conflicts.

3. For example, the attack on Pearl Harbour was surprising mainly in that the U.S. expected that the Japanese aggression would be initially directed against the Philippines, a U.S. dependency at the time, rather than Hawaii.

Natural disasters do have supply side effects: they cause damage to buildings and the infrastructure and may also cause loss of life. In developed economies, such loss of life is usually limited. This is in part because although natural disasters are generally unpredictable, it is usually known whether a particular region is prone to suffer from a particular type of natural disaster. This can then be taken into account in building regulations and the like. Furthermore, even if they are difficult to predict over longer periods, natural disasters often come with enough warning signs to give the local population time to flee or prepare immediately before the natural disaster strikes. Finally, natural disasters can even have a positive effect on the economy because the older physical assets tend to be less robust and are thus more prone to be damaged: Crespo et al. (2008) argue that in this way natural disasters can help 'cull' old fixed assets, which are then replaced by newer and more efficient ones. Moreover, while the adverse supply side effects are actually localized to a limited area and usually do not spill over a wider area, the government spending response is likely to affect the economy at the national level. This is because the relief and reconstruction work can be done by construction companies from other areas, and the resources such as building materials and vehicles from all over the country are usually used.

In the next section, we discuss the preceding literature on the macroeconomic effects of fiscal policy and on the different effects obtained with the standard structural vector autoregression (SVAR) model and the so-called narrative approach based on observed military build-ups. Section 3 describes the recent trends of Korean fiscal policy and section 4 explains how we construct the new series of exogenous fiscal shocks based on Korean data. We consider Korea because the data on emergency spending is readily available for this country. In most instances, emergency spending there does not require any additional borrowing or revenue raising as the Korean government keeps 1% of the general budget in an emergency response fund. That section also describes the data and the methodology. Section 5 presents the empirical results of government spending shocks in the narrative approach and compares them with the results of the SVAR approach. Section 6 runs a variety of robustness checks and, finally, section 7 concludes.

2. Effects of fiscal policy shocks: What do we know?

There are numerous studies on the effectiveness of fiscal policy. Given that the theoretical macroeconomic models have different predictions about the effects of fiscal policy, the answer to the question regarding the effect of fiscal policy could ultimately be empirical. However, the empirical literature also shows widely different results regarding the responses of macroeconomic variables to government spending shocks, and the estimated multipliers differ in their size too.

The existing empirical studies can be divided mainly into two groups: the Structural Vector Autoregression (SVAR) approach and the narrative approach. The estimated response differs for the two approaches, and crucially depends on the identification method used. Studies using the SVAR approach generally find results consistent with the New Keynesian model: consumption and wages rise in response to a positive government spending shock. On the other hand, those produced with the narrative approach tend to be consistent with the neoclassical model: consumption and wages fall when the government spending increases. Below, we discuss the theoretical background and the two main empirical approaches in greater detail.

2.1. Theory

Two macroeconomic models have evolved with very different predictions concerning the dynamic effects of government spending shocks. The first model is the New Keynesian model with price rigidity, where government spending shocks increase labour demand, real wages, private consumption and GDP. Rothemberg and Woodford (1992) and Devereux et al. (1996) introduce models with increasing returns to scale and imperfect competition to show that positive government shocks raise the real wage. Ravn et al. (2006) introduce ‘deep habits’ on a good-by-good basis which gives rise to countercyclical markups in imperfectly competitive markets. They argue that private consumption and the real wage increase in response to government spending shocks. Galí et al. (2007) introduce sticky price model with ‘rule-of-thumb consumers’ who consume their current income fully in a non-Ricardian fashion. They show that real wages increase due to countercyclical markups and that the response of consumption can be positive due to the existence of rule-of thumb households.

On the other hand, in the Neoclassical model, such as the Real Business Cycle model with constant returns to scale, standard preferences and competitive markets, government spending shocks increase GDP and produce negative wealth effects due to the households' expectation of higher taxes in the future or because of intertemporal substitution effects due to temporarily increased interest rate. This causes consumption to decrease and labour supply to increase which in turn leads to a fall in real wages. Baxter and King (1993) show that an increase in government spending financed by non-distortionary taxes reduces the representative agent's wealth, which leads to an increase in the labour supply and a decrease in both real wages and consumption. They also show that depending on the persistence of the shock, marginal productivity of capital may rise and thereby lead to an increase in investment. Moreover, in response to criticism that neoclassical theory cannot account for macroeconomic performance during the World War II (Mulligan 1998, Rotemberg and Woodford, 1992), McGrattan and Ohanian (1999) introduce some plausible features such as uncertainty over the duration of the war, rationing, and a fear of a post-war depression into the neoclassical model. They show that these simple modifications can account for the high labour input and low after-tax wages and interest rates. Edelberg et al. (1999) made a variant of the neoclassical model by dividing the type of capital into residential investment and nonresidential investment to account for their empirical results of the responses of the U.S. economy to a persistent government spending shocks. They show that the residential investment in the stock of durable consumption goods falls while the nonresidential investment rises in response to the government spending shocks. Burnside et al. (2004) show that their model can account for the effects of a fiscal policy shock on hours worked and the real wage even in the case of distortionary tax rates. Moreover, they show that allowing for habit formation and investment adjustment costs in a neoclassical model can lead to an improvement in accounting for both the qualitative and quantitative effects of fiscal policy shocks on consumption and investment.

2.2. Empirical literature based on the SVAR Approach

The SVAR approach has been used in a number of studies to assess the effects of monetary policy. Blanchard and Perotti (2002) were the first to use it to study the effects of fiscal shocks. In their approach, fiscal shocks are identified by using decision lags in fiscal

policymaking, which assumes that policymakers do not respond to shocks within the current quarter. They formulate a three-variable VAR model, including GDP, government spending and net taxes, and estimate the effects of fiscal policy using U.S. data. The results suggest that positive government spending shocks have a positive effect on GDP and positive tax shocks have a negative effect on GDP. They conclude that the multiplier is small: GDP increase in response to a one dollar shock of government spending peaks by 1.29 dollars after almost four years. Then, in a four-variable VAR model, which includes the main components of GDP, consumption responds positively to but investment is crowded out by government spending shocks.

Blanchard and Perotti's (2002) approach is followed in many subsequent studies. Perotti (2005) constructs a VAR model with GDP, inflation, interest rate, government spending and taxes for 5 OECD countries. He finds the estimated effect of fiscal policy on GDP to be small. The effect of government spending shocks on private consumption is significantly positive over a three-year horizon. To assess the effects of fiscal policy in Italy, Giordano et al. (2007) use a six-variable VAR, adding employment to the five variables used by Perotti (2005). The response of GDP to a shock in government spending is relatively small and fades away quickly. The response of private consumption is again positive. Using Spanish data, De Castro and Hernández De Cos (2008) find that government spending increases GDP and private consumption. Fatas and Mihov (2001) and Caldara and Kamps (2008) show that positive government spending shocks raise the real wage as well as consumption. Most other studies which also adopt the SVAR approach arrive at similar results and the SVAR model thus tends to produce findings consistent with the New Keynesian model.

2.3. Empirical literature based on the Narrative (Event Study) Approach

Under the narrative approach, the effects of policy are examined by combining time-series data with the event-study method. This approach has been used mainly in studies focusing on the U.S. Ramey and Shapiro (1998) use it to identify fiscal policy shocks in an application of methodology that Romer and Romer (1989) used to study monetary policy. They identify three major military build-ups – the Korean War, Vietnam War, and the Carter-Reagan build-up – that occurred independently of the state of the domestic economy. Ramey and Shapiro (1998) use a univariate autoregressive model which relates each variable of

interest to lags of itself and the current and lagged military build-up dummy. They find that government spending has a positive effect on GDP. The response of GDP to a military shock remains positive for three years while the shock lowers consumption and real wages. Edelberg et al. (1999) use a multivariate VAR model with Ramey and Shapiro's dummy while Burnside et al. (2004) allow each episode to have a different intensity according to the amount by which government spending increased. These studies also obtain very similar results: consumption and the real wage decline in response to an expansionary shock in government purchases while the GDP and hours worked increase. The findings obtained with the narrative approach thus are in line with the neoclassical model.

Recent literature aims to compare and reconcile these two empirical approaches. Caldara and Kamps (2008) show that GDP and consumption increase in response to government spending shocks regardless of the identification approach used, but the difference is that while the effects are more persistent under SVAR, they die out quickly in the narrative approach. The real wage response is, however, positive with the SVAR but negative with the narrative approach, but they do not discuss the reasons for this difference. Engemann et al. (2008) report that GDP, consumption, and real wage display positive responses with the SVAR approach, but the responses of consumption and the real wage are negative for the first two periods with the narrative approach. Perotti (2007) compares the two approaches, focusing on the responses of consumption and the real wage. He argues that the differences are due to two restrictions of the narrative approach. First, it assumes that the build-ups have the same intensity and the fiscal shock is also the same.[4] The other assumption is that abnormal fiscal events can explain all the deviation from normal of all variables for several quarters after these events occur. He shows that when these restrictions are removed, the results from this approach are consistent with the New Keynesian model.

In a recent contribution, Ramey (2011a) produces both sets of results and argues that the key difference between the two approaches is in the timing. Correspondingly, the VAR-identified spending shocks may have been expected, producing an 'anticipation effect'. She shows that delaying the timing of military build-ups yields New Keynesian results. In

4. He argues that each fiscal shock might instead involve different policies, such as a tax cut in one instance and a tax increase in another.

addition, Ramey (2011a) constructs new variables which are richer than the original military build-ups dummy: she uses news sources to measure quantitative information about anticipation of fiscal-policy shocks. She finds that the analysis with the new variables produces similar results: consumption and wages fall in response to an increase in government spending and the multipliers range from 0.6 to 1.2.

In summary, an advantage of the SVAR approach is that we can estimate the size and persistence of policy effects by using impulse response functions in an empirical analysis while avoiding a theoretical debate. However, the identification of shocks depends on assumptions such as time lags and the elasticity of fiscal variables with respect to macroeconomic variables. Moreover, in case of long implementation lags, the results can be distorted by 'anticipation effects' whereby the fiscal policy measures are anticipated by the private sector before government spending takes place. On the other hand, the narrative approach is more direct. Daniel et al. (2010) indicate that the narrative approach is more accurate in identifying periods of fiscal consolidation. However, if there are not enough events, the results can be influenced by the economic situations after the event.

So far, the narrative approach has been applied only to studying the effects of government spending in the U.S. because of the availability of military build-up data constructed by Ramey and Shapiro (1998). The relatively few studies on the macroeconomic effects of fiscal policy in Korea, in contrast, all use the SVAR approach. The results tend to be similar to those obtained for other countries: in the short term, government spending increases have a positive but not large effect on GDP. Moreover, because these studies mainly focus on comparing the effectiveness of government spending increases and tax cuts as an expansionary fiscal policy tools, the responses of consumption and real wages to the fiscal shock are not analyzed.

W. Kim (2006), following the SVAR approach of Blanchard and Perotti (2002), uses quarterly data based on the monthly statistical survey of the Bank of Korea from 1970 to 2000. He shows that government spending shocks have a positive effect on GDP and tax shocks have a negative effect, which is similar to Blanchard and Perotti's (2002) finding. He also suggests that tax cuts are a more effective way than government spending increases to stimulate the economy. Hur (2007) estimates the effects of fiscal policy with quarterly data

using the SVAR approach and extends the three-variable model to four variables by adding the real effective exchange rate as a proxy for external shocks. He suggests that the size and significance of the estimated fiscal multipliers in Korea are small and that the effects of fiscal policy dissipate very fast. S. Kim (2007) investigates the short-term effects of fiscal policy shocks on the Korean economy in a SVAR model with quarterly consolidated government finance data from 1994 to 2006. He shows that spending shocks decrease output, inflation rate and interest rate, while tax-cuts increase output and interest rate but decrease inflation. These findings go against the conventional wisdom. He ascribes these results to the too short a period for analysis and the sharp economic downturn and structural changes since the Asian crisis of 1997. B. Kim (2011), unlike the other studies, uses data from quarterly national accounts for the period 1999:1q~2010:1q, classifying government spending into consumption and investment. He shows that the effects of an increase in government spending are much bigger than those of tax cuts and especially that the government investment multiplier (2.86) is larger than the government consumption multiplier (1.85).

We are the first to use the narrative approach to analyze the effects of Korean fiscal policy, and also to compare the two approaches with non-U.S. data. As we argued above, the absence of studies using the narrative approach in the context of countries other than the U.S. reflects the availability of Ramey and Shapiro's military build-up data. This, in turn, is because other countries have not had enough episodes of military build-ups associated with extra-territorial events. Korea was involved in the Korean War, which was fought on its territory. Thereafter, it remained technically at war with North Korea, with hostilities occasionally breaking out. The military expenditure, while high relative to other countries, has not varied sufficiently to allow an analysis similar to that of Ramey and Shapiro (1998) and their followers.

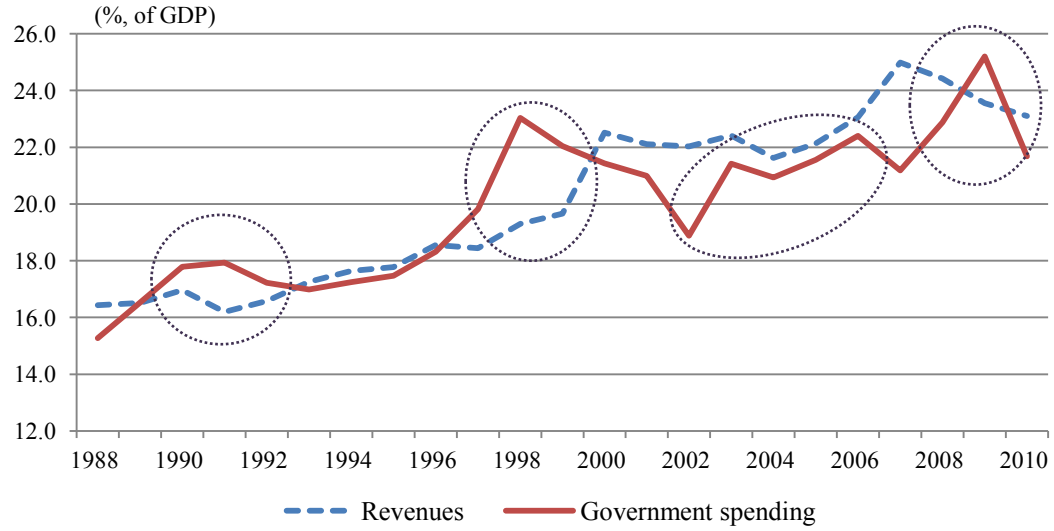
A crucial contribution of this chapter, therefore, is to propose a new instrument for identifying fiscal shocks that allows us to extend the analysis of the effects of fiscal policy beyond the U.S. We use natural disasters instead of military build-ups as a source of exogenous variation in fiscal policy. We use both the timing and the intensity of natural disasters, using the estimated economic damages as a measure of the latter. Having constructed the new exogenous series, we then use it to estimate the macroeconomic effects

of government spending shocks in Korea. While we apply this identification strategy to Korea, economic damages from natural disasters can be used to identify fiscal shocks in other countries as well.

3. Recent trends in Korean fiscal policy

This section discusses briefly the main aspects of Korean fiscal policy. Figure 2.1 shows the annual Korean government spending and revenues as percentages of GDP. Both variables increase over time. Prior to the 1997 crisis, fiscal policy was not commonly used as a stabilization tool. As a result, both government spending and revenues increased steadily as the economy expanded. However, since 1998, although both variables are still trending upward, the fluctuations have increased because of the active use of counter-cyclical fiscal policy (Lee, Rhee and Sung, 2006).

Figure 2.1 Government spending and revenues in the consolidated government finance

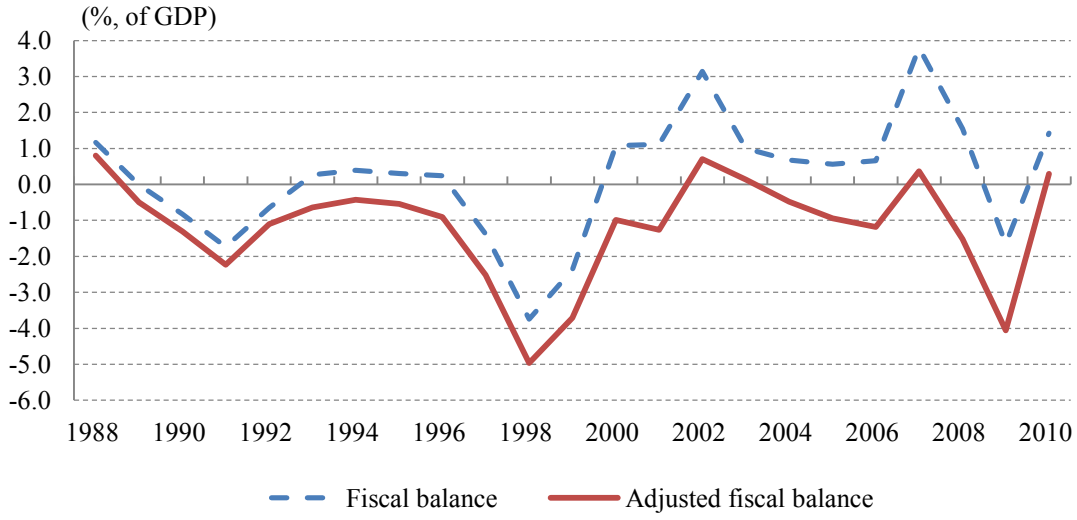


The Korean government budget has been in balance in most years, following the principle of 'spending within revenues'. The main exceptions are the two economic crises: the Asian crisis of 1997 and the global crisis of 2008. Due to its sound fiscal position, the Korean government could implement an expansionary fiscal policy to provide stimulus to the economy, which helped the economy to recover rapidly from these economic crises (Hong, 2010). In Figure 2.1, there are four noticeable episodes of fluctuations in government spending. The two fiscal expansions of 1998~1999 and 2009 are mainly driven by the

stimulus packages explained above. In 1990~1991, the government set to reverse the retrenchment of the 1980s to stimulate social and economic development. During the period from 2003 to 2006, the large changes in government spending are attributed to the redemption of public funds[5] which were used for financial restructuring during the crisis of 1997. Finally, since 2010, the Korean government has tried to cut spending to improve the fiscal position. Hence, except for responding to the two economic crises, the Korean government maintained a sound fiscal position.

Figures 2.2 and 2.3 show the time series of Korean government budget balance and debt as percentages of GDP. The consolidated budget balance stayed between -2.0% and 3.0% except for the two crises. The adjusted budget balance[6], defined as the consolidated budget balance minus the social security balance plus the redemption of public funds, was between -2.0% and 1.0%. Again, we can see clearly that both in 1998 and 2009, the government used fiscal policy as a counter-cyclical tool for stabilizing the economy. After 1999 and 2009, respectively, the government budget balance to GDP ratio returned to the pre-crisis level.

Figure 2.2 Fiscal balance to GDP ratio in Korea

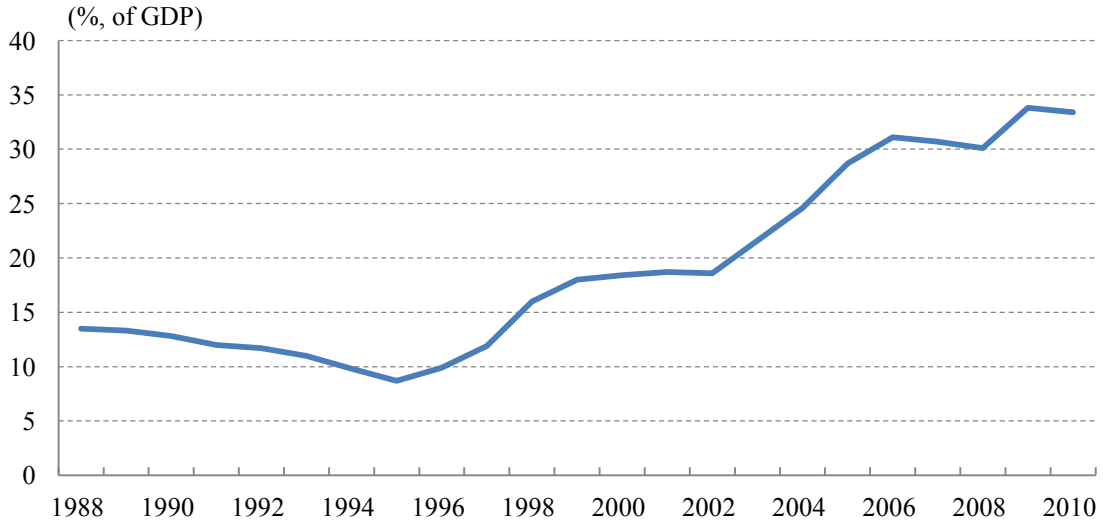


5. From 1998 to 2000, the government issued 102 trillion won in bonds, and the proceeds were used for financial restructuring such as settling deposit insurance claims as well as equity participation in and non-performing loan purchases from ailing financial institutions (Lee, Rhee and Sung, 2006).

6. The Korean government focuses on adjusted fiscal balance rather than consolidated fiscal balance when formulating fiscal policy.

Korean government debt also had been low, at around 10.0% of GDP, until 1997. However, the fiscal debt-to-GDP ratio has been increasing rapidly since 1998. This rapid rise can be attributed to a combination of the deficit stemming from the proactive counter-cyclical fiscal policy and fiscal facilities implemented during and in the wake of the 1997 crisis.[7] The debt has deteriorated further since the outbreak of the recent global crisis of 2008, as in many other countries. However, the Korean government has made considerable effort to return the level of national debt to the pre-crisis level as well as to prepare for fiscal consequences of the low birth rate and ageing. As a result of this effort, the government debt to GDP ratio was 33.4% in 2010, which is well below the average of OECD countries (97.6%).

Figure 2.3 Government debt to GDP ratio in Korea



To summarize, with the principle of 'spending within revenues', Korean fiscal policy has been focusing on achieving fiscal balance. Especially recently, Korean fiscal policy has given priority to fiscal soundness and sustainability. Nevertheless, the importance of fiscal policy in economic stabilization has grown since the Asian crisis of 1997. Therefore, this chapter focuses on the effects of government spending in Korea since the 1990s.

7. These are the Foreign Exchange Stabilization Bond, issued to raise funds to stabilize the foreign exchange market, the National Housing Bond, used for public provision of housing services, and the Public Fund, issued during the Asian financial crisis by the Korea Deposit Insurance Corporation and the Korea Asset Management Corporation, and gradually turned into government debt from 2003 to 2006.

4. Empirical Framework and Data

4.1. Constructing the exogenous fiscal series

(1) Identifying exogenous government spending shocks

In their narrative-approach study of the effects of government expenditure, Ramey and Shapiro (1998) are the first to use military build-ups to identify exogenous government-spending shocks. They argue that the large increases in military spending during such build-ups can be seen as exogenous shocks with respect to the state of the economy for several reasons. First, the demand for private-sector resources from military build-ups is heavily concentrated in the manufacturing sector. Second, they occur rapidly and unexpectedly and therefore can be interpreted as shocks. Third, because of their nature, military build-ups are less likely to affect private technology or to substitute for private consumption than other big spending programs such as building the highway system or upgrading the health care. Fourth, as they are driven by geopolitical shocks, military build-ups are likely to be exogenous and unrelated to macroeconomic variables. Ramey (2011a) extends the analysis by focusing on the role of expectations. She argues that the military built-ups have strong exogenous nature but lack quantitative information about expectations. Therefore, she constructs an estimate of changes in the expected present value of government spending from news sources to create a richer defense shocks variable.

However, the applicability of this approach is largely limited to the U.S. First, as Barro and Redlick (2011) point out, the destruction of domestic capital stock in many countries during wars prevents an analogous analysis. Most countries seldom experience military build-ups during which the country's territory is not threatened or directly affected by the conflict. The U.S., in contrast, was involved in several extra-territorial conflicts such as the Korean and Vietnam wars and the invasions of Afghanistan and Iraq. Second, military build-ups are far from representative of general government spending shocks. During military build-ups, government spending increases mainly in the defense sector. The effect on the economy therefore may be very different from those of fiscal shocks in the non-defense sector. Barro and Redlick (2011) make this point and argue that the resulting defense spending multiplier is different from the non-defense spending multiplier.

To address these concerns, we create a new exogenous series, the economic damages caused by natural disasters and the government spending response in their wake (natural disaster relief expenditure, henceforth NDRE). By their nature, natural disasters are unexpected and largely random events.[8] As a result, the relief expenditure in their aftermath can be used as exogenous government spending shocks.[9] These variables have important advantages compared to military build-ups. First, NDRE does not remove resources from the private or public sector because, in Korea, it is drawn from a dedicated emergency reserve fund.[10] Second, it constitutes urgent spending on alleviating the consequences of natural disasters. Therefore, NDRE has shorter time implementation lag compared to other fiscal policy innovations. As a result, it is easy to identify fiscal shocks, as the incidence of natural disasters is well known. Moreover, as NDRE is executed over a short period, it is better suited for an analysis of the short-run effects of government spending. Third, while military build-ups focus on the defense sector, NDRE usually covers a broad range of sectors. This broader coverage makes it similar in scope to the general government spending. Lastly, NDRE is less likely to affect labour productivity[11] or technological progress because it is basically used only for repairs and restoration to the original state.

To sum up, NDRE is better suited to analyze the effects of exogenous government spending shocks than military build-ups. This is particularly true in countries other than the U.S. for which using military build-ups is not practically possible. Furthermore, combining NDRE with the estimated economic damages from natural disaster is similar to Ramey's (2011a) approach: she collects quantitative information based on news reports on

8. Some natural disasters may to an extent be expected in that some areas are more prone to earthquakes or climate-related disasters than others. Furthermore, heavy storms, typhoons and other weather-related events tend to occur during particular times of year. However, the exact point at which such events occur and especially the extent of the damage remain largely unexpected.

9. The spending shock can be associated with anticipation effects in that the private sector may expect the increased spending after the natural disaster occurs and before the NDRE response is announced and implemented. However, the disaster itself and its propensity to inflict damage are exogenous and unexpected.

10. In Korea, up to 1% of the general budget is allocated to contingency funds in advance. NDRE draws on these funds to pay for urgent repair and relief. If necessary, additional expenditure is allocated into the public sector section of the general account in the following year's budget.

11. Labour and labour productivity can be affected by the damage and casualties caused by natural disasters. However, when compared to wars (even extra-territorial), casualties are small. In Korea, the highest number of casualties from a single natural disaster is 324. In contrast to this, the casualties from U.S. involvement in extraterritorial wars were considerable. Military build-ups, furthermore, also affect the labour market by removing large numbers of able-bodied men and women from the labour force, which is not the case with natural disasters.

expectations about future fiscal developments. Estimates of economic damages associated with each disaster are usually reported shortly after the disaster has occurred, and this can give rise to expectations in the private sector about the size of the NDRE response. We therefore augment the quantitative figure on NDRE with qualitative information about the damage caused.

One drawback of using damages from natural disasters to identify fiscal shocks is that disasters can be associated with adverse supply shocks from the destruction of capital stock and loss of lives. These could offset the effect of government spending on the demand side. However, the severity of natural disasters in Korea is usually not extreme and also each disaster typically affects only a limited geographical area. According to the EM-DAT database of the Centre for Research on the Epidemiology of Disasters (CRED)[12], during the last 20 years from 1991~2011, the most serious natural disaster in Korea, which occurred in August 2002, is ranked as 72th among the 7,944 disasters recorded in the world. Table 2.1 shows the Top 5 natural disasters in Korea for this period. The economic damages from the heaviest typhoon corresponded to just 2.83% of the GDP of the current quarter. Therefore, natural disasters in Korea are likely not to affect the supply side of the economy too strongly. Nevertheless, we will consider this issue in the section on robustness checks below. However, since output declines due to the natural disaster, the effect of the subsequent government spending on GDP may be compounded with the initial direct effects of the natural disaster. Therefore, in the strictest sense, we cannot interpret the effects of government spending in isolation from those of natural disasters exactly. As the two effects go in opposite directions, with the natural disaster depressing output and the fiscal response raising it, the effect we estimate can be interpreted as less than the effect of a fiscal shock alone.

(2) Sources

In Korea, up to 1% of the general budget is allocated to contingency funds for unexpected spending and emergencies. The contingency funds can be used promptly as their use requires only an approval by the Cabinet. We construct the NDRE series by reviewing the agendas of Cabinet meeting: these are available on the website of the National Archives of

12. The CRED was established in 1973 and has been active in the fields of natural disasters and conflict studies. Their EM-DAT database covers worldwide natural disaster and is freely available at http://www.cred.be/.

Korea for the period 1949 to 2001. Since 2004, the contents of each Cabinet meeting have been also reported on the official website for government policy promotion. To fill the occasional gaps between the two sources, we rely on the major Korean economic dailies such as ‘Hankyung’ and ‘Maekyung’ and official press releases.

The next step is to identify the spending on natural disaster relief among the many uses of the contingency funds. The contingency funds can be used for diverse unexpected purposes such as disaster relief, establishing new official organizations and implementation of new policies. Although there may be a difference between the amounts budgeted and the amounts actually spent on disaster relief, we collect the budgeted amounts, as it is very hard to discern the quarterly amounts of actual spending. In the case when the contingency funds are insufficient to cover the relief needs, such as when a particularly serious natural disaster occurs, the government makes a revised supplementary budget. To identify these cases, we consult the reports of revised supplementary budget reviews in the National Assembly. As with contingency funds, the revised supplementary budgets are made for several reasons such as economic stimuli, disaster relief and shortfall of government revenues. Therefore, it is necessary to classify the revised supplementary budgets according to their use.

Finally, we collect the estimated economic damages due to natural disasters from the National Emergency Management Agency of Korea. Missing observations are filled in based on information contained in the Cabinet meeting agendas.

Table 2.1 Top 5 Natural Disasters and corresponding NDRE from 1994 to 2010 (real billion won, 2005=100)

Disaster Quarter	NDRE Quarter	Total Damage	Main Disaster					NDRE		
			Description (Dates)	Damage	(%, of GDP)	No. Killed	Area	Total	Emergency Fund (Dates)	Supplement Budget (Dates)
1998.3q	1998.3q	1,460	Heavy rain (31/7~12/8/1998)	1,434	(1.00)	324	Chungchong, Gyeongsang	2,302	1,232 (20/8, 15/9)	1,070 (8/9)
1999.3q	1999.3q	1,369	Typhoon 'Olga' (23/07/1999)	1,199	(0.75)	67	Nation-wide, except Daegu	3,041	1,338 (13/8, 7/9)	1,703 (24/8)
2002.3q	2002.4q	6,556	Typhoon 'Rusa' (30/8/2002)	5,529	(2.83)	246	Chungchong, Gyeongsang	3,881	347 (24/9)	3,534 (17/9)
2003.3q	2003.4q	4,547	Typhoon 'Maemi' (12/9/2003)	4,367	(2.19)	131	Gyeongsang, Gangwon	3,773	621 (16/9, 23/9)	3,102 (24/10)
2006.3q	2006.3q	1,828	Typhoon 'Ewiniar' (9/7/2006)	1,814	(0.79)	62	Seoul, Incheon Kyunggido	2,620	583 (21/7, 17/8)	2,038 (31/8)

Notes: Disaster quarter and NDRE quarter refer to quarters in which the disaster occurred and the quarter to which the associated NDRE was allocated. Total damage is per quarter, main disaster damage refers to the main event of that quarter. Damage as percentage of GDP refers to quarterly GDP.

(3) Transforming the narrative information into quarterly data

The timing of NDRE is straightforward to identify because the relief expenditure closely follows the natural disasters. Therefore, NDRE data should be less affected by decision and implementation lags than other government spending. However, there is still the problem of anticipation effects associated even with relatively short lags. In other words, when the natural disaster occurs, the private sector can anticipate the NDRE response before the actual announcement of NDRE. The effects of anticipated policy changes can be different from those of unanticipated policy changes, as is the case also with military build-ups[13] or when using the SVAR approach.[14] To deal with the possible anticipation effect, the estimated economic damages are first transformed into quarterly data. The natural disasters are attributed to quarters depending on the last day of the underlying event. If the natural disaster ends during the last week of a quarter, following Ramey (2011a), it is assigned to next quarter because it has more effect on the response of private sector in the next quarter rather than the current quarter. Similarly, after collecting the amount of NDRE and the approval dates of contingency funds and revised supplementary budgets, we assign these spending decisions to quarters, with a rule that if the approval occurs in the last two weeks of a quarter, it is dated as belonging to the following quarter.[15]

Table 2.2 and Figure 2.4 show the transformed economic damages and NDRE. Several observations can be made based on these figures. First, the timing of NDRE closely tracks that of natural disasters: NDRE expenditure occurs in the same quarter as natural disaster or in the following quarter. This implies that we can indeed use natural disasters to identify exogenous government spending shocks. Second, the NDRE tracks the damages caused by natural disasters only imperfectly. As a rough

13. Ramey (2011a) uses the expected discounted value of government spending change to deal with anticipation due to long delays between the decision to increase military spending and the actual increase.

14. Blanchard and Perotti (2002) include expectation of fiscal shocks one quarter ahead in VAR because of the problem of anticipated policy, while Perotti (2007) tests the predictability of SVAR fiscal shocks and concludes that there is little evidence that SVAR shocks are predictable.

15. According to the Board of Audit and Inspection's analysis (2006), it took on average 6.3 days to allocate NDRE budget to executive agencies after Cabinet approval in 2004~2005.

indication, the correlation coefficient between the damages and NDRE is 0.26.[16] In other words, while the government generally responds to natural disasters by directing NDRE spending into the affected area, it has considerable discretion about the amount of spending. The natural disasters therefore can be used to identify spending shocks but the incidence of a natural disaster or even its severity does not predict the size of this shock. This is an important feature of our analysis: the macroeconomic effects that we identify using natural disasters are indeed those of spending shocks, not the effects of the natural disaster themselves.

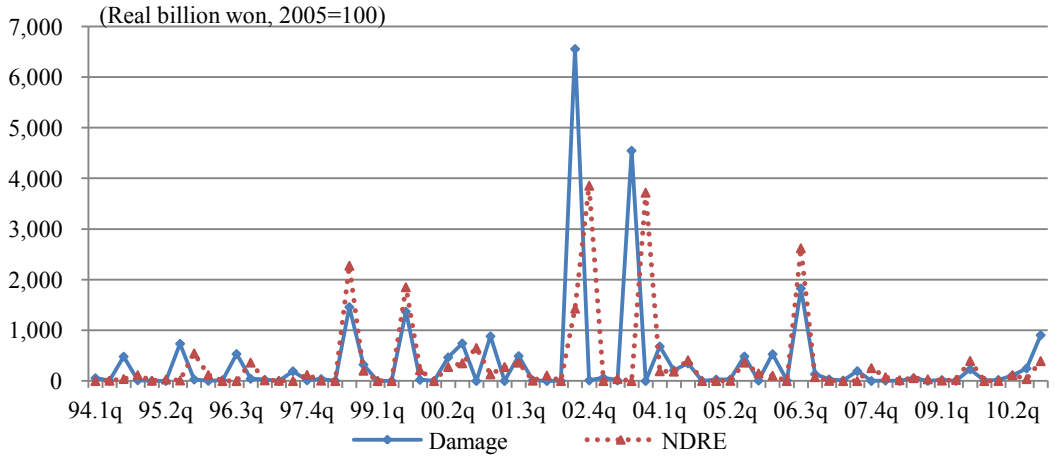
Table 2.2 The Economic damages and NDRE

(Real billion won, 2005=100)

Quarter	Damage	NDRE	NDRE/ GOV (%)	Quarter	Damage	NDRE	NDRE/ GOV (%)
94.1q	56.8	0.0	0.00	02.3q	6556.2	1430.2	7.40
94.2q	5.0	6.9	0.05	02.4q	12.2	3856.0	11.00
94.3q	481.1	39.8	0.29	03.1q	63.9	0.0	0.00
94.4q	13.9	115.8	0.56	03.2q	11.4	38.3	0.14
95.1q	0.8	5.4	0.05	03.3q	4547.4	0.0	0.00
95.2q	0.5	29.3	0.22	03.4q	0.0	3719.0	11.00
95.3q	736.1	11.4	0.07	04.1q	682.8	193.4	0.60
95.4q	30.0	546.2	2.37	04.2q	209.7	185.6	0.76
96.1q	3.6	119.3	0.86	04.3q	347.6	410.5	1.69
96.2q	16.0	0.0	0.00	04.4q	0.0	0.0	0.00
96.3q	533.3	0.0	0.00	05.1q	29.3	0.0	0.00
96.4q	44.7	363.6	1.37	05.2q	31.0	3.8	0.01
97.1q	23.4	13.6	0.09	05.3q	485.7	363.9	1.58
97.2q	0.0	5.7	0.03	05.4q	8.3	151.1	0.55
97.3q	193.1	0.0	0.00	06.1q	530.0	104.0	0.37
97.4q	12.3	120.3	0.43	06.2q	11.3	0.0	0.00
98.1q	38.8	7.6	0.06	06.3q	1827.7	2620.4	8.07
98.2q	3.4	0.0	0.00	06.4q	134.8	77.0	0.25
98.3q	1459.9	2275.7	10.16	07.1q	32.8	2.8	0.01
98.4q	323.0	203.6	0.80	07.2q	9.3	0.0	0.00
99.1q	1.3	0.0	0.00	07.3q	195.6	0.0	0.00
99.2q	0.0	0.0	0.00	07.4q	0.0	254.0	0.86
99.3q	1369.8	1852.0	9.82	08.1q	8.7	74.6	0.21
99.4q	23.1	218.0	0.94	08.2q	0.0	17.7	0.04
00.1q	0.0	0.0	0.00	08.3q	55.5	57.5	0.17
00.2q	467.6	277.6	1.41	08.4q	2.3	33.5	0.09
00.3q	742.8	349.8	1.57	09.1q	18.8	9.1	0.02
00.4q	0.0	652.9	2.41	09.2q	3.2	22.5	0.05
01.1q	883.0	131.5	0.62	09.3q	231.3	397.4	1.20
01.2q	0.0	275.8	1.25	09.4q	6.4	0.0	0.00
01.3q	493.1	363.5	1.45	10.1q	21.8	2.1	0.00
01.4q	12.9	7.6	0.02	10.2q	111.0	114.5	0.27
02.1q	0.0	107.8	0.49	10.3q	248.5	37.8	0.15
02.2q	0.0	0.0	0.00	10.4q	906.1	392.6	1.29

16. This, however, does not take into account the fact that some NDRE spending occurs with a lag of one quarter.

Figure 2.4 The comparison of economic damages and NDRE



This observation can be demonstrated by means of an example, drawn from Table 2.1, which reports on the top 5 disasters, the NDRE corresponding to them, as well as the timing of both the disasters and the NDRE responses. In each of these cases, revised supplementary budgets were required in order to make up for the shortage of contingency funds. The two largest disasters, typhoons 'Rusa' and 'Maemi' that struck Korea in the third quarters of 2002 and 2003, respectively, caused damages of won 5.5 and 4.4 trillion. The NDREs in their wake, however, were quite similar: won 3.8-3.9 trillion. Thus, two large events with substantially different economic impacts were met with almost identical responses in terms of the relief response.

Tables 2.3 and 2.4 show the explanatory power of the damages and NDRE variables with respect to changes of government spending. In the process of this analysis, government spending is divided into investment spending and consumption spending according to its nature in order to investigate the relationship between the variables more closely. Moreover, although the main analysis in the next section seasonally adjusts all variables, at this stage no seasonal adjustment is made because natural disasters themselves have seasonal characteristics. In Korea, typhoons and heavy rains almost always happen in the summer, heavy snowfalls in winter and droughts in spring. If only some variables are seasonally-adjusted, the actual relation between the variables would be underestimated.

Table 2.3 presents the Granger-causality test results. Regardless of the lags, damages clearly Granger-cause NDRE, government spending and especially

government investment spending. Table 2.4 shows the correlation between the various government spending variables and current and lagged disaster damages or NDRE. The strong positive correlation between government spending and lagged natural disaster damages again confirms that government spending responds to natural disasters, with a slight lag. Moreover, damages and NDRE are especially strong predictors of government investment spending, which is not surprising considering that much of the response to natural disasters is focused on infrastructure repair and restoration. However, current disaster damages have negative correlation with government spending and government consumption spending respectively, even if the significance is not high.[17] In summary, the natural disaster damage and NDRE are relevant instruments for analyzing the effects of government spending.

Table 2.3 Granger Causality Test

(Lags: 1)

Null Hypothesis	F-Statistic	P-value
Damages does not Granger Cause NDRE	71.469	0.000
NDRE does not Granger Cause Damages	0.062	0.804
Damages does not Granger Cause Government spending	4.936	0.030
Government spending does not Granger Cause Damages	0.035	0.852
Damages does not Granger Cause Government consumption spending	0.002	0.964
Government consumption spending does not Granger Cause Damages	0.051	0.823
NDRE does not Granger Cause Government investment spending	35.849	0.000
Government investment spending does not Granger Cause NDRE	0.001	0.970

Table 2.4 Correlation between government spending and natural disaster damages

Variables	Damage	Damage(-1)	NDRE	NDRE(-1)
Natural disaster relief spending (NDRE)	0.257 (0.036)	0.706 (0.000)	1	1
Government spending	-0.246 (0.045)	0.279 (0.022)	0.173 (0.162)	0.072 (0.565)
Government investment spending	-0.118 (0.342)	0.605 (0.000)	0.446 (0.000)	0.229 (0.062)
Government consumption spending	-0.253 (0.039)	-0.022 (0.857)	-0.060 (0.629)	-0.054 (0.663)

Note: Government spending variables are linearly-detrended and real per capita. P-value in parentheses.

17. One possible interpretation for the negative correlation is the seasonality. In Korea, while most severe natural disasters strike during summer, government spending in the third quarter is relatively small due to common practices such as front-loading of the budget execution. Therefore, this correlation may be spurious.

4.2. Macroeconomic Data

To analyze the dynamic effects of exogenous government spending on economic activity, quarterly data for the following 8 macroeconomic variables are used in this chapter: government spending (g_t) and revenues (t_t), GDP (y_t), private consumption (c_t), investment (i_t), real wage (w_t), interest rate (r_t), and real effective exchange rate (e_t). The data are available for the period, 1994-2010, which could be regarded as being somewhat short for VAR analysis. The relatively short period may be a limitation of our analysis in this chapter.[18]

All variables are seasonally adjusted using the X-12 ARIMA method and expressed in real terms by using the GDP deflator, except for the nominal interest rate. In addition, all variables except the real effective exchange rate (e_t) are linearly-detrended to emphasize the short-term changes and expressed as logs of real per capita terms to remove the effects of demographic changes.

(1) Government spending (g_t) and revenues (t_t)

These data are collected from the Consolidated Government Finance Statistics of the Ministry of Finance. In Korea, quarterly data on government spending (g_t) and revenues (t_t) are available only from 1994 onwards. They are recorded on cash basis[19] and cover only the fiscal activity of the central government. The data for the general government including local governments have been made public only since 2005. In line with the definition used by Blanchard and Perotti (2002), government spending (g_t) is defined as total purchases of goods and services (i.e., government consumption + government investment). Revenues (t_t) are net revenues (i.e. total revenues – transfers – interest payments). We adjust the total expenditure and total revenues of consolidated government finance according to this definition.

(2) GDP (y_t), Private Consumption (c_t), Investment (i_t) and Private wage (w_t)

The first three variables are collected from the National Accounts published by

18. Nevertheless, other papers also use a VAR model with quarterly data and with similar numbers of observations, see for example Giordano et al. (2007) and De Castro and Hernandez De Cos (2008).

19. Spending and taxes are recorded at the time the cash transaction actually occurs, for instance, when a tax is actually paid. This is different from accruals in which case spending and taxes are recorded at the time of the activity that generates the pending obligation to pay or revenues to be recognized, even though the actual transaction occurs later.

the Bank of Korea. We include these variables to analyze the macroeconomic effects of fiscal policy. Quarterly private investment data can be obtained only from 2000. Therefore, the variable that we use comprises investment in both the private and public sectors.[20] Private wage (w_t) is the average wage of firms with 10 or more full-time employees, as reported by the Korean Statistical Information Service of the Statistics Korea.

(3) Interest rate (r_t) and Real effective exchange rate (e_t)

Interest rate (r_t,) and real effective exchange rate (e_t) are included to control for monetary policy and external factors. The interest rate that we use is the call rate of the Bank of Korea. This variable is included in order to control for monetary policy (Ramey, 2011a). The call rate had been used as a policy rate by the Monetary Policy Committee of Korea from 1999 to 2008. Real effective exchange rate (e_t) is obtained from the statistics system of The Bank for International Settlement. This variables is added to reflect external factors as in Hur (2006)

4.3. Analytical framework

For the narrative approach, the effects of a fiscal shock are estimated with the following reduced-form VAR:

$$X_t = A + B(L)X_{t-1} + C(L)D_t + \varepsilon_t$$

X_t is a vector of endogenous variables, A is a constant term. B(L) is a P-order lag polynomial and C(L) is an (R+1)-order lag polynomial. D_t is the narrative-based measure of fiscal shocks and ε_t is the vector of reduced-form innovations. The narrative fiscal shock variable, D_t, comprises the economic damages from natural disasters. This specification follows Burnside et al. (2004) and Engemann et al. (2008) who include narrative shocks as an exogenous variable in their VAR system, unlike Ramey and Shapiro (1998) who include them as a dummy variable in a univariate AR, or Ramey (2011a) who includes them as an endogenous variable in a VAR.[21] To analyze the effects on a number of variables without losing degrees of

20. This is a potentially important drawback. The shocks to government spending include investment spending by the government. Therefore, because the response of the investment variable comprises government investment spending itself, the effect on private investment can be overestimated.

21. We also analyze a specification with D_t as a dummy variable as in Ramey and Shapiro (1998). In

freedom by including too many variables in the VAR, we follow Burnside et al. (2004) in that we use a fixed set of variables in X_t and add other variables to X_t one at a time. The fixed set consists of government spending (g_t), revenues (t_t), GDP (y_t), interest rate (r_t), and real effective exchange rate (e_t).

5. Empirical Results[22]

This section shows the impulse responses resulting from one unit fiscal shock. Each equation includes the endogenous variables with four lags, based on the results of LR and AIC test, and exogenous variables with lags 0 to 2, according to the lag exclusion tests. The confidence interval is 68% bands as in most previous studies.[23] Therefore, "statistical significance" can be defined as the error band not containing zero. To compare the results of the two approaches, we follow Ramey (2011a) and normalize the effects of shocks so that the response of government spending is 1.00 at its peak.

5.1. The response of macroeconomic variables using the narrative approach

Figure 2.5 depicts the response of macroeconomic variables to the increase of government spending in the wake of natural disasters. First, when natural disaster occurs, government spending rises for 2 quarters, peaking in the first one. This is in line with our observation in the previous section that it takes 1~2 quarters for government to execute the Natural Disaster Relief Expenditure (NDRE) after a natural disaster. After the third quarter, the response of government spending returns to being insignificant. GDP also rises, peaking in the third quarter. The government spending shock therefore appears to raise the GDP. The response of GDP is positive

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this analysis, the dummy variable takes a value of unity only in 1998.3q, 1999.3q, 2002.3q, 2003.3q and 2006.3q and zero in others. This result is very similar, as shown in Appendix 1. A.

22. The analysis based on the narrative approach follows the procedures used in Engemann et al. (2008) using Matlab. For the SVAR analysis, we follow the procedures of Ramey (2011a) using Stata.

23. In the narrative approach, to get 68% confidence intervals, bootstrapped confidence interval is obtained by the percentile method (16/100*500, 84/100*500) with 500 replications (Matlab software). In the SVAR approach, one standard error is computed by the asymptotic standard error (Stata software). The empirical literature on the effects of fiscal policy uses 68% or 95% error bands. 68% is used in Ramey (2011a), Blanchard and Perotti (2002), Francisco et al. (2006), Caldara and Kamps (2008), Engemann et al. (2008), while 95% is used in Burnside et al. (2003), Perotti (2005, 2007), Ramey (2011a). Additionally, our results with 95% error bands using the narrative approach are shown in Appendix 1. B.

already during the first quarter, which has two possible interpretations. One is that natural disasters do not affect the supply side of the economy, which we return to again in the next section when we present robustness checks. The other is that the anticipation of the rise in government spending makes the GDP rise. The elasticity of GDP to the government spending peak is 0.18. This is similar to Ramey's finding of 0.23. Since the average ratio of nominal GDP to nominal government spending is 7.78 during the period covered by this analysis, the government spending multiplier is 1.42 which is larger than the 0.48 obtained by W. Kim (2006) for Korea, or 1.29 of Blanchard and Perotti (2002) and 1.1 of Ramey (2011a) for the U.S. After the recent fiscal stimulus in response to the global crisis, several new contributions study the size of fiscal multiplier and how it depends on the underlying state of the economy (Auerbach and Gorodnichenko 2011, 2012; Baum et al., 2012). They show that the government spending multiplier tends to be much larger in recessions than in expansions. This is because of excess capacity during recessions, which leads to less crowding-out in the private sector. According to Auerbach and Gorodnichenko (2011, 2012), government spending peak multiplier is 0.57 in expansions, and 2.48 in recessions for the U.S., and 0.04 in expansions and 0.68 in recessions for OECD countries. In our analysis, even although the decline of GDP due to natural disasters is not large, the negative effect of natural disaster preceding the fiscal shock may be similar to the effect of recessions identified by the aforementioned literature. Therefore, our multiplier is likely to be larger than the typical fiscal multiplier.

The effect on revenues closely mirrors the response of GDP and consumption with a lag of 2 quarters. This is not surprising, given that tax receipts reflect economic activity over the preceding months. In addition, the increase in government spending is financed mainly by emergency funds which do not require any new taxes to be levied while the revised supplementary budget is financed by issuing new government debt and by non-tax revenues rather than tax revenues.[24] Revenues display large positive response to the increase of government spending during the first quarter. When total revenues are replaced by tax revenues, the

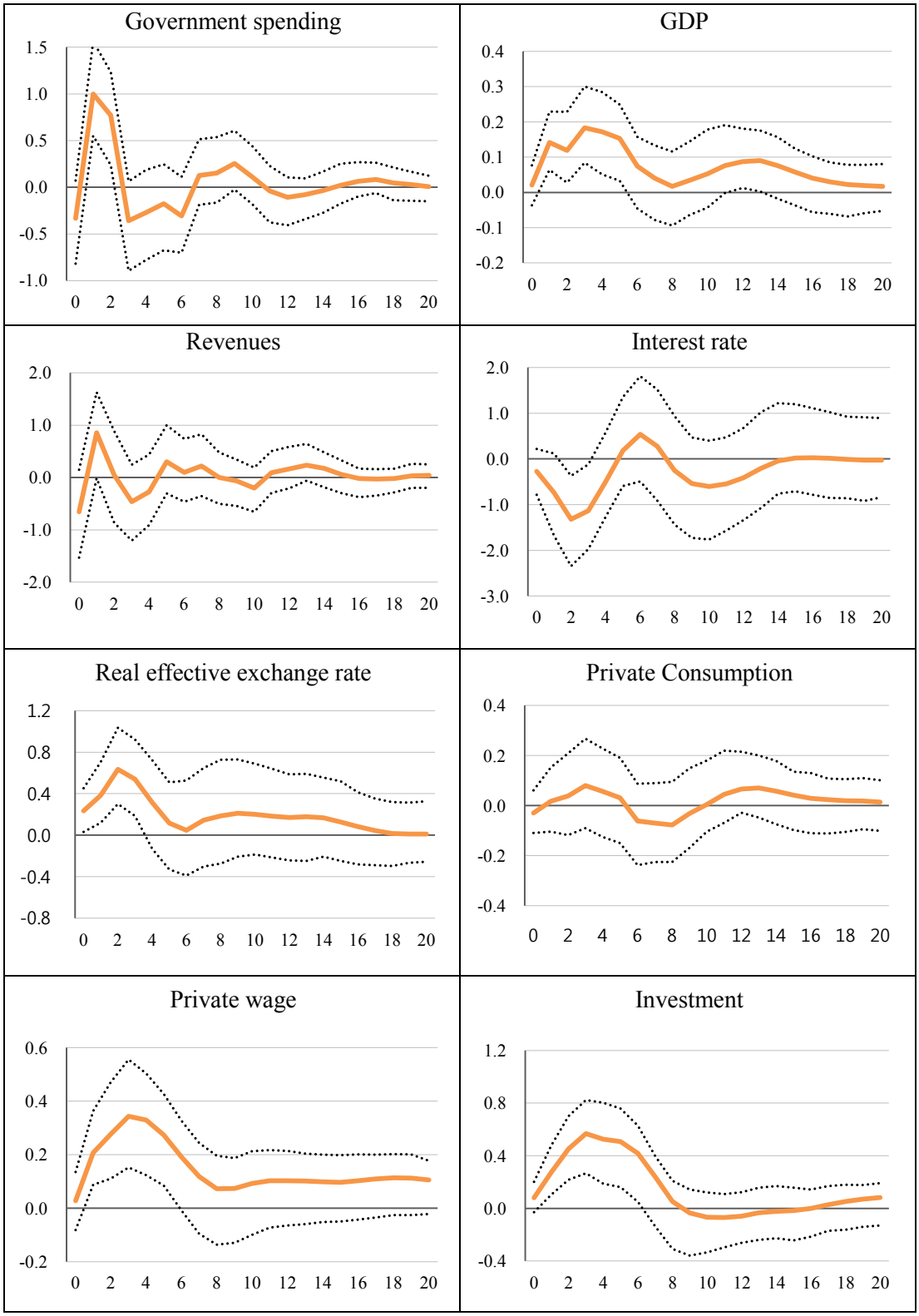
24. Revenue is comprised of tax revenue, non-tax revenue, capital revenue, and grants. For example, while the revised supplementary budget of Oct.2003 (3,000 billion won) was financed totally by government debt, the one of Aug.2006 (2,155 billion won) was financed by government debt (60.3%) and the surplus of finance of previous year (39.7%). Therefore, the government debt, which is not included in government revenues, can be a variable of interest too. However, it cannot be used in our analysis because government debt is published not in quarterly data but only in annual frequency.

response in the first quarter is negative but subsequently turns upwards.[25] This implies that the increase in government spending is driven mainly by non-tax revenues such as sales of public enterprises' stocks or government debt. From the second quarter onwards, the response of revenues is not related to government spending. Figure 2.5 also shows the response of the interest rate and real effective exchange rate. The interest rate falls for four quarters after the shock. On the other hand, the real effective exchange rate appreciates over the same period. As of the fifth quarter, the responses of these two variables return to being insignificantly different from zero. These results go against the generally inverse relation between interest rate and exchange rate according to the interest parity condition. These two variables are included to control for monetary policy and foreign effect. Therefore, this response is most likely due to monetary policy and foreign effects rather than government shocks. We will return to this in the next section.

The next set of graphs depicts the response of the components of GDP. The previous literature tends to find different responses of private consumption and real wage according to the two identification approaches. In most studies relying on the narrative approach, for example, Ramey and Shapiro (1998), Ramey (2011a) and Burnside et al. (2004), private consumption and real wage fall, which is consistent with a negative wealth effect. However, in our analysis, consumption increases, although the error band includes the zero. This increase of private consumption continues until the fifth quarter. Therefore, we can conclude that private consumption is not crowded out by government spending. The response of the real wage is similar: it remains significantly positive for five quarters. These results are consistent with the New Keynesian model. Nevertheless, they can be reconciled also with the Neoclassical model. As Aiyagari et al. (1992) and Baxter and King (1993) argue, a temporary increase in government spending creates a weak negative wealth effect compared to a permanent increase, leading to much smaller effects on consumption and labour-supply. In the case of natural disasters, the increase in government spending for relief and repair is indeed quite temporary. Therefore, private agents are aware of this fact so that their permanent income does not get affected much.

25. The results with tax revenue are in Appendix 1. C.

Figure 2.5 The response of macroeconomic variables using the narrative approach



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

The results for the response of investment vary in the previous literature, and in this case this variation does not seem to depend on the identification method.[26] Baxter and King (1993) and Blanchard and Perotti (2002) argue that investment can rise or fall depending on the persistence of the shocks and the relative strength of the effects of GDP and interest rate. In our analysis, investment increases significantly and substantially during two years after the shock. The large and long-term positive response can be attributed to two factors. The first one is the decrease in the interest rate in response to government spending shocks. The other is a limitation of the investment data in that they include government investment: the relief effort in the wake of natural disasters usually involves large-scale construction (both public and private). Because investment includes public investment, the effect on investment can be overestimated. We, therefore, analyze the response of private investment only, for which data are available since 2000. This response is smaller than before but still positive.[27] The investment response, along with that of private consumption, is likely to contribute to the response of GDP, given that the patterns of their responses are very similar.[28]

To sum up, the response of GDP to the government spending shock is positive, as expected. As for nominal interest rate and real effective exchange rate, they are included to control factors such as monetary policy and foreign factors. As a result, their responses are less related to the government spending shock. Although we use a narrative approach, consumption and real wage increase for five quarters, which contradicts the previous findings based on the narrative approach such as Ramey (2011a). Therefore, what is important for the analysis is not the identification method but the instrument used. All previous narrative studies use the military build-ups of the U.S. Using relief spending in the wake of natural disasters, we obtain strikingly different results.

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26. Blanchard and Perotti (2002), Perotti (2005) and Ramey (2011a) find a negative response of investment, while Burnside et al. (2004), Giordano et al. (2007), and Francisco et al. (2006) obtain a positive response.

27. This result is shown in Appendix 1. D.

28. For the period of 1994~2010, the average contribution of investment to change in real GDP is 33.1% and that of private consumption is 51.2%.

5.2. The response of macroeconomic variables using the SVAR

Much of the literature on Korean fiscal policy uses the SVAR approach, following the approach of Blanchard and Perotti (2002). Therefore, it is instructive to compare our results (obtained with the narrative approach with natural disaster damage) with those obtained with the SVAR approach. In this chapter, the SVAR specification follows Perotti (2005) who uses five variables rather than Blanchard and Perotti (2002) who include three variables (*g, t,* and *y*).

The reduced form p-order VAR is formulated as follows[29]:

$$Y_t = B(L)\, Y_{t-1} + U_t.$$

Y_t is n×1 vector of economic variables, B(L) is a polynomial of lag operators and $U_t \sim N(0,\Sigma)$ are reduced-form innovations, which in general have non-zero correlations.

The structural representation of the VAR can be written as

$$A_0 Y_t = A(L)\, Y_{t-1} + e_t$$

The objective is to identify structural shocks (e_t), which are defined as linear combinations of the reduced-form innovations (U_t); $e_t = A_0 U_t$, where $A_0^{-1}\Omega A_0^{-1'} = \Sigma$, $e_t \sim N(0, \Omega)$ and structural innovations(e_t) are mutually uncorrelated.[30]

The reduced-form innovations of government spending (u_t^g) and revenues (u_t^t) can be expressed as linear combinations of three types of shocks: first, the automatic response of government spending and revenues to innovations in the macroeconomic variables, second, the systematic discretionary response of policymakers to these innovations, third, random discretionary fiscal policy shocks which are taken as uncorrelated with structural shocks. Thus, we can write the following two equations:

$$u_t^g = \alpha_{gy} u_t^y + \alpha_{gr} u_t^r + \alpha_{ge} u_t^e + \alpha_{gc} u_t^c + \beta_{gt} e_t^t + e_t^g$$

$$u_t^t = \alpha_{ty} u_t^y + \alpha_{tr} u_t^r + \alpha_{te} u_t^e + \alpha_{tc} u_t^c + \beta_{tg} e_t^g + e_t^t$$

29. We analyze this effect by the recursive approach with Cholesky ordering again. However, the results are not significantly different from those obtained with standard SVAR.

30. The covariance matrix (Ω) of structural innovations is assumed to be a diagonal matrix.

When using quarterly variables, the systematic discretionary response of policymakers to the macroeconomic variables is zero because it typically takes more than a quarter for policymakers to implement new measures due to the decision and implementation lags. Therefore, the coefficients α_{ij} capture only the automatic elasticity of the fiscal variable *i* to the macroeconomic variable *j*. The coefficients β_{ij} reflect how the structural shock to fiscal variable *j* affects contemporaneously the fiscal variable *i*. Similarly, as for other macroeconomic variables, assuming that GDP is ordered first[31] followed by the interest rate, real effective exchange rate and components of GDP, the relationship between the reduced-form innovations (U_t) and the structural shocks (e_t) can be written as

$$u_t^y = \alpha_{yg} u_t^g + \alpha_{yt} u_t^t + e_t^y$$

$$u_t^r = \alpha_{rg} u_t^g + \alpha_{ry} u_t^y + \alpha_{rt} u_t^t + e_t^r$$

$$u_t^e = \alpha_{eg} u_t^g + \alpha_{ey} u_t^y + \alpha_{et} u_t^t + \alpha_{er} u_t^r + e_t^e$$

$$u_t^c = \alpha_{cg} u_t^g + \alpha_{cy} u_t^y + \alpha_{ct} u_t^t + \alpha_{cr} u_t^r + \alpha_{ce} u_t^e + e_t^c$$

The variance-covariance matrix of the reduced-form innovation has 21 elements while the above system of equations has 24 coefficients to be identified. In order to identify it, some restrictions on coefficients must be imposed. First, as in Blanchard and Perotti (2002), because government spending (g_t) and revenues (t_t) are defined net of transfers and interest payments, their elasticities with respect to the interest rate are zero. Second, government spending is determined before GDP and any other economic variables in quarterly data.[32] This assumption presumes that all other variables have no contemporaneous impact on government spending, which means that $\alpha_{gy} = \alpha_{ge} = \alpha_{gc} = \beta_{gt} = 0$.[33] Lastly, the output elasticity of net revenues is estimated as α_{ty}=1.116; this figure being based on the national fiscal management

31. According to Perotti (2005), the ordering of the other variables after GDP is immaterial if one is only interested in estimating the effects of fiscal policy shocks.

32. In Korea, the government usually determines the spending for the next fiscal year on the basis of prospective revenue. During the fiscal year, subsequent fluctuations of tax receipts then do not affect government spending.

33. According to Blanchard and Perotti (2002) and Perotti (2005), the ordering among the fiscal shocks does not matter so that assuming β_{gt}=0 or β_{tg}=0 makes little difference to the results.

plan (2009) of Korea.[34] Imposing these restrictions on the coefficients, the relation between the reduced-form innovations and the structural shocks can be expressed in a matrix form as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ -\alpha_{yg} & 1 & -\alpha_{yt} & 0 & 0 & 0 \\ 0 & -1.116 & 1 & 0 & -\alpha_{te} & -\alpha_{tc} \\ -\alpha_{rg} & -\alpha_{ry} & -\alpha_{rt} & 1 & 0 & 0 \\ -\alpha_{eg} & -\alpha_{ey} & -\alpha_{et} & -\alpha_{er} & 1 & 0 \\ -\alpha_{cg} & -\alpha_{cy} & -\alpha_{ct} & -\alpha_{cr} & -\alpha_{ce} & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^y \\ u_t^t \\ u_t^r \\ u_t^e \\ u_t^c \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ \beta_{tg} & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^g \\ e_t^y \\ e_t^t \\ e_t^r \\ e_t^e \\ e_t^c \end{bmatrix}$$

As in the narrative analysis, the other variables of interest such as investment (i_t) and real wage (w_t) are added one by one instead of private consumption.

Table 2.5 shows the estimated coefficients of the contemporaneous relations between the reduced-form innovations and the structural shocks.[35] The signs of the contemporaneous effects of taxes and spending on GDP meet the general expectation that government spending has a positive effect on GDP and revenues have a negative effect. Most of the other coefficients except for α_{rg} have the expected signs. Similar to the narrative approach, interest rate is more related to monetary rather than fiscal policy. Therefore, this specification and assumptions could be regarded as reasonable.

Table 2.5 Estimated contemporaneous coefficients

	α_{yg}	α_{yt}	α_{te}	α_{tc}	α_{rg}	α_{ry}	α_{rt}	α_{eg}	α_{ey}
Coef	1.15***	-7.19***	-31.72***	105.69***	-1.34***	105.89***	-2.90***	4.64***	50.08***
t-stat	-7.15	11.27	-7.34	11.36	6.39	-10.95	3.10	-9.53	-3.60
	α_{et}	α_{er}	α_{cg}	α_{cy}	α_{ct}	α_{cr}	α_{ce}	β_{tg}	
Coef	-1.55	13.26***	-2.74***	109.02***	-1.79**	-9.32***	-46.05***	1.33***	
t-stat	1.58	-11.08	4.04	-6.22	1.79	5.02	11.24	6.17	

Note: *** significant at 0.01 level, ** significant at 0.05 level, * significant at 0.10 level

34. The national fiscal management plan calculates the elasticity using the OECD Revenue Statistics (Oct. 2008). It also shows that the average OECD elasticity is 1.07. Elasticities used elsewhere in the literature are 1.85 (Perotti, 2005), 1.09 (W. Kim, 2006) and 0.62 (De Castro and Hernández De Cos, 2008).

35. While we follow the specification of Perotti (2005), we use the SVAR model of STATA (Ver.11.2) instead of using structural fiscal shocks (e_t^g, e_t^t) as a mean of instrumental variables like Perotti (2005).

Figure 2.6 shows the impulse response function with 68% error bands.[36] In the SVAR approach, the shock to government spending displays little persistence. This is similar to the finding of Hur (2007) with Korean data and Giordano et al. (2006) with Italian data. However, in most other SVAR studies (Blanchard and Perotti, 2002; Perotti, 2005; De Castro and Hernández De Cos, 2008; and Caldara and Kamps, 2008), the response of government spending to its own shock persists for quite a long time. As Giordano et al. (2006) suggest, one possible explanation is the different aggregation. Korean fiscal data, just as Italian fiscal data, are reported quarterly on a cash-basis.[37] However, in most other studies, fiscal data are reported on an accrual-basis. According to Giordano et al. (2006), there is no consensus as to whether the cash-basis or accrual-basis data are more appropriate when studying the impact of government operations on the economy. However, in this chapter, the lack of persistence of fiscal shocks is rather useful when comparing it with the temporary government shock by the natural disaster in the narrative approach.

GDP increases for five quarters in response to a shock in government spending, peaking in the third quarter and returning to normal in a hump-shaped pattern as expected. The elasticity of the GDP peak is 0.07 and the government spending multiplier is 0.56, given the average ratio (7.78) of nominal GDP to nominal government spending.[38] This multiplier is very close to W. Kim's (2006) estimate of 0.48, even though the data and period are different. Note that the multiplier is substantially lower when estimated with the SVAR compared to the one obtained with the narrative approach: a possible reason for this difference is the fact that the SVAR approach is often regarded to omit anticipation effects (Ramey, 2011a).

Revenues rise in the quarter in which the shock of government spending occurs. However, they fall thereafter in the first quarter and then return to normal soon afterwards and follow GDP with one quarter lag. The response of the interest rate is negative for four quarters and afterwards remains near zero. This negative response is contrary to the theory which predicts a positive response because of higher

36. As in the narrative analysis, results with 95% error bands using the SVAR approach are in Appendix 1. E.

37. In Korea, national account quarterly data for government investment have been reported only since 2000. In Italy, national account quarterly series starting in 1980 are available.

38. Although the peak multiplier is relatively small, the cumulative multiplier for 2~4 quarters with significant response of GDP is 1.44.

demand and inflationary pressure, but is likely affected by monetary policy in the same way as in the narrative approach. The real effective exchange rate initially appreciates and then depreciates slightly. The next two variables (private consumption and investment) display similar response patterns. They increase at first for one and half years, then fall for about two years and return to zero. The positive response of investment is partly related to the negative response of interest rate to a shock of government spending. Likewise, the response of real private wage is significantly positive at almost all horizons. These results are consistent with most of other SVAR studies for other countries. Given that private consumption and investment are components of GDP, the response of GDP follows a similar pattern.

Figure 2.6 The response of macroeconomic variables using the SVAR approach

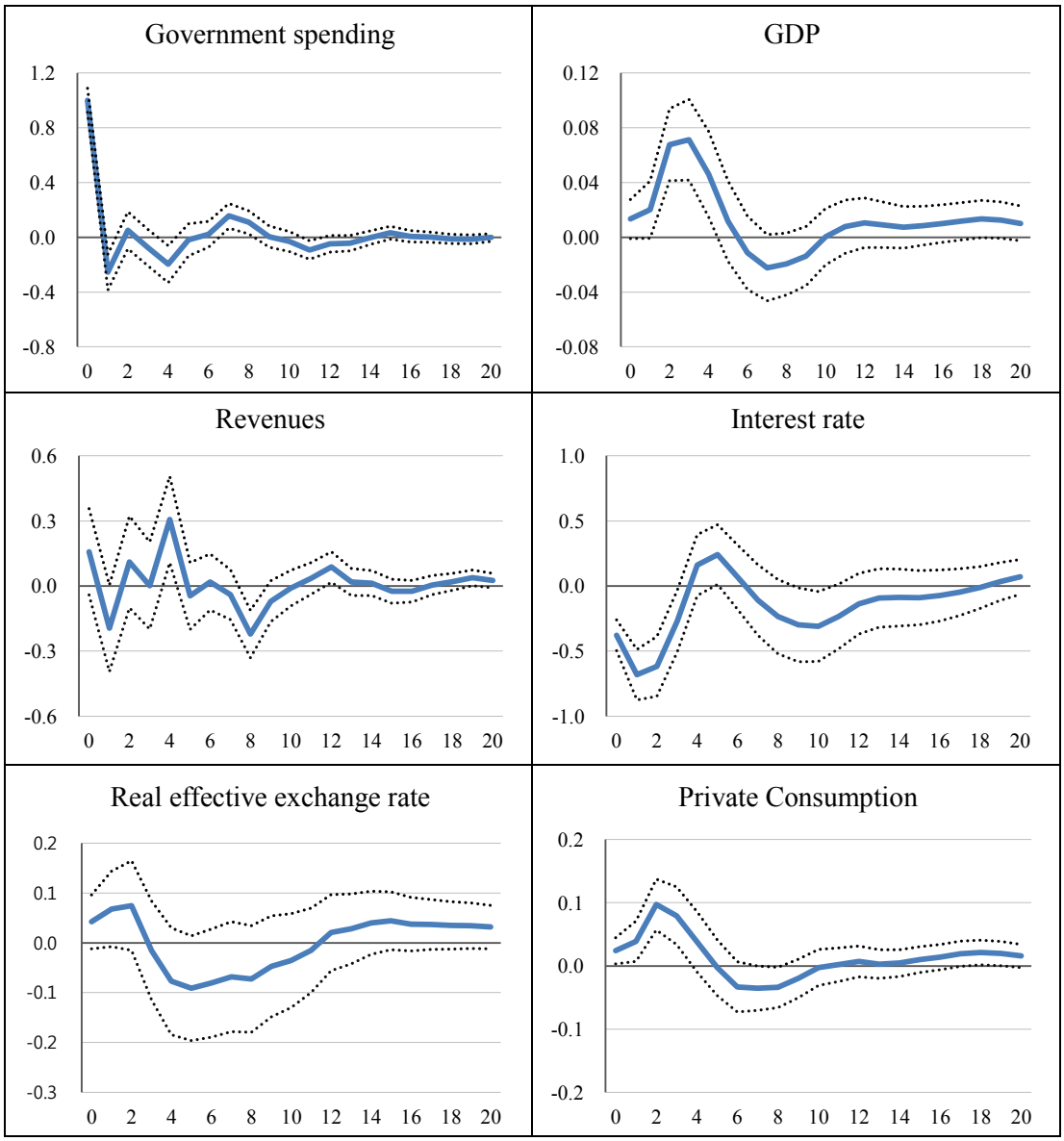
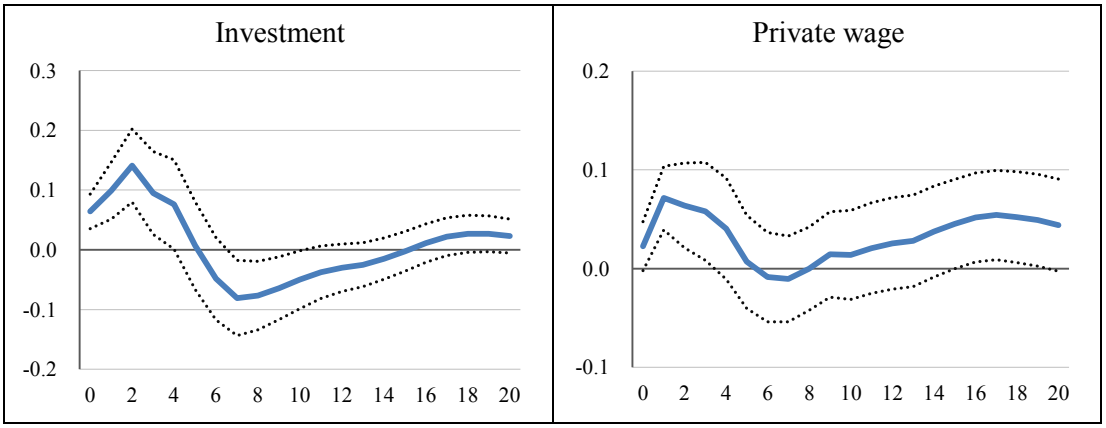


Figure 2.6 The response of macroeconomic variables using the SVAR approach (continued)



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

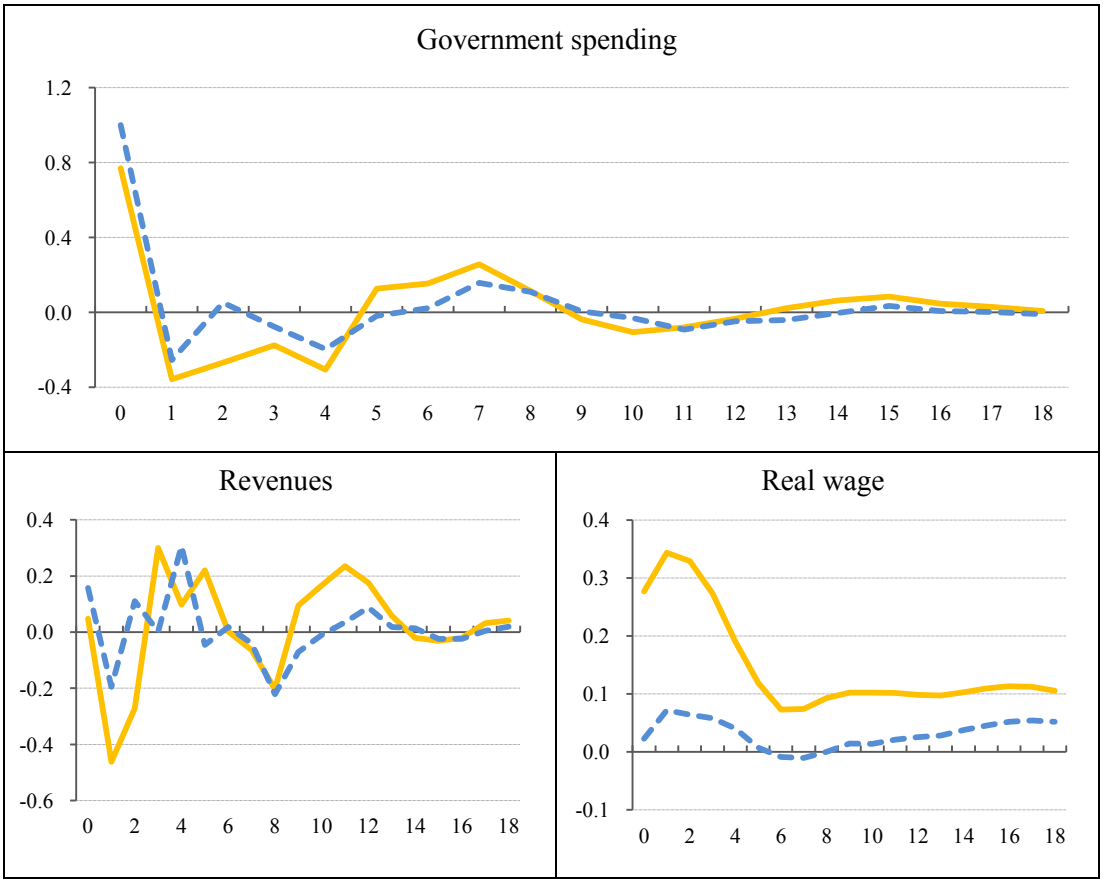
5.3. Narrative and SVAR approaches compared

Comparing the results from the two approaches reveals two interesting observations. First, the two sets of results show very similar response patterns but with a lag. This is analogous to the observation of Ramey (2011a). For all variables, the peak response appears several quarters later in the narrative approach than in the SVAR approach. For the responses of government spending, the peak appears in the zero-th quarter according to the SVAR approach. However, in the narrative approach, it takes place 1~2 quarters later. In order to take account of this lag, we shift the response of fiscal variables (government spending and revenues) two quarters ahead in the narrative approach to align the impulse responses with those obtained in the SVAR approach. We shift the other variables (GDP, interest rate, private consumption, and investment) by only one quarter ahead because this again produces impulse responses similar to those of SVAR.[39] The real wage impulse response, finally, is lagged by two quarters. This means that the private sector responds in advance of the increase of government spending. This could be due to an 'anticipation effect' which was highlighted in many other studies (Blanchard and Perotti, 2002; Perotti, 2005; and Ramey, 2011a). We can guess that after natural disaster, people expect the subsidy from the government and buy relief items even before receiving the subsidy. Therefore, reconstruction is already in progress before government expenditure for relief is disbursed.

39. In this analysis of time lags, we exclude the real effective exchange rate because it is more related to foreign factors than to Korean fiscal policy.

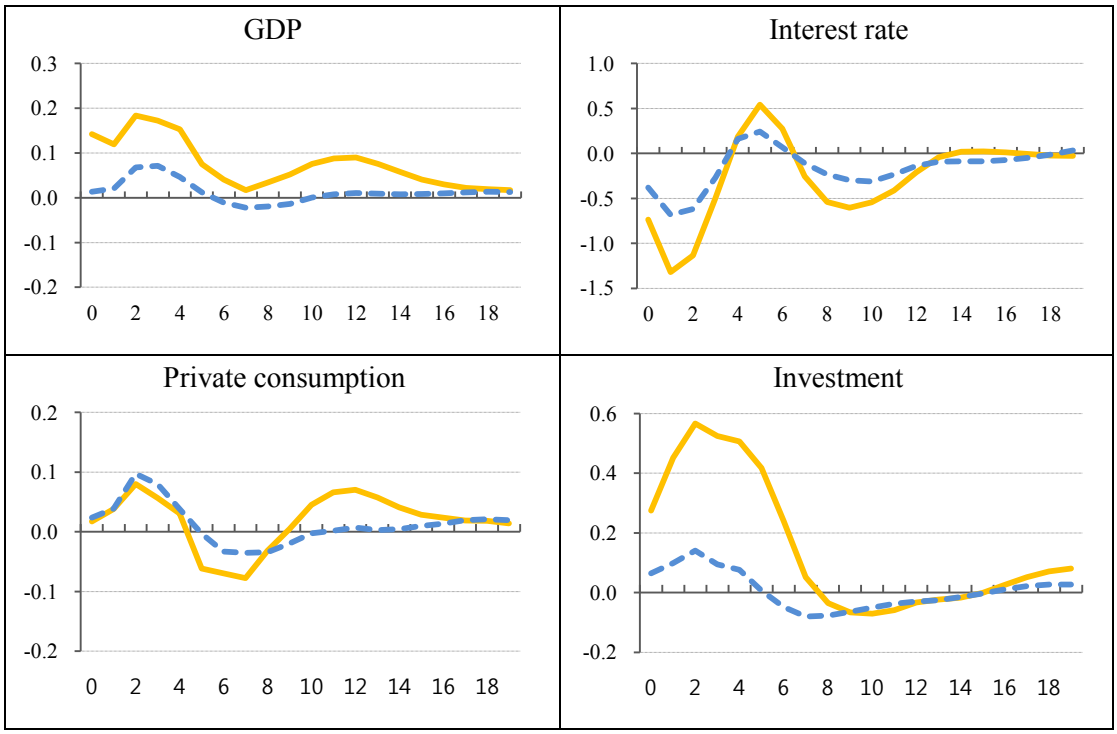
Figures 2.7 and 2.8 show the results with forward-shifted responses obtained with the narrative approach. Considering that the previous literature finds different effects on consumption and real wage depending on the identification method, the similarity between the two sets of results is very interesting. Government spending shocks raise the GDP, private consumption, investment and the real wage. Therefore, in the short term, a temporary increase in government spending can stimulate the economy through its crowding-in effects on private consumption and investment. This empirical result fits the New Keynesian model better, although the negative response of interest rate is somewhat inconsistent with it. At the same time, it also shows that the natural disaster damage variable has explanatory power to identify exogenous fiscal shocks.

Figure 2.7 The comparison of the responses from two quarters forward-shifted in the Narrative approach



Note: The solid lines display the responses from two quarters forward-shifted in the Narrative approach and the dash lines display the responses from SVAR approach.

Figure 2.8 The comparison of the responses from one quarter forward-shifted in the Narrative approach



Note: The solid lines display the responses from one quarter forward-shifted in the Narrative approach and the dash lines display the responses from SVAR approach.

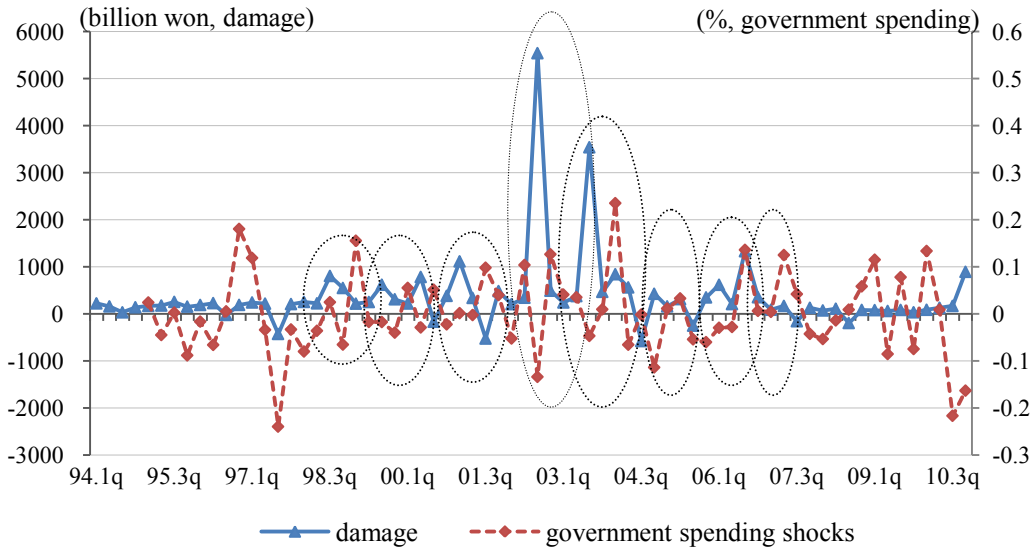
The second interesting finding is that although the directions of responses according to the two approaches are similar, the magnitudes of the responses are very different. For example, both approaches suggest that GDP increases in response to a government spending shock following a hump-shaped pattern but the elasticity of GDP according to the narrative approach (0.18) is almost two and half times larger than that obtained with the SVAR (0.07).

Several possible explanations could be made for this observation. One is that this reflects the aforementioned anticipation effects. As argued before, in the narrative approach, we identify the origin of the shock (natural disaster) but the fiscal policy response arrives with a lag. Private agents may anticipate this response to the natural disaster. As a result, the response observed in the narrative approach is reinforced by this anticipation effect. Consequently, the size of the effect is greater in the narrative approach than in SVAR. This result could be found in other studies too. Blanchard and Perotti (2002) show that although the responses of GDP are qualitatively similar to each other, the response of GDP, when combined with an anticipation effect, is much greater than that without it. Also, Ramey (2011a) shows

that when the government spending shocks are identified by war dates or by defense news, the response in the narrative approach is larger than that in the VAR approach. On the other hand, the anticipation effect is likely to work in the opposite direction in the SVAR analysis: when fiscal shocks are anticipated, they affect the behaviour of households already before they actually take place. Therefore, when they do take place, their effects appear muted.

The other possible explanation for the difference in magnitude is the nature of the fiscal shocks. The SVAR approach identifies all kinds of shocks to government spending regardless of the size and cause, as long as they occur unexpectedly and do not reflect an automatic response in a given quarter. However, in the narrative approach, fiscal shocks are identified as exogenous and unanticipated events such as the military build-ups of Ramey (2011a) or the economic damages due to natural disasters in this chapter. Therefore, the SVAR approach identifies a broader range of fiscal shocks, including but not limited to those identified by the narrative approach. Figure 2.9 shows that the shocks identified by natural disaster damages precede by 1~2 quarters most large government spending shocks identified by the SVAR model. Therefore, although the responses are normalized so that the peak of shock to the government spending is unity, the shocks to government spending from the narrative approach are generally the larger ones. As a result, the responses of other variables are also relatively large.

Figure 2.9 The comparison of the government spending shocks according to SVAR and the narrative approach



Third, as we argued before, the defense news variable of Ramey (2011) is restricted mainly to the defense sector. Therefore, the resulting multiplier can be different from that for nondefense purchases (Barro and Redlick, 2011). When using natural disaster damages, government spending in response to a natural disaster primarily takes the form of government investment spending rather than government consumption spending, although this instrument is more similar to general government spending than defense purchases. According to Bénétrix and Lane (2009), S. Kim (2010), and B. Kim (2011), the impact of government spending shocks depends on the nature of fiscal innovation: whether shocks affect government consumption or government investment. The latter has a larger fiscal multiplier. Therefore, when comparing the two approaches, the narrative approach identifies shocks that entail mainly government investment and as a result these shocks have a stronger effect on the other variables.

Finally, according to some literature using non-linear models dependent on the state of economy (Auerbach and Gorodnichenko 2011, 2012; Baum et al., 2012), the effect of government spending on output is much larger in a recession than the effect identified by a standard linear model such as SVAR.[40] Therefore, in cases where a natural disaster causes direct negative effects on the economy, an increase in government spending has much larger effects on the economy than would otherwise have been the case.

6. Robustness Checks

This section presents a variety of robustness checks. First, we wish to check how much the natural disaster damages affect the economy directly. Second, we use natural disaster relief expenditure (NDRE) instead of the damages due to natural disasters to identify government spending shocks in the narrative approach and also to compare the results obtained with the narrative approach and SVAR, discussed in the previous section. The shocks identified in the two approaches are different from each other: NDRE shocks are relatively large government spending shocks among

40. Auerbach and Gorodnichenko (2011): 0.68(recession), 0.04 (expansion) and 0.19 (linear) for OECD countries, Auerbach and Gorodnichenko (2012): 2.48(recession), 0.57 (expansion) and 1.00 (linear) for the U.S.

those identified by the SVAR which, furthermore, may be compounded by anticipation effects. We therefore explore further the timing of the shocks identified by the two approaches. Lastly, the response of interest rate is opposite to the theoretical prediction, which we attribute to the fact that it responds to monetary rather than fiscal policy. We test whether this interpretation is justified.

6.1. Direct effects of natural disasters

When natural disasters occur, they destroy property, including manufacturing facilities and infrastructure, and may also cause human casualties. This may affect industrial production, labour supply and investment, which would make government spending shocks endogenous with respect to macroeconomic variables.[41] In particular, if natural disasters destroy physical capital, they are likely to lead to increased investment (public and private) in the immediate aftermath of the event. Similarly, damage to production facilities may force firms to run down their inventories.

To explore the potential direct effects of natural disasters, we test the correlation between the natural disaster variable and a number of variables. Production variables such as agriculture-forestry-fishing sector of GDP (primary industries), manufacturing operation ratio and production capacity index, industrial production index, and producer price index are chosen as representative of the supply side. The agriculture-forestry-fishing sector of GDP is selected because natural disasters typically affect these primary industries especially strongly. We also consider employment to population ratio and unemployment rate as variables representing the labour market. In addition, we also consider the effect of natural disasters on physical assets investment and inventories.

Table 2.6 tests whether the damage due to natural disaster has any explanatory power with respect to the changes in the aforementioned variables using Granger-Causality test with 2 and 4 quarters of lags. Clearly, natural disasters do not Granger-

41. Note the effect of natural disasters need not necessarily be negative, especially in the long term, as argued by Crespo et al. (2008). Furthermore, the effect may depend on country characteristics. Noy (2009) finds that in the short-term, natural disasters have an adverse impact on the macroeconomy. However, the resulting GDP decline is larger in developing and small countries than in developed and large ones. In contrast, Raddatz (2007) argues that although natural disasters have negative effect on GDP in low income countries, the effect is very small.

cause any of these variables except for the agriculture-forestry-fishing sector with 4 quarters of lags. The output of these primary industries is highly seasonal and the same is true for natural disasters (most of which are weather related in Korea). Therefore, this correlation may be spurious in that it is driven by the seasonality of both the primary-sector output and natural disasters. However, even if natural disasters indeed affect the output of this sector, primary production accounts for a very small portion (on average 3.3%) of Korea's GDP.[42] Importantly, the changes in investment or inventories are also not caused by the direct effect of natural disasters. In other words, this result confirms that the increase in investment reported in the preceding section is indeed a response to the fiscal shocks in the wake of natural disasters and not a direct effect of the natural disaster itself. Therefore, we can conclude that natural disaster damages have very weak or no direct impact on the Korean economy.

Table 2.6 Granger Causality Test

Null Hypothesis: Damages by natural disasters does not Granger Cause dependent variable

Dependent variable	F-statistic (P-value)	
	1~2 Lags	1~4 Lags
Agriculture-Forest-Fishing Sector of GDP	2.041 (0.139)	3.744 (0.009)
Manufacturing production capacity Index	0.329 (0.721)	0.190 (0.943
Manufacturing operation ratio Index	0.194 (0.824)	0.752 (0.561)
Industrial production Index	1.760 (0.181)	1.862 (0.493)
Producer price Index	0.159 (0.853)	0.282 (0.889)
Employment to population ratio	0.245 (0.783)	0.040 (0.997)
Unemployment rate	0.119 (0.888)	0.103 (0.981)
Fixed investment (Gross fixed capital formation)	0.700 (0.501)	0.425 (0.790)
Changes in Inventories	2.201 (0.119)	1.185 (0.328)

Notes: All data are obtained from the statistical Database of the Korean Statistical Information Service. All variables except employment ratio, unemployment rate, and inventories are log-transformed and linearly time-detrended. The manufacturing production capacity index is in first differences in order to remove the unit root. All variables are seasonally- adjusted.

42. Moreover, the Granger Causality test of the reverse relationship indicates that this sector also Granger-causes the damages. Given that output of the primary sector cannot cause natural disasters, we can conclude that the causality between these two variables is due to omitted factors.

6.2. Effects of Natural Disaster Relief Expenditure (NDRE)

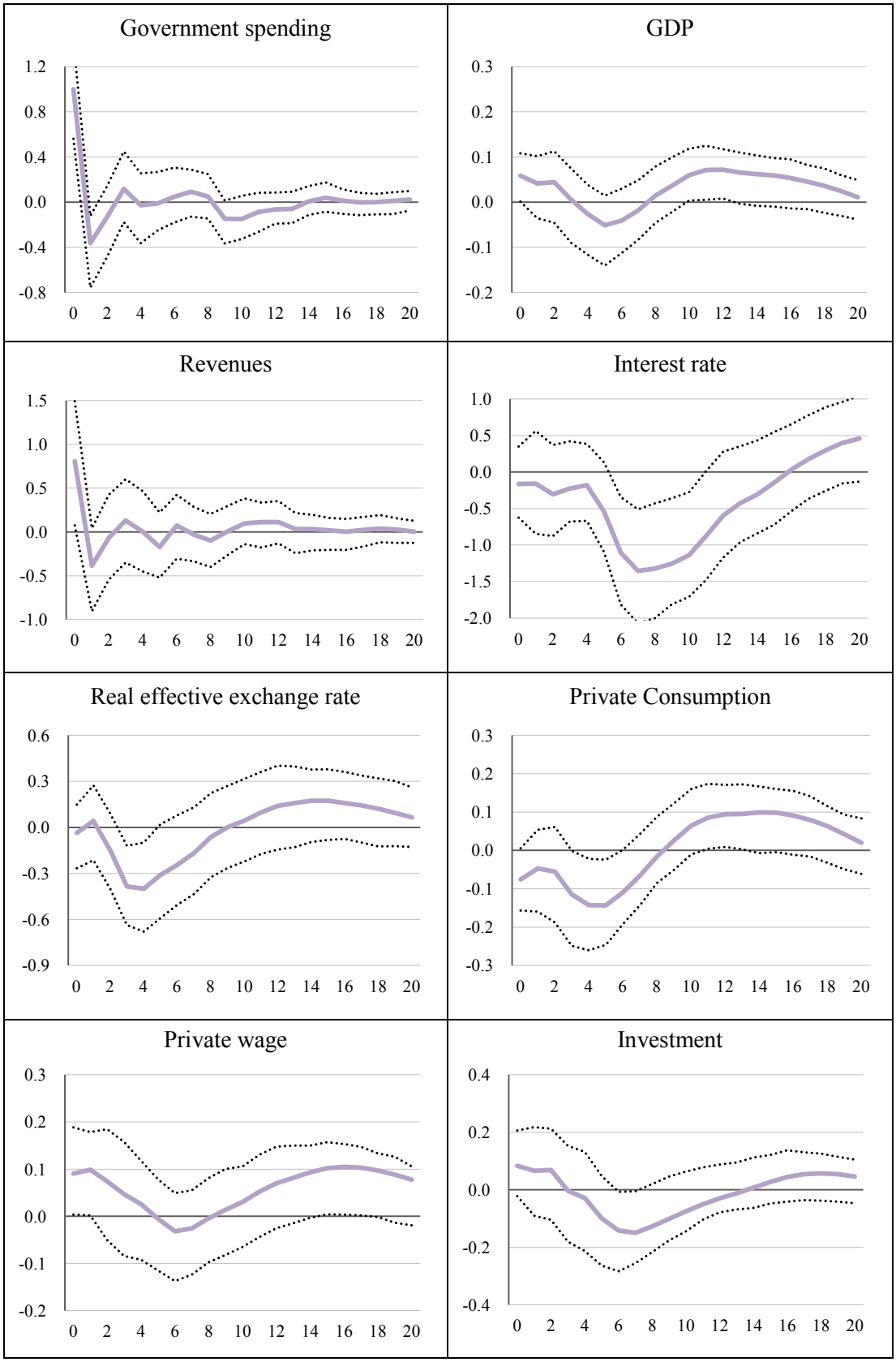
As pointed out before, the damages variable is not only a significant cause of the government spending shocks but also an important predictor of such shocks. When economic damages are used in the preceding section, the specification includes this exogenous variable with lags of 0 to 2 according to the lag exclusion tests. However, as NDRE is itself a temporary and contemporaneous government spending shock, it is included as the exogenous variable without any lags in this subsection. The other specifications of the analysis are the same as in the previous analysis using the narrative approach.

Figure 2.10 shows the results obtained when using NDRE instead of natural disasters as the exogenous variable. The response of government spending is very similar to that of the SVAR. The responses and trends of the other variables are also similar to the SVAR results, except for the interest rate, real effective exchange rate, and private consumption. Therefore, when comparing this set of results with those of the previous section, we can reconfirm the 'anticipation effects'. Firstly, in the previous comparison in Figures 2.7 and 2.8, the anticipation effects cause the faster and larger responses obtained with the narrative approach relative to the SVAR results. However, the shocks in the two approaches are different because the shocks identified with natural disasters are a subset of the shocks identified by the SVAR model. Therefore, when comparing the results obtained with economic damages (Figure 2.5) and with NDRE (Figure 2.10), both of which capture the same shocks, we can similarly observe time lags. These lags capture more accurately the 'anticipation effect' discussed previously. Secondly, when comparing the narrative NDRE-based results (Figure 2.10) with the SVAR ones (Figure 2.6), the responses in Figure 2.10 follow the trends of SVAR in Figure 2.6, only one or two quarters later. As in the previous section, the responses obtained with the SVAR forward-shifted by 1~2 quarters bear a striking likeness to the responses obtained with NDRE. Due to the 'anticipation effect' that the narrative approach can capture, the macroeconomic effects of government spending shocks appears later when using NDRE than with the SVAR.[43]

43. Another possible reason is a difference of accounting standard in that NDRE are reported on accrual-basis while the SVAR shocks are based on government spending on cash-basis.

This analysis therefore confirms the existence of an anticipation effect, which is hard to capture with the SVAR approach. As Ramey (2011a) argues, the timing of shocks is very important in identifying the government spending shocks. Depending on the timing, the results can be shown to be in accord with either the New Keynesian model or with the Neoclassical model.

Figure 2.10 The response of macroeconomic variables to the NDRE shocks



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

6.3. Response of interest rate without considering monetary policy

In our analysis, the short-term interest rate is used to account for monetary policy. However, it is the long-term interest rate that has a closer relationship with the components of GDP such as investment and private consumption.[44] Therefore, firstly, instead of the short-term interest rate (call rate), we use the long-term interest rate (corporate 3-year bond and Treasury 3-year bond). The results are almost the same as in the previous analysis in that the response of interest rate to the government spending shocks is negative.[45]

Korea has experienced two big economic crises: the Asian crisis of 1997 and the global financial crisis of 2008. During the former, interest rates, which had previously been regulated, were fully liberalized and the exchange rate, which had earlier been allowed to fluctuate within a band, was fully floated. Moreover, to overcome the two recessions, Korean government actively implemented expansionary monetary as well as fiscal policy. Therefore, except for these two periods, it is likely that monetary policy has been neutral to fiscal policy. Since 1998, the interest rate has replaced the money supply as the intermediate target of monetary policy. Figure 2.11 shows the trends of market rates and the policy rate.[46] From 1999 to the third quarter of 2008, before the global financial crisis started, the interest rate displays no large fluctuations. Therefore, in order to check the response of interest rates to the government spending shocks, we reduce the period of analysis to the above period, although it may be too short a period for VAR analysis.

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44. Perotti (2005), De Castro and Hernández De Cos (2008), and Giordano et al. (2007) use the long-term interest rate. On the other hand, Ramey (2011a) and Caldara and Kamps (2008) use the short-term interest rate.

45. Giordano et al. (2007) similarly analyze the response of short-term interest rate as robustness checks and find that there is no noticeable difference between the results with long-term and short-term interest rate.

46. The call rate was used as the policy rate from May 1999 to February 2008. Since then, the base rate has been used instead of the call rate.

Figure 2.11 The trends in interest rates in Korea

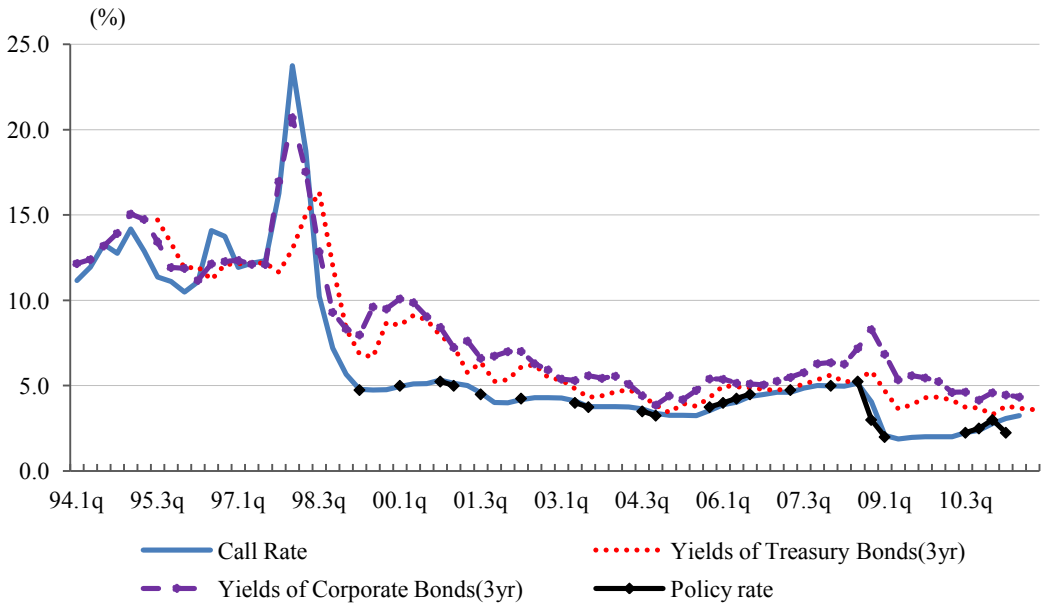
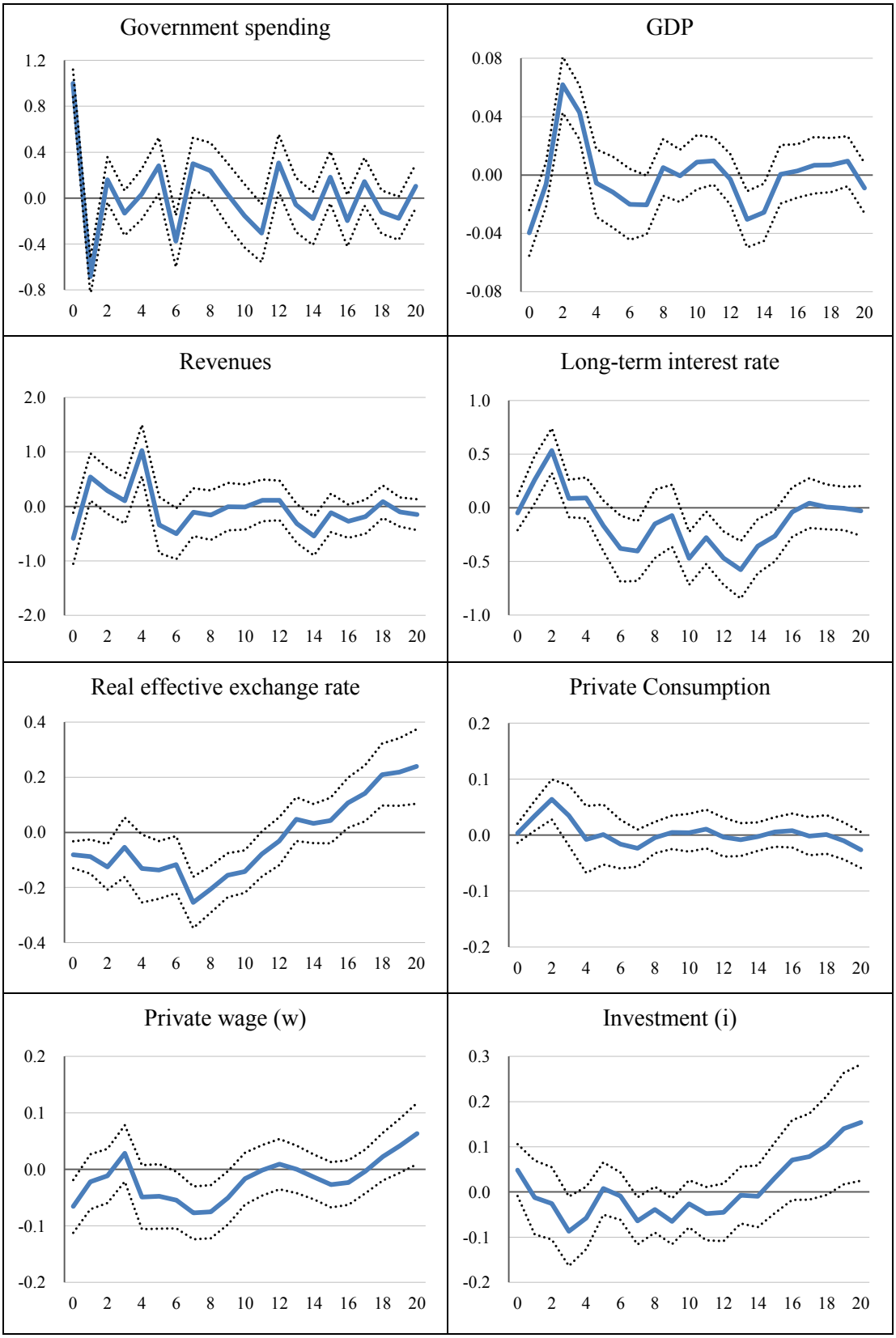


Figure 2.12 presents the effects of government spending shocks on the macroeconomic variables, according to the SVAR approach. In this analysis, everything is the same as in the previous SVAR analysis, except that the period for the analysis is from 1999.1q to 2008.3q and the Yields of Treasury Bonds (3 years) are used as the long-term interest rate instead of the call rate. The response of interest rate to spending shocks is significantly positive for one year and then becomes negative. Given this response of the interest rate, investment falls in response to the shock. This is consistent with Blanchard and Perotti (2002) and contradicts the previous results. Another interesting observation is that the magnitudes of responses are smaller than those obtained for the full period. As for GDP, the peak of its response (0.062) is smaller than the peak in the previous analysis (0.071). When the government spending shock occurs, the rise of interest rates causes a fall in private consumption and private investment. To be more precise, the effects of monetary policy are added to the results of the previous analysis of fiscal policy. With this comparison, it is also easily checked that fiscal policy and monetary policy together are much more effective in stimulating the economy. With the narrative approach, the same analysis is carried out. However, the results are not significant and also the response of interest rate is still negative. This pattern is likely due to the short period for the VAR analysis with the narrative approach.

Figure 2.12 The response to government spending shocks for 1999.1q~2008.3q



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

7. Conclusions

In this chapter, we analyze the effects of government spending shocks on key macroeconomic variables in Korea. Our analysis compares two approaches used for identifying fiscal shocks: the narrative approach and the SVAR model. The narrative approach requires an instrument that can effectively identify exogenous and unanticipated shocks to government spending. The previous literature highlighted one such instrument, military build-ups, and used it to estimate the effects of fiscal policy on the U.S. economy. We argue that military build-ups have a limited application beyond the U.S: few other countries have been involved in multiple extra-territorial conflicts associated with increases in government spending without a concurrent negative supply effect. Moreover, the relevance of studying government spending shocks associated with military build-ups is also questionable: the nature of spending associated with such build-ups is dramatically different from the general government spending.

We therefore propose a new instrument, damages caused by natural disasters and the subsequent relief spending by the government, which we use to investigate the macroeconomic effects of spending shocks using Korean data. We find that economic damages due to natural disasters are a strong and relevant instrument for identifying government spending shocks. The relief expenditure associated with economic damages due to natural disasters is similar to the general government activities and therefore the results of this analysis are more informative concerning the effects of government spending shocks than looking at military build-ups. In addition, unlike military build-ups used in the literature on U.S. fiscal shocks, our methodology can be easily extended to other countries.

Our main findings are as follows. First, although government spending increases only temporarily, the response of GDP remains positive for a considerable time according to both approaches. The responses of private consumption and real wage are also positive. Similarly, investment increases in response to the increase of government spending. Therefore, our results are consistent with the New Keynesian model, regardless of the method used. This stands in contrast to the previous findings where the results depend on the identification method used. Future research should

show whether the fact that both approaches yield the same results is unique to Korea or whether this is because we use natural disasters rather than military build-ups to identify government spending shocks.

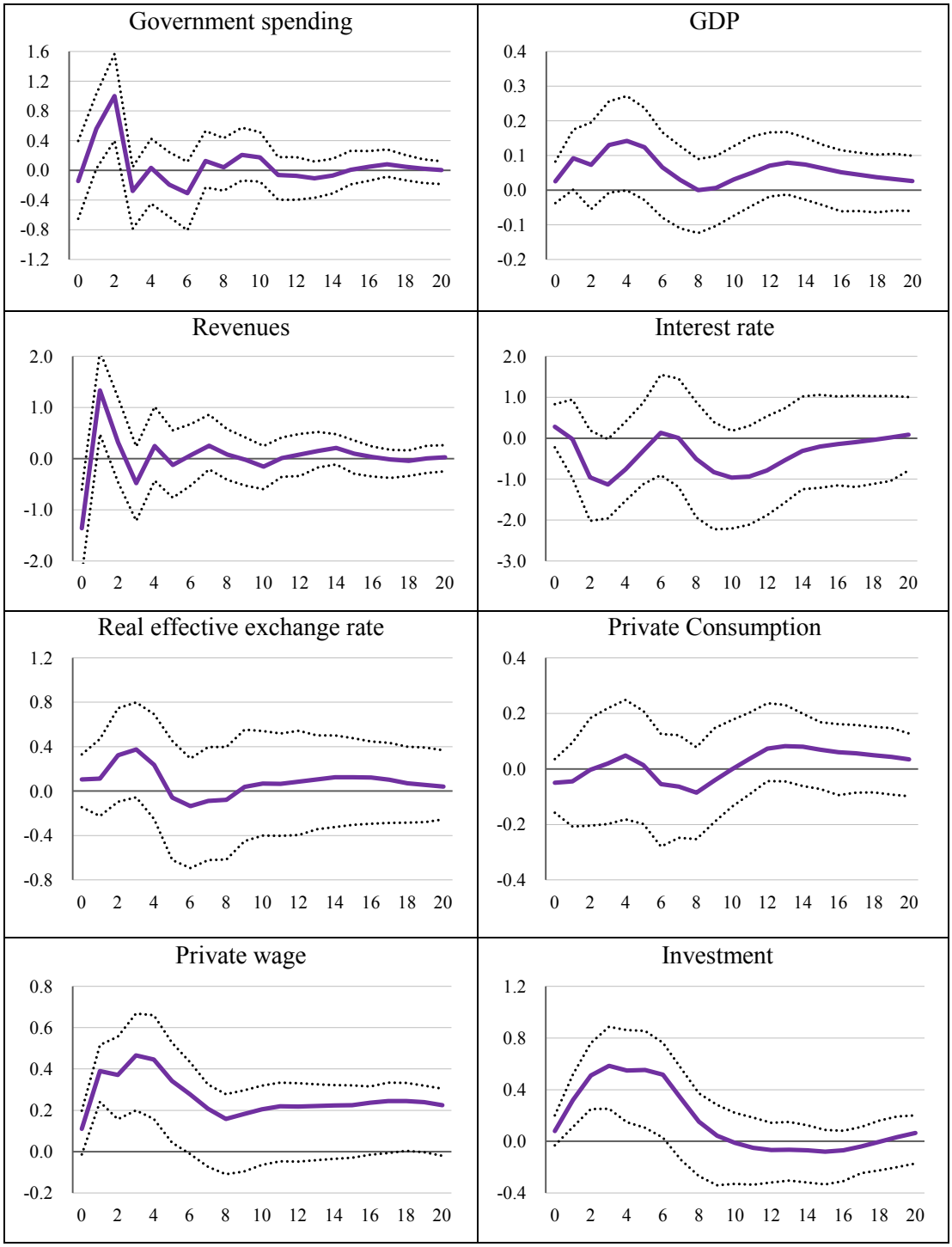
Second, and in line with Ramey (2011a), the timing is very important in identifying government spending shocks due to 'anticipation effects': the private sector can anticipate an increase in government spending in the wake of natural disasters and therefore the effects can be observed already prior to the spending shock. Failure to account for this can lead to misleading conclusions about the effect of spending shocks.

Further research could use natural disaster to identify fiscal shocks and their effects in other countries. This would help confirm the general applicability of this method and our findings. In contrast to military build-ups, many countries are sufficiently exposed to natural disasters to make this method feasible outside of the U.S. context. The data on such disasters and the associated damages are publicly available from the EM-DAT/CRED database. Future work should also shed more light on the potential supply side effects of natural disasters, especially in countries that encounter large and damaging natural disasters. As we argue in this chapter, most natural disasters befalling Korea are relatively small and localized and therefore are likely to have at the most modest direct effects, which justifies our approach to using natural disasters for identifying fiscal policy shocks.

Appendix 1

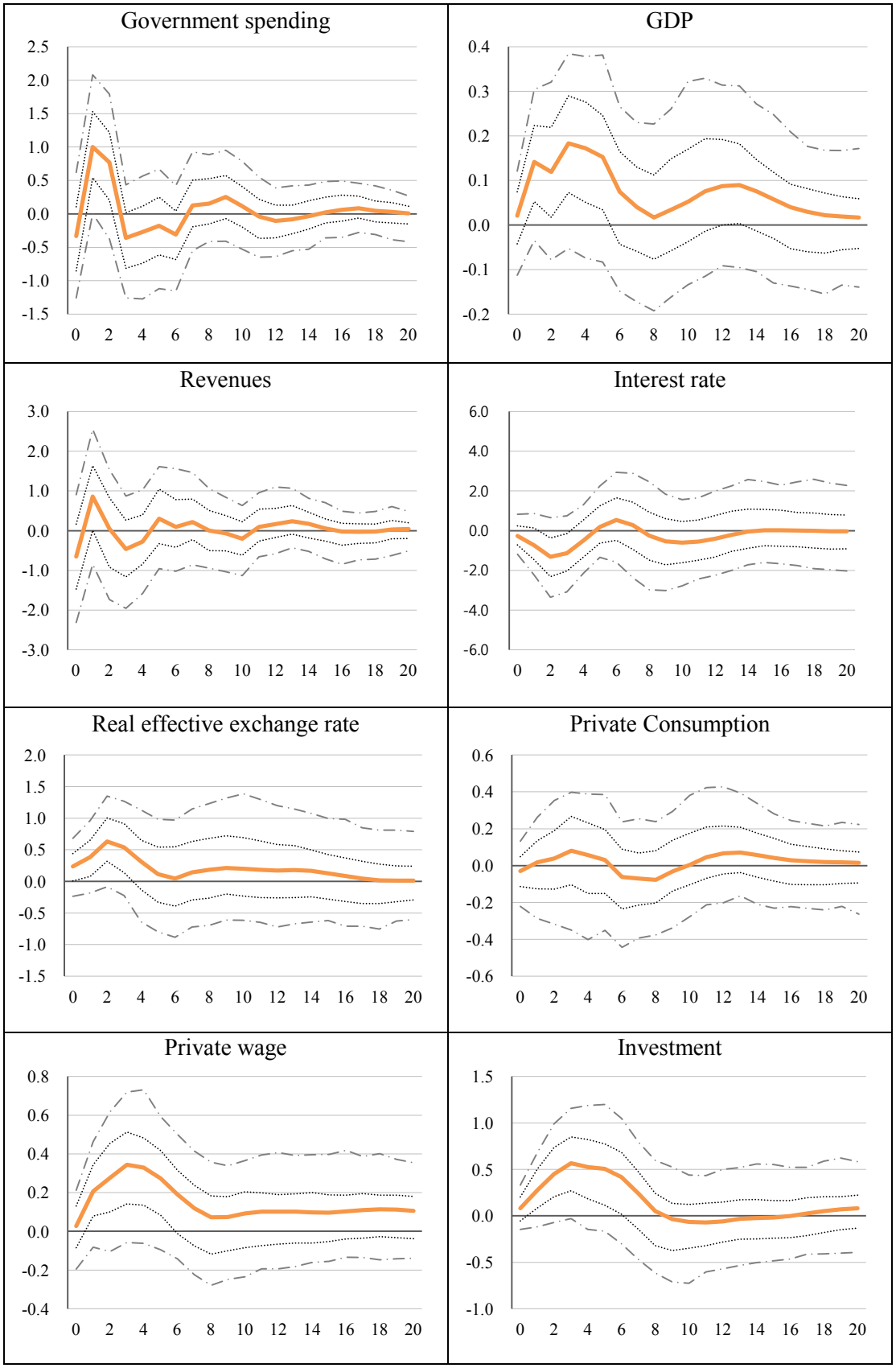
A. Results from the specification with a dummy variable of natural disasters

Dummy variable =1 only in 1998.3q, 199.3q, 2002.3q, 2003.3q and 2006.3q chosen by the criteria that economic damage/GDP > 0.8% and NDRE/Government spending >10%



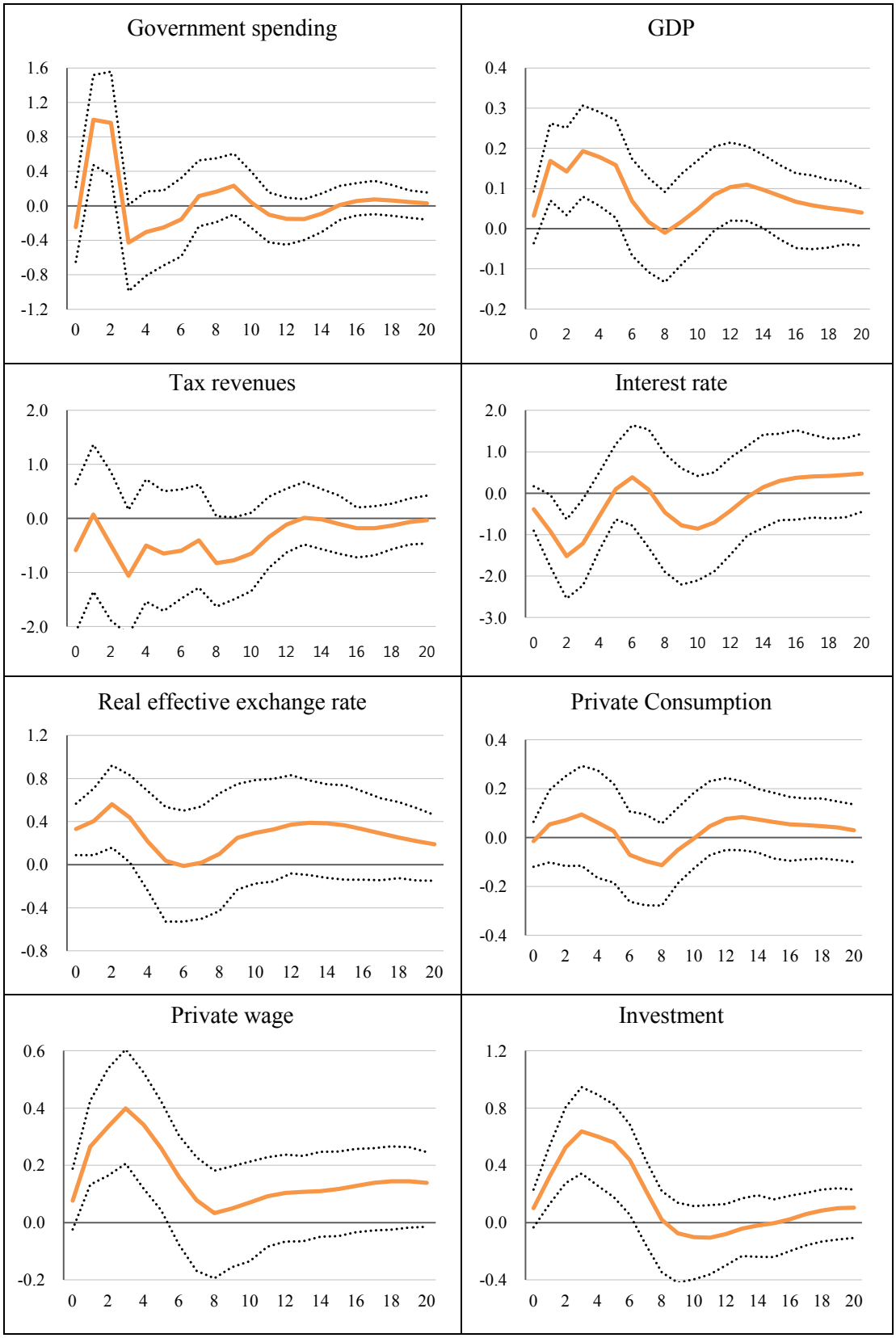
Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

B. 68% and 95% confidence bands using the narrative approach



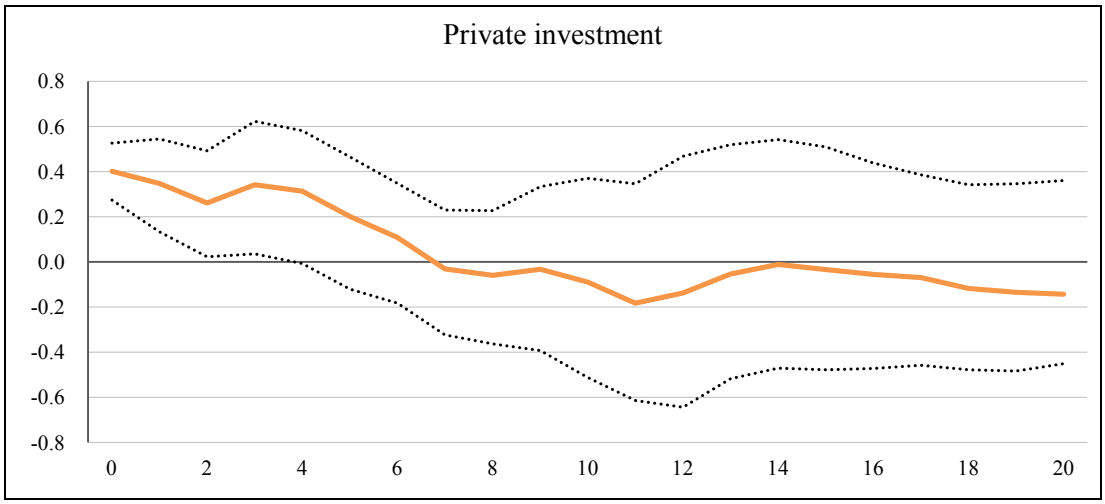
Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

C. Analysis with tax revenues using the narrative approach



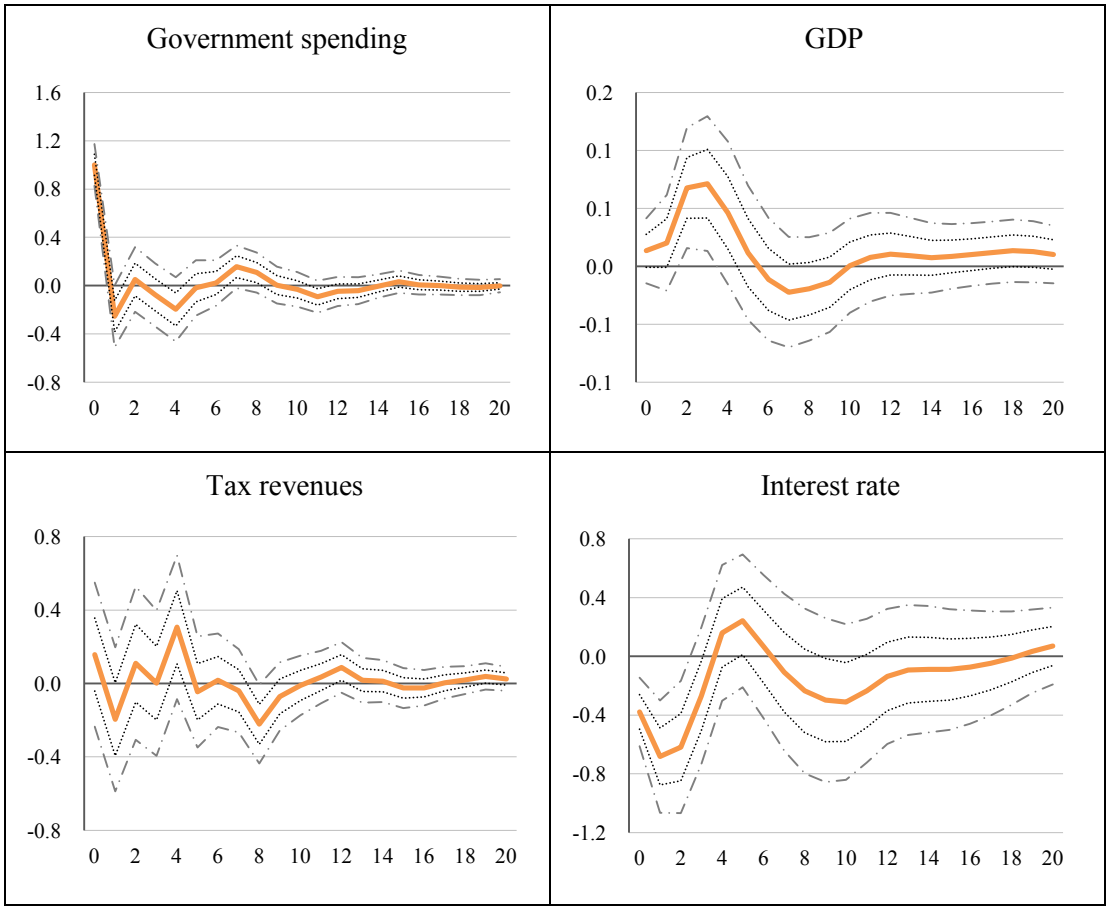
Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

D. The response of private investment to government spending increase using the narrative approach for 2000~ 2010



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

E. 68% and 95% confidence bands using the SVAR approach



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

E. 68% and 95% confidence bands using the SVAR approach (continued)

Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

Chapter 3

Government Spending Shocks and the Multiplier:
New Evidence from the U.S. Based on Natural Disasters

1. Introduction

Recently, in response to the financial crisis and its impact on the economy, many governments have increased their spending in order to stimulate economic growth, while other governments, stricken by fiscal and debt crises, were forced to cut theirs sharply. As a result, the interest in the short-run effects of government spending has been revived again. From an economic policy perspective, it is of crucial importance to know whether fiscal policy can be used as an effective tool to dampen economic fluctuations and foster growth. However, for all its importance, the effectiveness of fiscal policy still remains a controversial issue, with neoclassical and (new) Keynesian theories making dramatically different predictions in this respect.

Although most studies agree that fiscal policy stimulates output in the short-run, there is considerable disagreement regarding the size and the transmission of its effect on economic activities. There are two strands of the empirical literature on macroeconomic effects of government spending shocks. The first one relies on structural VAR models to analyze national or international data. In order to identify the government spending shocks, it requires certain assumptions such as the use of time lags and additional information such as various elasticities (Blanchard and Perotti 2002, Perotti 2005, and Giordano et al. 2007). While it has the advantage of easy implementation and application, the results are highly sensitive to these assumptions. Moreover, as Ramey (2011a) points out, the fiscal shocks identified with this method could be subject to an 'anticipation effect': the shocks identified by the model are expected by the private sector. Because of this criticism, the second, so called 'narrative', approach seeks to identify shocks to government spending by using events associated with unexpected changes in government expenditure. In particular, military build-ups (sometimes combined with contemporaneous professional forecasts of government spending) were suggested as sources of such exogenous variation in government spending (Ramey and Shapiro, 1998; Burnside et al., 2004; Ramey, 2011a; and Barro and Redlick, 2011). It is argued that unlike the general government expenditure, wars and international tensions that lead to military build-ups are both sufficiently difficult to predict and independent of GDP.

While most of the initial literature was concerned with time-series studies, some recent analyses use panel or cross-section data to estimate the effects of fiscal policy. Ilzetzki et al. (2011) use a novel quarterly dataset of government spending in 44 countries with the structural VAR approach. They show that the impact of government spending shocks depends on the key characteristics of the country such as the level of development, exchange rate regime, openness to trade, and public indebtedness. Nakamura and Steinsson (2011), in turn, use military spending data across U.S. regions to estimate the effects of government spending in a monetary union in a narrative approach.

While the narrative approach can take better account of the anticipation effect, it has some important limitations. First, the identification strategy relies on relatively infrequent events. The U.S. is in a rather unique position in that it was involved in several military conflicts (hot or cold) that did not unfold on its territory. Therefore, it can be argued that these conflicts gave rise to demand shocks associated with increased government spending without affecting also the supply much. That can be said about few other countries: either they were not involved in military conflicts or these took place (at least in part) on their own territory. Second, the composition of military spending differs considerably from general government spending. Therefore, estimating the macroeconomic effect of military build-ups may have limited applicability to other categories of government spending.

The effect of government spending on the economy is often summarized by a multiplier: a change of output caused by a one unit increase in government spending. As Barro and Redlick (2011) indicate, the multiplier based on military build-ups is close only to the defense spending multiplier. To assess the effect of more typical fiscal stimulus packages, we are interested in the multiplier for nondefense spending such as infrastructure, health, education and others. However, a big hurdle in obtaining estimates of nondefense spending multiplier is that it is hard to find a satisfactory instrument for nondefense spending because most of the variation in nondefense spending tends to be endogenous with respect to the state of economy.

This chapter contributes to the small but growing literature seeking to identify such new instruments. Serrato and Wingender (2010) use changes in allocations of federal spending to states caused by population changes identified by means of the

Census every 10 years. Their estimates imply that government spending has a local income multiplier of 1.88. Shoag (2010), in turn, collects a new dataset on the returns of state pension plans which can be predictor of subsequent state government spending. He shows that state government spending has a large positive effect on in-state income with a multiplier of 2.11. Fishback and Kachanovskaya (2010) use political competiveness across states to estimate the effects of New Deal spending and find a multiplier of 1.7. Given that multipliers obtained with military build-ups tend to be lower, ranging from 0.6 to 1.2 (Ramey, 2011a; Barro and Redlick, 2011), it appears that the defense and non-defense spending multipliers are indeed different from each other.

In this chapter, we confirm that natural disasters constitute another suitable instrument to identify exogenous variation in government spending: they are relatively frequent and unexpected as argued in Chapter 2. Importantly, governments respond to natural disasters by spending on relief and repair as well as on precautions against future calamities.[47] Natural disasters in this way cause government spending shocks, and those shocks are unexpected and sudden, making them exogenous with respect to the state of the economy.

There is already a vast literature on the short and long-run impacts of natural disaster on macroeconomy. Recently, Cavallo and Noy (2009) surveyed this literature comprehensively. According to them, the consensus is emerging that natural disasters have a negative impact on short-term economic growth. Raddatz (2007) analyzes the effects of external shocks including natural disasters on output fluctuations in low-income countries. He concludes that natural disasters cause a significant decline in output. Noy (2009) analyzes the determinants of adverse effects of natural disaster on output in the short-run and shows that countries with a higher literacy rate, better institutions, higher per capita income, higher degree of openness to trade, higher levels of government spending, more foreign exchange

47. In the wake of Hurricane Katrina, for example, the U.S. Congress provided $14.6 billion to build new levies and floodgates in New Orleans (see "Beyond the walls," The Economist, Sept 1, 2012). Similarly, the reconstruction in the wake of Hurricane Sandy was expected to "serve as a mini-stimulus for the regional economy" ("Wild is the Wind," The Economist, Nov. 3, 2012). Some estimates have the cost of building new levies and storm-surge barriers to protect New York and New Jersey from future storms as high as $30 billion ("Can New York become New Amsterdam again?", The Economist Gulliver Blog, Nov. 5, 2012,

(http://www.economist.com/blogs/gulliver/2012/11/defending-new-york-floods.)

reserves, and higher levels of domestic credit, but with less open capital accounts are able to withstand the initial shock better and avoid spillovers into the wider economy. Raddatz (2009) shows that smaller and poorer countries are more vulnerable, especially to climatic disasters, and that the level of external debt has no relation to the output impact of any type of disaster. Loayza et al. (2009) find that while small disasters may have a positive effect due to the reconstruction efforts, large disaster have severe negative impact on the economy immediately. Skidmore and Toya (2002) and Crespo et al. (2008), in contrast, examine the long-run impact of natural disasters on growth. They suggest that a higher frequency of natural disasters is associated with higher growth rate in the long-run in a process akin to 'creative destructions': older physical assets and technologies tend to be less robust and thus are more vulnerable to natural disasters. They are therefore replaced faster in the wake of natural disasters than they would have been otherwise.

Only a few papers explore the fiscal impact of natural disaster in a multi-country framework using panel data. Lis and Nickel (2009) explore the impact of large scale extreme weather events on changes of budget balances in country groups with fixed effects model. They conclude that natural disasters increase the budget deficits in developing countries while no significant effects are found for advanced countries. Melecky and Raddatz (2011) also estimate the impact of different types of natural disasters on government expenditures, revenues, and fiscal deficit for high and middle-income countries, employing a panel vector autoregressive model. They conclude that disasters have an important negative impact on the fiscal stance by decreasing output and increasing fiscal deficits, especially for low-middle-income countries. Moreover, they find that countries with more developed financial or insurance markets suffer less from disasters in terms of output declines. Finally, Noy and Nualsri (2011) estimate the fiscal consequences of natural disasters using a panel vector autoregressive model. They find that fiscal behaviour in the aftermath of disasters can be described as counter-cyclical in developed countries, but as pro-cyclical in developing countries.

This chapter estimates macroeconomic effects of the associated government response in the wake of natural disasters at the national level and state level in the U.S. Most literature analyzes the effects of natural disasters in multi-country

framework to obtain rich dataset. However, as the preceding discussion demonstrates, the results depend on income level, financial development, geography, and the like. Therefore, it is the best to analyze the effects with a rich dataset of natural disasters within one country. Moreover, when the aim is to estimate the effects of government spending on the economy, as stated before, though the natural disasters are really exogenous, the government spending shocks from it may be subject to supply shocks. Therefore, in order to minimize this problem, it is better to analyze the data of a country with high income and financial development where the adverse effect of such shocks has been found to be limited. That is the reason why we select the U.S. for this chapter.

We construct a list of natural disasters and the associated estimated economic damages at the level of U.S. states, using a wide range of sources. Since there is no systematic and comprehensive record of economic damage per state, we have to reconstruct it from narrative records. Therefore, the novelty of this chapter is that it is the first attempt to use the natural disaster series to estimate the effects of fiscal policy at the regional level. Even if natural disasters are truly unexpected and exogenous to the state of economy, one can argue that the government response to them is in fact endogenous. However, although it cannot be totally free from the endogeneity, any other instrument for fiscal policy is subject to the same criticism. For example, the military build-ups also are hardly exogenous. Often, wars and military build-ups are expected several weeks or months before they actually break out.[48] Such expectations can affect private economic activities significantly. Moreover, wars are usually accompanied by other important changes in economy policy. For example, during the World War II, the U.S. economy was under the imposition of rationing and price controls. In addition, the supply shocks in wars or war threats, which are related to the endogeneity of government response, are much larger than in natural disasters.[49] In the case of natural disasters, the government

48. For example, the breaking out of hostilities between the U.S. and Japan during the World War II was widely expected. What was unexpected was the direction of the initial Japanese attack: the U.S. military anticipated the first strike to be directed against the Philippines rather than Hawaii. Other conflicts, such as the Vietnam War or the two Gulf Wars, were also preceded by long periods of tensions and escalations.

49. While wars affect the entire national economy even if extraterritorial, natural disasters usually only have limited regional effects. For example, the Hurricane Katrina, the most severe natural disaster in the U.S., affected mainly southeastern states with $ 125 million damages (at most 1% of GDP of the third quarter in 2005). In terms of workforce, the World War II and Korean War affected

does not always respond to natural disasters and its response is different in its size and timing even across two similar disasters.[50] This difference in the fiscal response therefore helps identify fiscal policy shocks. Moreover, it has shorter implementation lag compared to other fiscal policies. For this reasons, although government response to natural disasters is not totally exogenous, the natural disasters and government response can be a good instrument for identifying fiscal shocks and especially for estimating nondefense spending multiplier. However, a limitation of our methodology, discussed already in Chapter 2, applies here as well: the presence of initial impact of natural disaster makes the response of output compounded with the effects of fiscal response. As the two effects on output go in opposite directions, with the impact of a natural disaster being negative and the impact of fiscal responses being positive, what we capture in our estimations could be interpreted as a net effect that lies between the effects of those two shocks.

This chapter has two main findings. First, we demonstrate that natural disasters constitute a strong and relevant instrument for identifying nondefense government spending shocks. We confirm this both at the national level as well as at the level of individual states. Second, the nondefense spending multiplier resulting from our analysis is higher than that for defense spending: our results suggest a range between 1.4 and 2.5. This multiplier is similar to the figures reported elsewhere in the literature and also to the nondefense spending multiplier (1.0~2.5) used by the Congressional Budget Office to estimate the effect of the stimulus package of 2010.

The remainder of this chapter is organized as follows. Section 2 replicates the analysis of the effects of defense spending shocks with military build-ups. Section 3 describes the background of the natural disaster and the new exogenous variable, its construction and properties. Section 4 presents the analysis of the effects of government spending, with several robustness checks, at the national level. Section 5 reports the results of the cross-state analysis for the 50 states in the state level.

19.1% and 2.4% of labour force, respectively, through conscription, and this effect lasted for several years, while the Hurricane Katrina affected 0.3 % of labour force for a few quarters.

50. The fiscal shock associated with Federal government assistance tends to vary considerably across natural disasters, with sometimes similar events resulting in responses of very different magnitudes. For example, although the Californian earthquake of 1994 and the Hurricane Wilma in Florida of 2005 were both estimated to cause similar economic damage (around nominal $20 billion), the assistance from the Federal Emergency Management Agency shows large difference: $6.0 billion for the former and $1.8 billion for the latter.

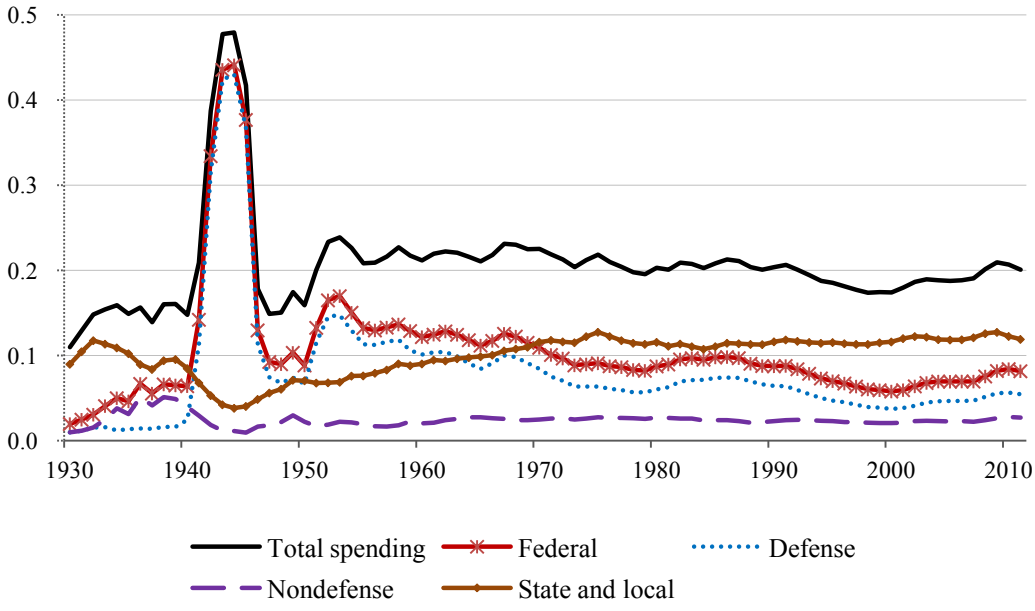
Finally section 6 concludes.

2. Analysis with military build-ups as an instrument

The narrative approach to analysis of economic effects of fiscal shocks relies on using military build-ups resulting from wars or war threats to identify exogenous fiscal shocks.[51] Ramey (2011a) shows that the defense news captures the expectations of future government spending shocks by the private agents.

Figure 3.1 shows the trend of defense and nondefense spending of the federal government, and state and local governments, expressed as a ratio to real GDP. The defense spending is a major part of total spending and federal government spending. Especially, the movement of federal government spending is almost perfectly copies of that of defense spending. This is the reasons that much literature chooses the military build-ups as an instrument of government spending shocks.

Figure 3.1 Components of real government spending fraction of GDP (chained 2005)



A potentially important problem with this instrument, however, is that it is dominated by two extraordinarily large events: the World War II and the Korean War. When these are excluded by considering only data after 1955, the ratio of defense

51. While Ramey and Shapiro (1998) use the Korean War, Vietnam War and the Soviet invasion of Afghanistan, Ramey (2011a) adds also the World War II and 9/11.

spending to GDP displays relatively little variation. Table 3.1 shows that during World War II and the Korean War, the defense spending accounts for most of the variation in government spending because its ratio to total government spending is much higher than in other periods. Indeed, Ramey (2011a) observes that the military build-ups have explanatory power only when these two large wars are included; the military build-ups after the Korean War have very low explanatory power and are not informative. Therefore, since the World War II and the Korean War dwarf all other military build-ups, this instrument may be viewed as based on only two events.

Table 3.1 Average ratio of defense spending to government spending

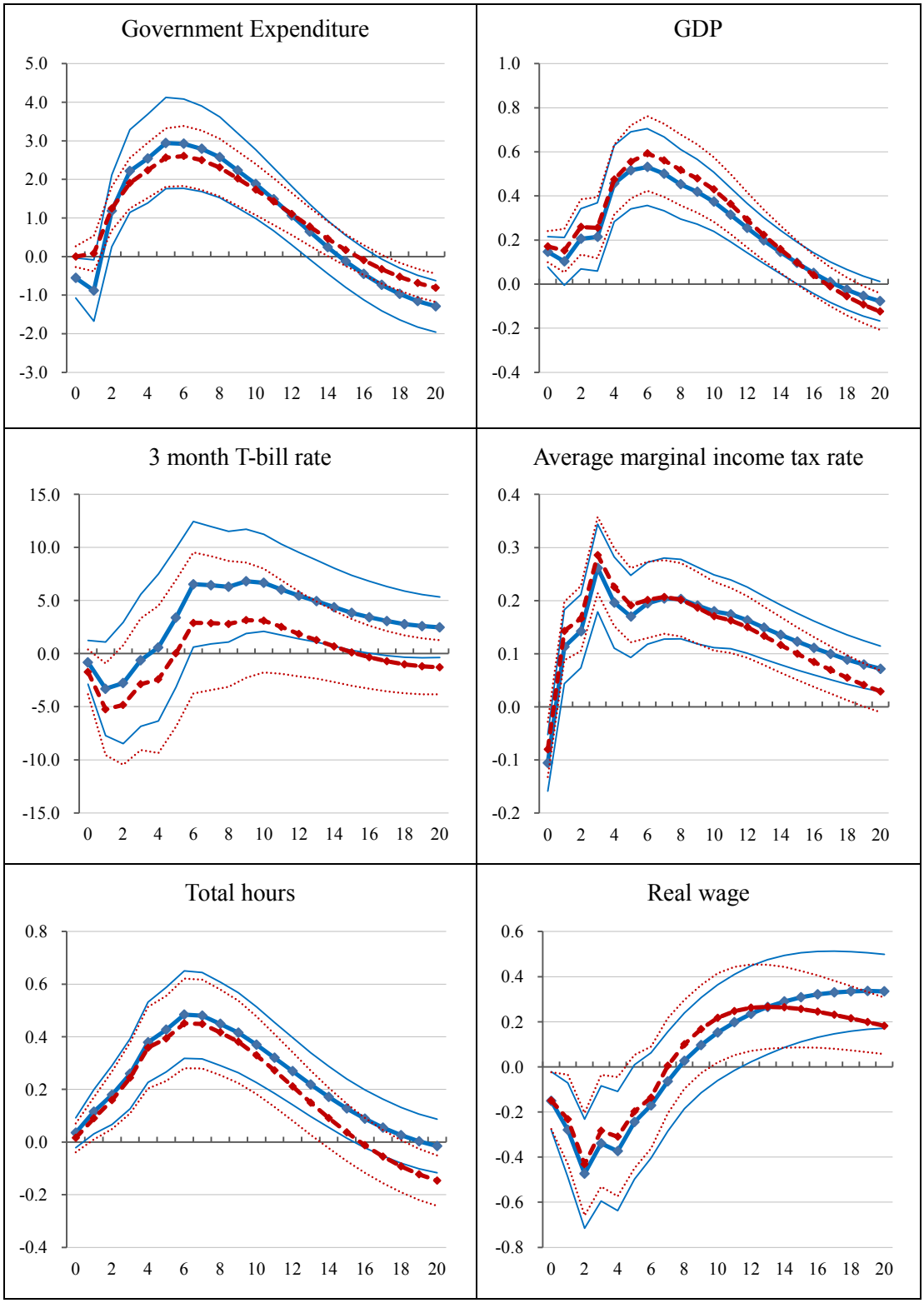
Period	1929~2011	1955~2011	1941~1946	1951~1956
Defense/Total government	0.39	0.33	0.78	0.58
Defense/Federal spending	0.70	0.73	0.92	0.87

Barro and Redlick (2011) highlight another problem associated with using military build-ups to study effects of government spending shocks. The nature of government spending during a military build-up differs dramatically from the general government expenditure. Barro and Redlick (2011) point out therefore that although military build-ups provide an excellent opportunity to estimate the multiplier, this multiplier is in fact only the multiplier for defense expenditure, not a multiplier for total government expenditure. Yet, Ramey (2011a) estimates the government spending multiplier and analyzes transmission of spending shocks using the military build-ups as if they were general government spending shocks.

To see how the results change depending on the definition of government spending, Figure 3.2 shows the impulse responses to a shock in the defense news variables, with data covering the period from 1939 to 2008 as in Ramey (2011a). Solid lines show the impulse responses when defense spending is used instead of total government spending and dashed lines show the results using total government spending.[52] The two impulse responses are very similar. This result is not surprising, considering that the data include the two exceptionally large wars and given that defense spending accounts for the bulk of government spending.

52. Total government spending consists of defense and nondefense spending of federal government, and the spending of state and local governments.

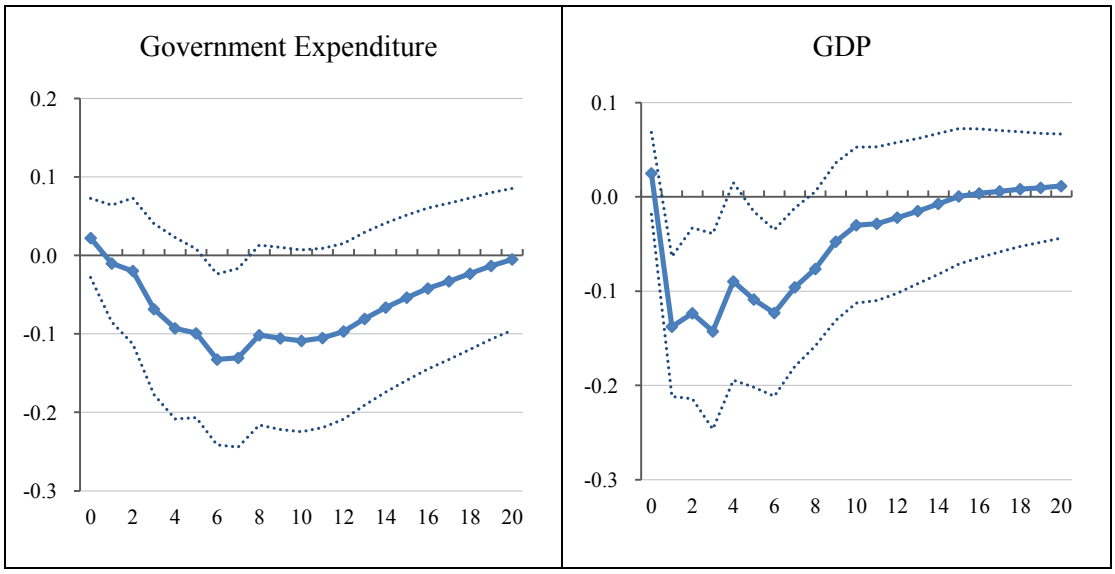
Figure 3.2 The effects of defense spending and government spending (1939~2008)



Notes: The solid lines show the responses with 68% confidence interval bands following Ramey's (2011a)'s specification with defense spending instead of total government spending. The dashed lines show the results of Ramey's specification with total government spending.

Ramey (2011a) analyzes the robustness of her results using a variety of specification such as excluding one of two big events and excluding both. When either the World War II or the Korean War is included, the results are qualitatively similar to those over the full period. However, when she restricts the sample to 1955 to 2008, excluding both large events, the result is qualitatively and quantitatively different. In particular, after a positive defense spending shock, government spending spikes ups only temporally and then turns negative. GDP also rises only on impacts and then its response becomes negative. We also analyze the period from 1975 to 2008, excluding even the Vietnam War. Figure 3.3 shows the effects of the defense news on the key variables in this case. The government spending increases only on impact and then falls for 5 years, although it is not significantly at conventional levels. The response of GDP is similar to that obtained by Ramey (2011a) when excluding the two large events. Finally, Ramey (2011a) also uses professional forecast errors instead of the defense news shocks for a period from 1968 to 2008 and gets results similar to those for 1955 to 2008 with defense news shocks. Therefore, Ramey's (2011a) hump-shaped responses of government spending and GDP appear driven by the World War II and the Korean War. The multiplier should therefore be interpreted as a defense spending multiplier.

Figure 3.3 The effects of defense news shocks from 1975 to 2008



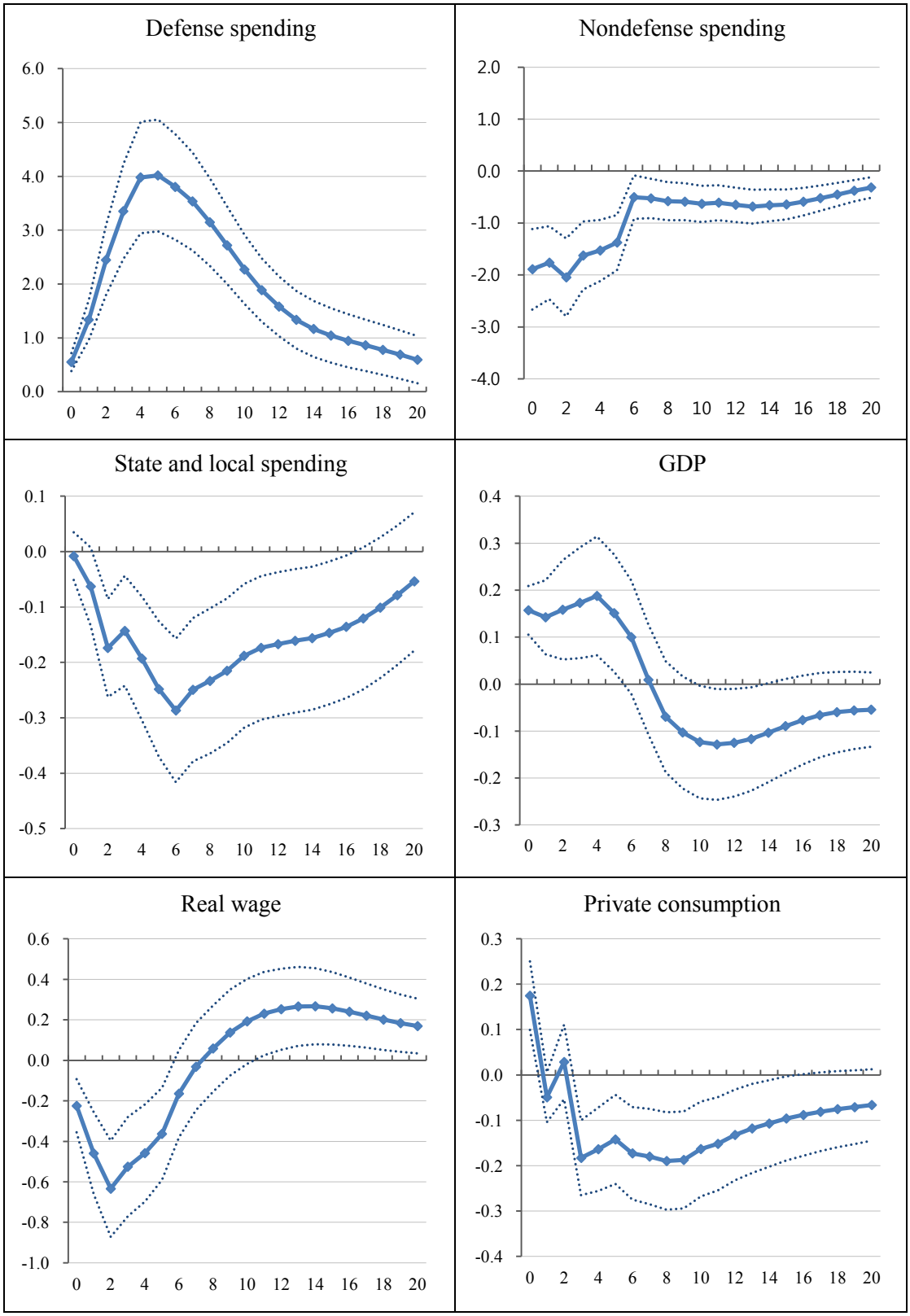
Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

In addition, Ramey and Shapiro (1998) argue that military build-ups have the advantage that they do not remove private resources except for manufacturing sector. Ramey (2011a) explains that the military spending was financed mostly by issuing debt during the World War II and by taxes during the Korean War. However, it should be noted that the increase of defense spending are financed partly by decreasing allocations to other sectors of government spending such as nondefense and state/local spending. It means that the military build-ups cause a transfer of resources within government sectors. As much literature such as Ilzetzki et al. (2011) and Bénétrix and Lane (2009) shows, the macroeconomic effects of government spending depend on its function.[53] Therefore, when using military build-ups which are concentrated in only defense sector, it is necessary to include the three remaining sectors of government spending among the endogenous variables to gauge the reallocation of funds in the wake of military build-ups.

We therefore again apply Ramey's (2011a) specification and data using defense news, with the three sectors of total government spending (defense, non-defense and state/local) featuring separately. Figure 3.4 shows the results. The impulse response of defense spending closely resembles consistent Ramey's results with a humped shaped pattern. However, we observe large and significant falls in nondefense and state/local spending: the increase in defense spending crowds out the spending in the other two sectors. The responses of other variables such as GDP, real wage and consumption are qualitatively similar to those of Ramey and Shapiro (1998) and Ramey (2011a). This analysis sheds light on the effects of military builds-ups on the total government spending: the increase defense spending is partly counterbalance by decreases in the remaining sectors so that the macroeconomic effects result from compositional responses of government spending sectors.

53. According to Bénétrix and Lane (2009), the effects of government spending shocks are different according to the nature of fiscal innovation: shocks to government consumption and shocks to government investment, and the latter has a positive and larger fiscal multiplier.

Figure 3.4 The effects of defense spending shocks from 1947 to 2008



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands

Another potential weakness of military build-ups relates to the assumption that they are exogenous and unexpected. Although wars can occur suddenly and unexpectedly, in many cases a military conflict ensues after weeks or months of rising tensions. For instance, the Japanese attack on the U.S. forces in the Pacific in 1941 was unexpected only to the extent that the U.S. expected the Japanese to attack the Philippines (held by the U.S. at the time) rather than Hawaii. Furthermore, once the war has started, it can take several years so that the continued increased spending no longer constitutes a fiscal shock.

Finally, military conflicts, even when they are extra-territorial, do have important supply-side effects: large numbers of young men are conscripted into the armed forces[54], firms switch their output towards military-use products and civilian-use physical assets such as trucks, boats and planes can be redirected for military uses such as transporting troops or ordnance.

To sum it up, although military build-ups have several advantages, they rely crucially on infrequent events with an atypical composition of spending. The macroeconomic effects are totally due to the increase of defense spending and the resulting multiplier cannot be representative of the effect of general government spending shocks, but only of changes in defense spending.

3. Natural disasters in the U.S.

Although military build-ups are related only to defense spending, much literature using narrative approach for identifying government spending shocks relies on these military build-ups because it is very hard to find a similar convincing exogenous instrument for nondefense spending. As Ramey (2011a) and Barro and Redlick (2011) indicate, the first problem is that the fluctuations in federal nondefense spending and state/local spending are much smaller compared to those of federal defense spending. In addition, federal nondefense spending is a minor part of total government spending and state/local spending is driven in large part by the variations in state revenues caused by economic cyclical fluctuations.

54. The number of draftees (the ratio of total labour) accounts for 10.1 million (19.1%) during the World War II, 1.5 million (2.4%) during Korean War, and 1.9 million (2.4%) during Vietnam War respectively.

We argue that natural disasters constitute another suitable instrument to identify exogenous variation in federal nondefense spending and state/local spending. Natural disasters are relatively frequent and, being 'acts of God', are by definition unexpected. When they happen, vast resources from federal, state and local governments are spent on disaster management such as response and recovery efforts, which affect housing, civilian safety, education, transportation, and other areas of nondefense spending. In this way, natural disasters cause government nondefense spending shocks which are more similar in their nature and scope to shocks to general government spending. A reasonable criticism of our approach is that although natural disasters are exogenous to economic conditions, the government response from them and its macroeconomic effect can be compounded by supply effects such as the loss or dislocation of labour and the destruction of physical assets and infrastructure. However, while the exact timing and extent of natural disasters is difficult to predict (certainly more than a few days ahead), the general risk of such disasters is well understood: in the context of the U.S., for example, the West Coast is known to have relatively frequent earthquakes, the Mississippi valley is at risk of floods and the states near the Gulf of Mexico are likely to be hit by hurricanes. Therefore, people living in high risk areas can engage in precautionary measures that minimize the potential adverse effect of disasters, especially to life. As we argued above, the literature on the short-run effects of natural disasters tends to find that the adverse effects are indeed less severe in developed countries. Moreover, the same criticism applies to military conflicts which, even when extraterritorial, are also bound to have supply side effects: both labour and capital are relocated towards the production of military assets (thus potentially increasing the costs of the civilian production) and a non-negligible share of the labour force is withdrawn to serve in the military. When considering that the estimated damage of the Hurricane Katrina, which is the most severe natural disaster in the U.S. recent history, is at most 1% of nominal GDP of the third quarter in 2005.[55] The adverse supply side effects are therefore relatively modest at the national level compared to other shocks such as military conflicts. Nevertheless, the presence of such adverse supply effects implies that our analysis using natural disaster is likely to underestimate the fiscal multipliers.

55. Hurricane Katrina was an exceptionally severe natural disaster in the U.S. In terms of the value at the time of occurrence, the damage of the Hurricane Katrina (125 billion $, 2005) is over 4 times than the second severest disaster, Hurricane Ike (29.6 billion $, 2008) followed by Hurricane Andrew (26 billion $, 1992), Hurricane Wilma (20.6 billion $, 2005), and the LA earthquake (20 billion $, 1994).

In addition, given that recent studies show that the impact of fiscal policy can be different according to the state of economy (Auerbach and Gorodnichenko 2011, 2012; Baum et al, 2012), the spending multiplier identified using our methodology is likely to be similar to a spending multiplier in recession. As such, our estimate can be useful for designing fiscal stimulus packages.

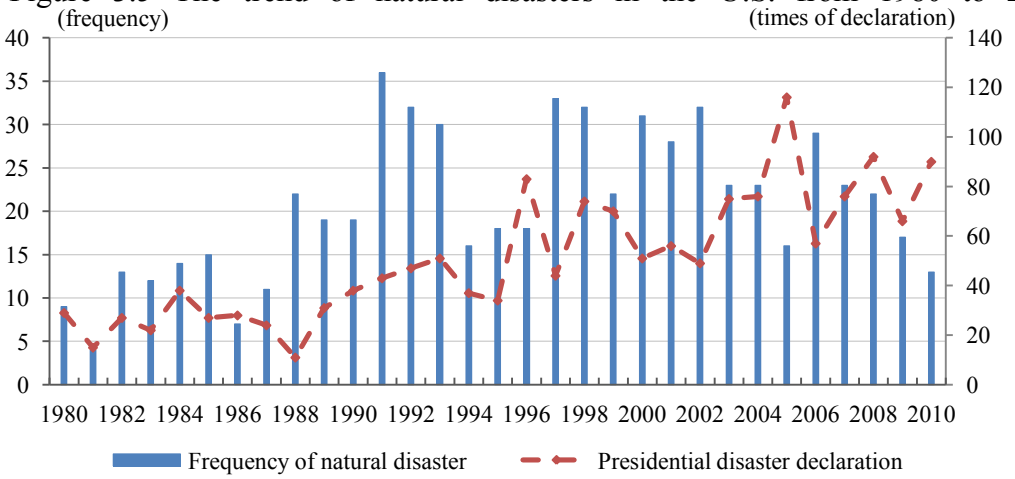
In this section, we describe the background of the natural disasters in the U.S. and how we construct the new exogenous series to identify the government spending shocks.

3.1. Stylized facts about natural disasters and the government response

Many reports suggest that the world is facing an increasing frequency and intensity of natural disasters. The U.S. is no exception. Since 1990, the U.S has experienced a sequence of unprecedented large and costly disasters including Hurricane Katrina (2005), Hurricane Ike (2008), Hurricane Andrew (1992), and others. The increasing impact of natural disasters in the U.S can be attributed in part to the increase in population and development of hazard-prone areas (Czerwinski, 1998).

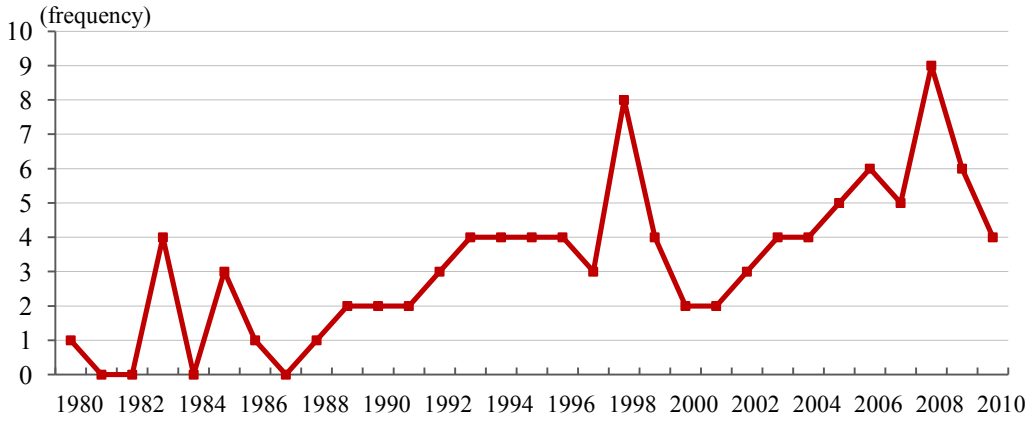
In Figure 3.5, the Emergency Disasters Database (EM-DAT) maintained by the Center for Research on the Epidemiology of Disasters (CRED) shows that the frequency of natural disasters in the U.S. has been increasing. In addition, according to the Federal Emergency Management Agency (FEMA) which coordinates the response to disasters in the U.S., there has also been an upward trend in the annual number of presidential disaster declarations. Figure 3.5 shows also this trend of natural disasters in the U.S since 1980. On average, there were 25.2 presidential disaster declarations per year in the 1980s, compared to 84.7 declarations on average since 2000.

Figure 3.5 The trend of natural disasters in the U.S. from 1980 to 2010



As to the severity and magnitude of disaster, Lott et al. (2012) show that the number of disasters which cause economic damages of more than 1 billion dollars has been increasing since 1980 as shown in Figure 3.6.

Figure 3.6 Frequency of disasters with economic damages more than $ 1 billion



Note: Estimated nominal economic damage in 2011 dollars.

When a natural disaster happens, the federal government and state and local governments respond to it cooperatively, following the Federal Response Plan and other applicable laws.[56] In the event of a disaster or local emergency, local government has the primary responsibility for responding to, recovering from and mitigating the adverse effects of the disaster. However, when effects of the disaster are beyond the capacity of local resources to respond effectively, the state and

56. For example, there are the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) for federal assistance and Natural Disaster Assistance Act (NDAA) for state assistance.

federal government assistance are provided through the emergency and disaster declaration process.[57] When the declaration for state or federal government is considered, the judgment criteria are mainly based on the damage assessment according to preliminary reports. This means that the state and federal assistance is closely related to the estimated economic damages and as a result, so are the government spending shocks. A presidential disaster declaration triggers actions by many federal agencies besides FEMA, including the U.S. Army Corps of Engineers, the Small Business Administration, the Departments of Agriculture, Transportation and Commerce, and others to provide supplemental assistance to state and local governments, families and individuals, and certain nonprofit organizations for mitigation, response and recovery. According to McCarty (2011) of Congressional research service, the amount of assistance provided through presidential disaster declarations to the Gulf coast region in the aftermath of Hurricanes Katrina and Rita has exceeded 140 billion dollars. Major part of this assistance comes from the Disaster Relief Fund (DRE) managed by FEMA as a category of grants-in-aid to state and local governments.[58] Under the Stafford Act, many disaster relief costs are to be shared between the federal government and the affected state and local governments. The federal share of funding is at least 75% for public assistance. However, depending on the circumstance, the federal government has raised the federal share for some disasters to as high as 90 % for the 1994 Northridge earthquake and 100% for 1992 Hurricane Andrew (Czerwinski, 1998).

3.2. Constructing the natural disaster variable

To estimate the effects of government spending shocks on the macroeconomy, it is necessary to identify an instrumental variable which is closely related to government spending shocks but exogenous with respect to the state of the economy. The gravity and impact of natural disasters can be measured with a number of variables, such as the number of persons killed, the number of persons affected or

57. There are three types of declaration: local emergency declaration, Governor's state of emergency proclamation and Presidential declaration of a federal major disaster or emergency.

58. The Disaster Relief Fund is a "no-year" fund managed by the Federal Emergency Management Agency (FEMA) and used only for spending related to presidentially declared disasters. While FEMA budgets are based on the current Fund balance for a given fiscal year (5.8 billion for FY 2008), in a case of its shortage, Congress makes supplemental emergency appropriations as needed to respond to large disasters. (For more information on federal funding for disasters, refer to GAO/RCED-00-182)

displaced, the estimated economic damage, and others. We select the economic damage as an instrumental variable because this is what usually determines the amount of government assistance as explained in the previous subsection. A natural disaster causes government spending shocks in two types: federal nondefense spending and state/local spending which includes the grant from the federal government. In order to reflect this, we proceed in two steps. First, we compile the total economic damages per natural disaster at the national level. Second, the economic damages are allocated to the 50 states used in a panel analysis at the state level.

For the first step, natural disaster list is compiled mainly with major disasters which cause sufficiently large damage to infrastructure, human capital and production facilities that they can exert a substantial effect on government spending. The preliminary disaster list is obtained from EM-DAT because it is a comprehensive database that includes data on the occurrence and effects of over 18,000 mass disasters in the world since 1900. In order to be entered into the EM-DAT database, a disaster must meet at least one of the following criteria: 10 or more people killed; 100 or more people affected; a declaration of a state of emergency; a call for international assistance. We select the period from 1977 to 2009, i.e. after the end of the Vietnam War, in order to minimize contamination of our results by fluctuations of government spending due to military build-ups. We complete this list of major disasters and total economic damages at the national level by cross-checking the EM-DAT database with the lists of presidential major disaster declarations from FEMA and with the list of climate-related disasters with damages exceeding one billion dollars from the National Ocean and Atmospheric Administration (NOAA).

The next step is to distribute the total economic damages per disaster to each state affected. As far as we know, there is no systematic and comprehensive data for this purpose because economic damages at the state-level were not consistently reported. Therefore, we construct a new economic damage series per state from various sources with several criteria applied in sequence.[59] The first criterion is the

59. The sources include EM-DAT of CRED, the Storm event database of National climate data Center, the National Hurricane Center, the National Weather Service, the Federal Emergency Management Agency, U.S. Department of Agriculture, individual state emergency management agencies, state and

disaster reports by the agencies such as the National Hurricane Center, National weather service, and Storm prediction Center and others. Most of these reports were written at the time of incidence so they can match better with the government spending shocks which is the variable of interest in this chapter. In the case of disasters with no report, we relied on other sources in sequence: the storm event database of the National Climate Data Center;[60] EM-DAT; U.S. Geological Survey report; and U.S. Army Corps of Engineers reports. Lastly, for some natural disasters only total damage but no damage data by state is available, we had to distribute it according to the ratio of related data such as financial assistance grant from FEMA, the number of counties where emergency was declared, the number of death and so on.

To analyze the effects of government spending shocks related to natural disasters, it is necessary to transform the constructed economic damages into time series data. At the national level, this requires assigning the calendar dates to quarters. When the natural disaster happens, state government needs some time to respond and spend expenditure for relief and recovery efforts due to fiscal policy lags. In case of major natural disasters, in the process of presidential disaster declaration, it takes some times to survey the damaged and destroyed facilities and determine eligibility for assistance. This decision lag for disaster declaration usually takes from 1 week to some months. Therefore, we use the date of the declaration as the date of the associated government spending shock. In addition, even after this declaration, it takes more time for the government to disburse and execute the disaster assistance (implementation lags). We assume that it usually takes about 1 week after the disaster declaration. In order to capture the government spending shock in time, if the disaster declaration occurs in the last week of a quarter, it is assigned to the next quarter[61], which is similar to the timing approach of Ramey (2011a).[62] On the other

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regional climate Centers, Geological Survey reports, U.S. Army Corps of Engineers reports, media reports and insurance industry estimates (Appendix 2. B).

60. The database currently contains data on property and crop damage in millions of dollars from 1996 to present. However, prior to 1996, it shows only range of damage. Therefore, we use the data from this database directly since 1996 but before 1996, we just consult it as a means of the ratio for distributing total economic damages to each state.

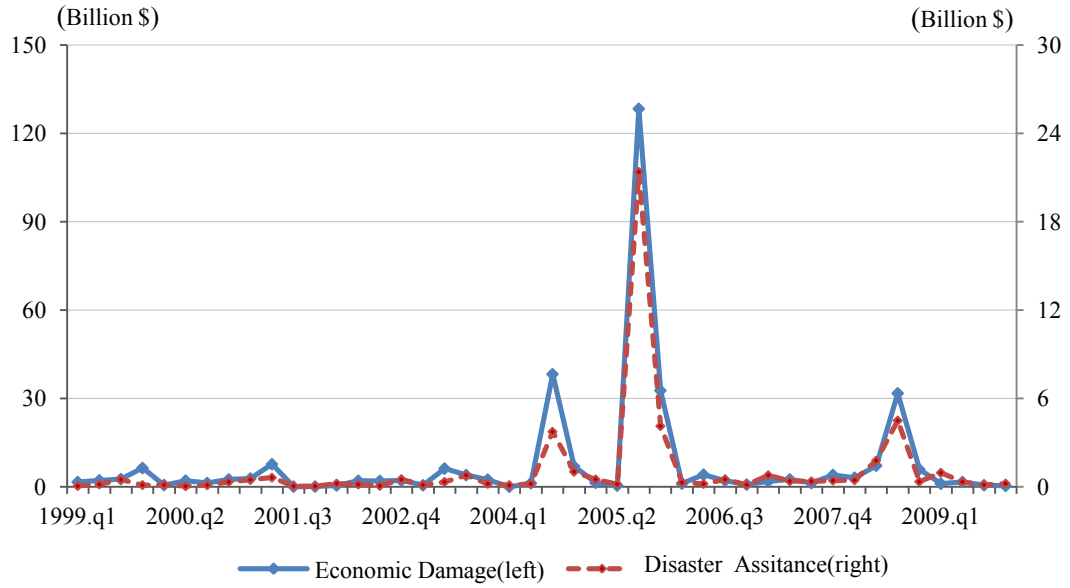
61. In case of no declaration for some disasters, if the natural disaster ends during the last week of a quarter, we assign it to next quarter.

62. Appendix 2. A shows the data of our constructed estimated economic quarterly damages of natural disasters.

hand, for a panel analysis at the state level, since there is no quarterly fiscal data but only annual fiscal data, we allocate the economic damages to fiscal years with a similar way.[63] Lastly, we deflate the nominal economic damages using CPI (2005=100).

Figure 3.7 shows the relation between the economic damages and the corresponding disaster assistance from FEMA at the national level. Data for the size of disaster assistance is available on FEMA website only from 1999 onward. Since other federal agencies and state governments besides FEMA contribute towards the response and repair costs, the disaster assistance from the Disaster Relief Fund is not enough to show the total government spending shocks. However, Figure 3.7 shows that disaster assistance expenditure occurs in the same quarter as natural disaster or in the following quarter and its size also tracks economic damages of natural disaster similarly. It means that our economic damage series is valid as an instrument for identifying government spending shocks.

Figure 3.7 The comparison of economic damages and disaster assistance (1999~2009)



63. In the U.S. while fiscal year of the federal government starts on Oct 1st and ends the following Sep 30th, the fiscal years of the 50 states are different to each other. 46 of the 50 state governments have a fiscal year that runs from July 1st until June 30th. Four states are exceptions: Alabama and Michigan (Oct.1st~Sep.30th), New York (Apr.1st~Mar.31th) and Texas (Sep.1st~Aug.31th).

Table 3.2 shows the basic statistics for disaster damage per state from FY 1977 to FY 2009. In terms of frequency per year, Texas has experienced major disasters more often than any other state, followed by California, Oklahoma, and Louisiana. Although natural disasters occur often in Oklahoma, the damages are small comparatively. On the other hand, the state with the greatest annual damage is Florida with $6.1 billion (not included in the table), followed by Louisiana ($4.5 billion) and California ($2.7 billion).

At the state level, severe disasters can clearly cause massive destructions and labour loss to an affected state as explained in previous section. Therefore, in the section on robustness check, the issue of adverse supply side shocks will be considered.

Table 3.2 Statistics for disaster damage in Top 5 frequency states

	Disaster years	Max damage fiscal year (million, $)	Number of events	Worst disaster (million, $)	Annual damage (million, $)
The U.S.	33	2006 (158,623)	320	Hurricane Katrina (120,414)	17,449
Texas	30	2009 (22,621)	73	Hurricane Ike (22,401)	2,057
California	25	1994 (27,032)	61	LA earthquake (26,220)	2,654
Oklahoma	23	1999 (3,662)	50	Extreme temperature (2,330)	402
Louisiana	22	2006 (84,923)	41	Hurricane Katrina (78,682)	4,533
Mississippi	21	2006 (39,778)	37	Hurricane Katrina (39,194)	2,386

Note: All damages are deflated to chained 2005 dollars and the 'annual damage' means average total damage per state computed with years in which disaster occurred, excluding no disaster years. 'Disaster years' refers to the number of years out of 33 in which at least one disaster occurred. 'Number of events' is the total number of disasters during this period per state.

4. Analysis at the national level

This section presents the macroeconomic effects of government spending shocks related to natural disasters at the national level of the U.S. To compare our results with other studies using military build-ups, we follow Ramey's (2011a) methodology, as hers is a representative and recent paper using military-build ups.

4.1. Data and specification

We use quarterly U.S. data over the period from 1977 to 2009. As mentioned earlier, this period is chosen to exclude the Vietnam War (and the previous wars) and thus to minimize the effects of military build-ups. The components of national income and fiscal series are collected in chained (2005) dollars from the NIPA tables of the Bureau of Economic Analysis (BEA). As an interest rate, the 3-month T-bill rate is drawn from the Federal Reserve Bank database (FRB). CPI, hours worked, and real wage are taken as an index (2005=100) from the Bureau of Labor Statistics (BLS).[64] Population data used to convert the series into per capita terms is drawn from the BEA. All data are seasonally adjusted and nominal values are deflated using the GDP deflator. All variables except the interest rate and economic damage series are expressed in logs of real per capita terms.[65]

Following other literature including an exogenous variable in an empirical model, our reduced-form VAR model can be expressed as

$$X_t = A_0 + A_1 t + B(L)X_{t-1} + C(L)D_t + \varepsilon_t$$

where X_t is a vector of endogenous variables, A_0 and A_1 are the constant term and a linear trend. B(L) and C(L) are lag polynomials of 4th degree to be consistent with the other literature with quarterly data on the U.S. fiscal policy. The narrative shocks D_t, economic damages as described in the previous section, is included as the exogenous variable and ε_t is a vector of reduced-form innovations. The vector of variables X_t consists of federal nondefense spending (Nondef), state/local government spending (State), and federal defense spending (Def), output (GDP), consumer price index (CPI), and short-term interest rate (TB3m). The total government spending is disaggregated into three components because the government spending shocks related to natural disasters rarely affect defense spending which is major part of total government spending:

$$X_t = \textit{(Nondef, State, Def, GDP, CPI, TB3m)'}$$

64. We use Consumer Price Index for All Urban Consumers and All Items, Hours worked index for hours of all persons in nonfarm business sector, and real wage index for real hourly compensation in nonfarm business sector.

65. Appendix 2. B describes the data sources.

Other variables of interest such as hours worked, real wage, private consumption and private investment are then added one at a time as in Burnside et al. (2004). In addition, to identify government spending shocks, the economic damage variable (D_t) is embedded in X_t, but ordered first, following Ramey (2011a)

4.2. Baseline results

This subsection presents the impulse responses of the fiscal and macroeconomic variables to the economic damages as exogenous shocks. The point estimates of impulse response are accompanied by corresponding 68% confidence intervals, which is computed by bootstrap standard errors on 1000 replications, like in most previous studies.[66] All impulse responses can be interpreted as percentage deviation from a variable's baseline path, except for those of the interest rate which are reported as deviations from its baseline, measured in percentage points.[67]

Figure 3.8 displays the dynamic responses of all variables to a natural disaster shock. The first three graphs show the responses of the three components of government spending. As predicted from the general government response to natural disaster, after a natural disaster shock, the nondefense government spending rises for only 1 year and then return to zero, peaking in the second quarter after the shock. This result explains the federal government response to a natural disaster well. When a natural disaster occurs, many federal agencies provide supplementary assistance for the initial emergency response for a short period, the cost of which is borne by federal nondefense spending. However, the major part of federal government assistance is the financial assistance from the Disaster Relief Fund, which is grant for state and local governments. Since state and local governments are responsible for the substantial part of relief and repair for a long period, the impulse response of state and local spending should capture this. However, as can be seen in the second graph, its response is not significantly different from zero at all horizons. One plausible explanation is that these grants for several states are too small to be a shock for total state-local spending of the 50 states at the national level. However, it is

66. Many empirical studies on fiscal policy use 68% confidence interval; Ramey (2011a), Melecky and Raddatz (2011), Blanchard and Perotti (2002), Burnside et al (2004), and Caldara and Kamps (2008) etc. Additionally, our results with 95% confidence bands are shown in Appendix 2. C.

67. Except for interest rates which percentages points are used for, all response are multiplied by 100 so that a growth rate from the change in log variables is expressed in percent (%).

certain that the affected state government has positive government spending shocks in responding to the natural disaster with its own resources and the federal grant. Therefore, we will deal with this issue in the next section of the cross-state analysis. Defense spending increases a little on impact and then falls insignificantly afterward. The initial short increase can be accounted for the relief and search and rescue efforts of the military including the National Guard. Finally, note that contrary to military build-ups of Ramey (2011a), an increase of nondefense spending does not crowd out the other components of government spending whose responses are insignificant (with the exception of the aforementioned modest and short-lived rise of defense spending).

The response of GDP shows a hump shaped pattern for two years, although it is significant only for one year. It confirms that at the national level, the adverse supply side shocks due to natural disasters are indeed negligible and the effect on GDP results not from the natural disaster itself, but from the government spending that follows it. The implied elasticity of the GDP peak with respect to the nondefense spending is 0.30 and the cumulative elasticity is 0.37 (note that to compute the cumulative elasticity, we consider only four quarters as the effect is not statistically significant thereafter). Since the average ratio of GDP to government spending is 4.7 from 1977 to 2009, the implied nondefense spending multiplier is 1.41 for peak and 1.74 for cumulative effect, which are higher than the defense spending multiplier (0.6~0.9) of Barro and Redlick (2011) and the multiplier (0.6~1.2) of Ramey (2011a), less than the multipliers (peak: 2.48, cumulative: 2.24) of Auerbach and Gorodnichenko (2012) in recession, but are within the range of the peak federal nondefense spending multiplier[68] of 1.0 to 2.5 used by the Congressional Budget Office (2010) for fiscal stimulus packages.[69]

The next two graphs report the responses of CPI and the interest rate. Although the response of CPI is not significantly different from zero, CPI and the 3-month Treasury bill rate increase after a positive spending shock, which is consistent with the theory. The fourth and last rows of Figure 3.8 show the responses of the variables

68. Congressional Budget Office (2010) calculates output peak multiplier by the purchase of goods and service of the Federal government from large macro-econometric models.

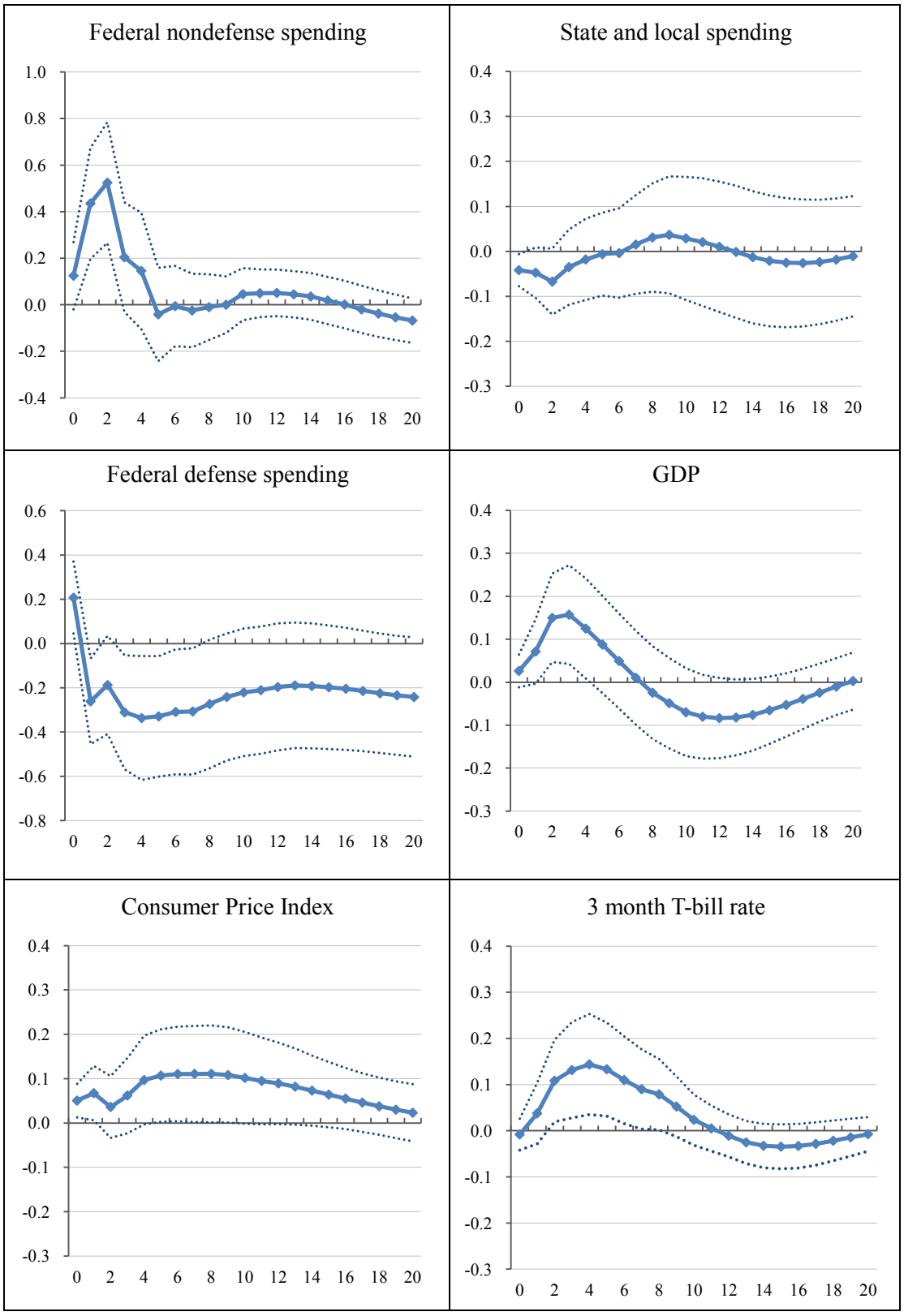
69. Appendix 2.D shows examples of government spending multiplier at the U.S. national level in several representative studies, of which the majority is quoted from Ramey (2011b, Table 2).

of interest, which as discussed above are added to the model one at a time. Firstly, as to the labour market variables, although their responses are not statistically significant except at the peak, their point estimates are qualitatively consistent with the neoclassical model. The hours worked increase over all horizons after positive government spending shocks and as a result, the response of real wage is negative. Given that government spending is used mainly for repairs and restoration to the original state, labour productivity is not affected[70] and the decrease of real wage corresponds closely with the increase of hours worked. On the other hand, the response of private consumption is not consistent with the neoclassical model which predicts a negative response of private consumption due to the negative wealth effect. Private consumption increases for 2 years and then falls, following a pattern similar to that of GDP, although it is insignificant. The investment response is large and positive for a long period. It reflects the repair and reconstruction works after a natural disaster.

To sum up, a natural disaster causes the federal nondefense spending to increase for one year, but does not affect the other components of government spending at the national level. Based on the response of GDP which is positive significantly for one year after the government spending shocks, the estimated peak nondefense multiplier is 1.41 and the cumulative one is 1.74. The positive response of hours worked and the negative response of real wage is consistent with the neoclassical model. However, private consumption and investment rise for a long period as the government responds to a natural disaster, contrary to the predictions of the neoclassical model.

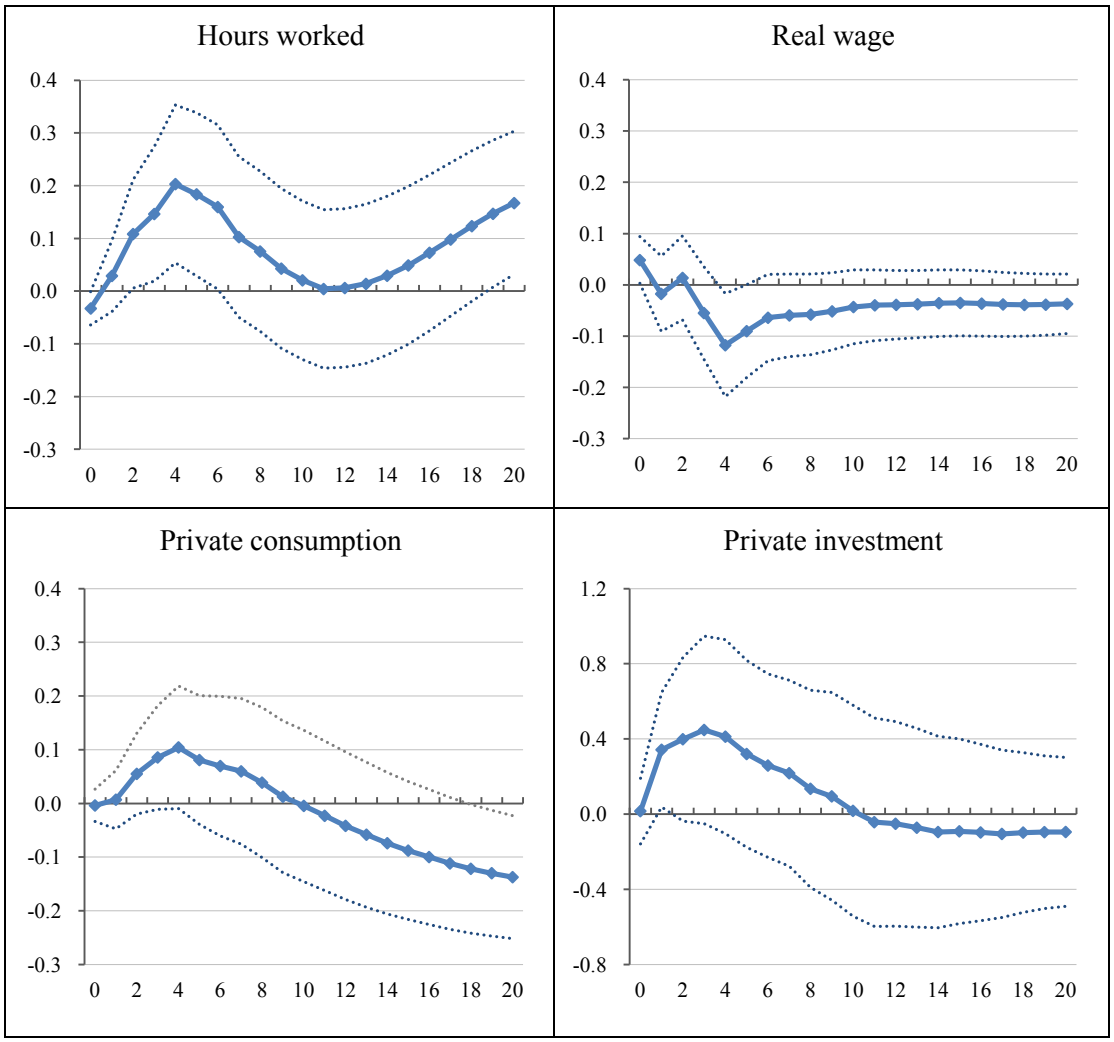
70. A comparison of the peak of the hours worked to the peak of the GDP shows that the productivity does not improve.

Figure 3.8 The effects of government spending shocks



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

Figure 3.8 The effects of government spending shocks (Continued)



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands.

4.3. Robustness checks

To check the robustness of the baseline results, this subsection presents several additional results regarding the usage of three components of government spending and the responses of some variables

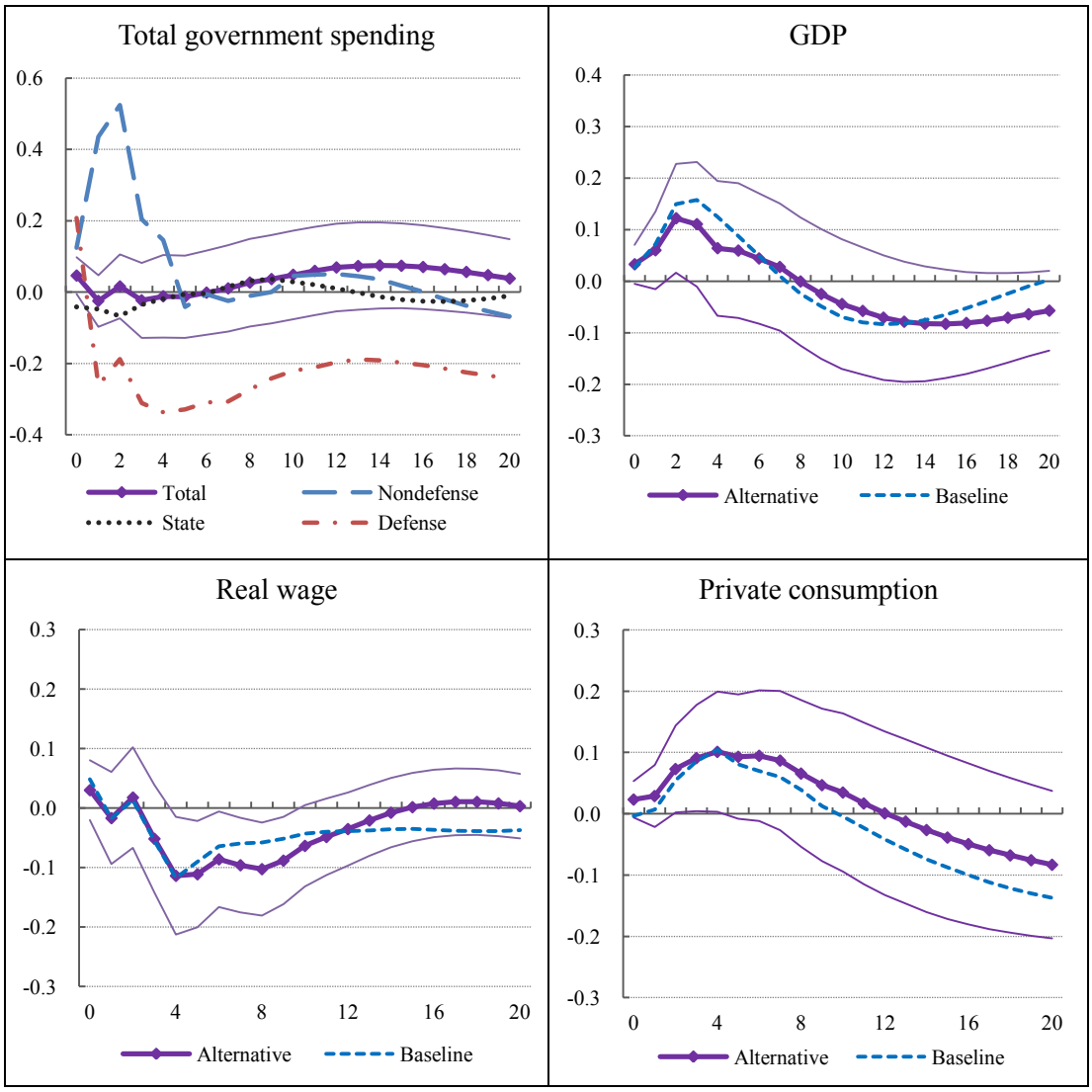
4.3.1. Response of total government spending

In the baseline analysis, we use three components of total government spending in order to identify the effects of nondefense spending shocks. As a robustness check and to produce results more in line with the rest of the literature, we now use the

total government spending instead of these components (despite the fact that the natural disaster shocks are rather small compared with the total government spending at the national level).

Figure 3.9 shows the responses of key variables after total government spending shocks, comparing with the baseline results. Total government spending does not respond significantly to natural disaster shocks. One plausible explanation is that nondefense spending is too small to affect the fluctuation of total government expenditure. With the exception of government spending, the responses of other key variables are qualitatively and quantitatively similar to those of the baseline model.

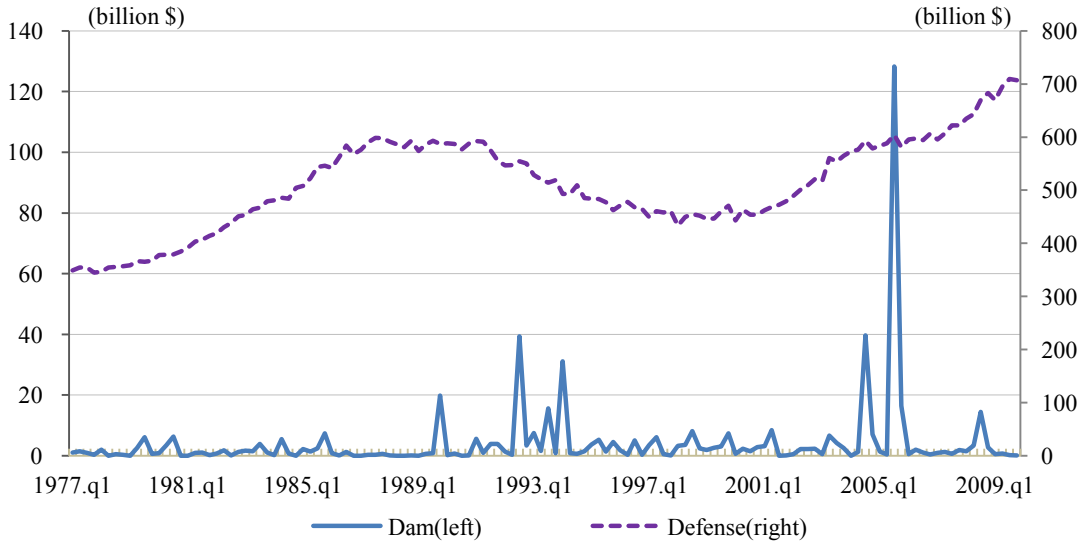
Figure 3.9 The effects of total government spending shocks



4.3.2. The relation between natural disasters and federal defense spending

In the baseline result, defense spending responds negatively and strongly after natural disaster shocks, although this response is not significant. The possible reason is that there is another factor to cause the fall in defense spending, which coincides with the occurrence of natural disasters. Figure 3.10 shows the trends of defense spending and natural disasters. As explained before, defense spending fluctuated more than other categories of spending due to external factors. Since the end of the Vietnam War, the fluctuation of defense spending has been more modest but still large, mainly reflecting the military build-ups due to the Soviet invasion of Afghanistan (1979) and 9/11 (2001), and the military build-downs due to the end of the Vietnam War (1975) and the collapse of the Soviet Union (1991). Coincidently, big natural disasters such as Hurricane Andrew (1992), LA earthquake (1994), and Hurricane Ike (2008) occurred in the period of military build-downs. As a result, natural disaster seems to cause defense spending to fall statistically.

Figure 3.10 The trends of natural disasters and defense spending



We perform various checks of the relation between natural disaster and defense spending. Table 3.3 shows the results. During the military build-ups up to 1990, there is no relation between them. However, since 1990, there appears to be a strong negative relationship, which, we argue, reflects the end of the cold war coinciding with increased frequency of natural disasters. In analyzing the fiscal policy with the U.S data, the discretionary fiscal shocks are strongly affected by the fluctuation of defense spending due to its high proportion in total government spending. Further

work is needed to explore how to disentangle discretionary nondefense fiscal shocks from defense spending.

Table 3.3 The relation between natural disaster and defense spending

Samples	1977~2009	1977~1990	1990~2009	2000~2009
Correlation	-0.22	-0.11	-0.22	-0.42
Coefficient	-0.7705*** (0.01)	-1.2816 (0.43)	-0.6650** (0.05)	-0.9103*** (0.01)
Granger-causality	Yes*** (0.01)	No (0.40)	Yes** (0.05)	Yes*** (0.01)

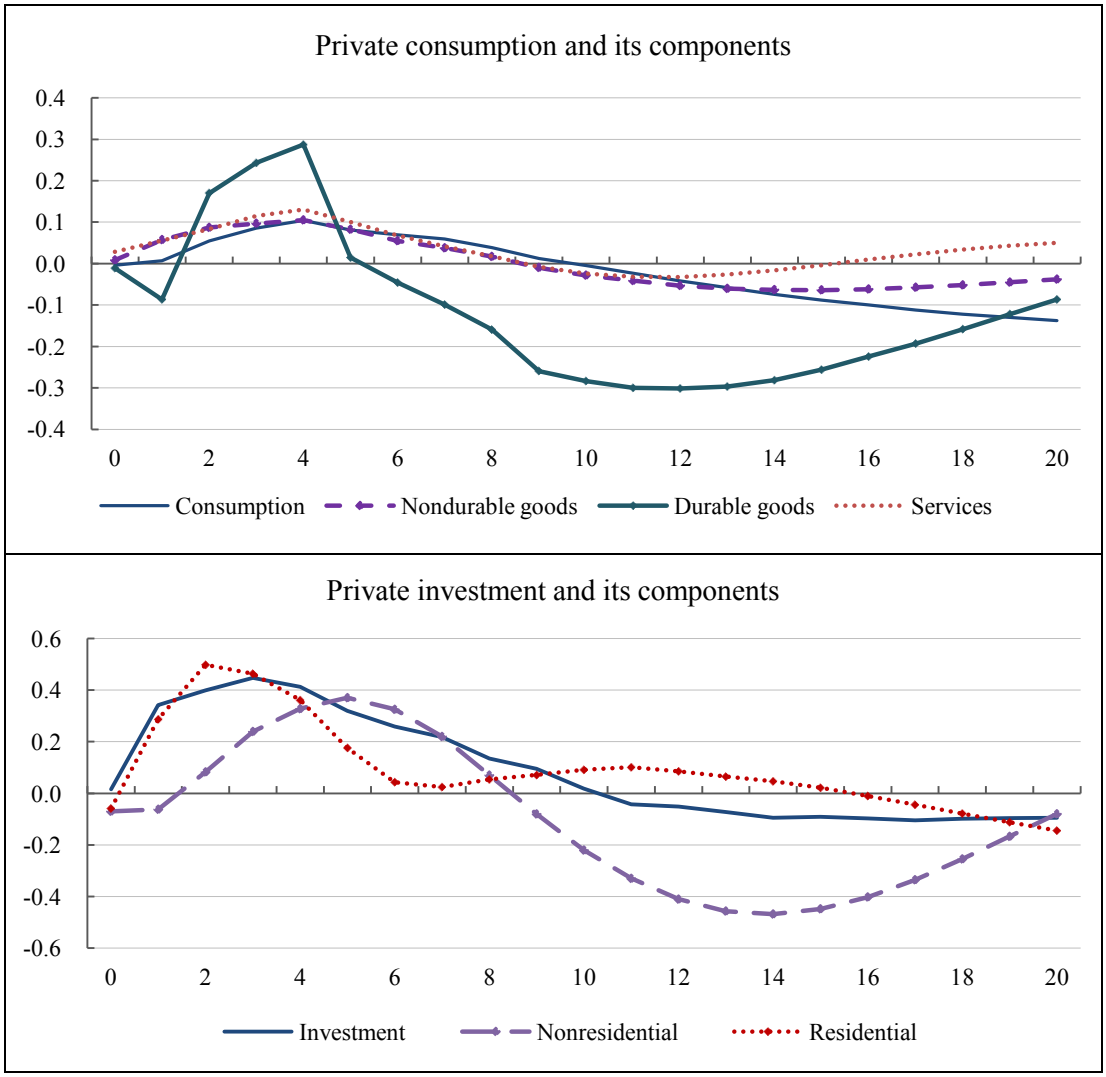
Note: Defense spending data is the change from the previous quarter in per capital real defense spending. First, the correlation is for between the 1 lagged value of real economic damage (billion dollars) and the change of defense spending. Second, the coefficient is obtained from a regression of defense spending on 1 lags of the economic damage series. Third, Granger-causality test is done with 1 lag for the hypothesis: Do natural disaster Granger-cause the change of defense spending? Figures in parenthesis refer to P-value. *** Significant at 0.01 level, **Significant at 0.05 level.

4.3.3. Responses of components of consumption and investment

As the other literature does, we analyze the effects on the components of private consumption and private investment after government spending shocks in order to identify their responses and the speed of their responses. First, we split private consumption into its three components: nondurable goods, durable goods, and services. The private consumption is replaced with these three components one at a time in the baseline model. Similarly, the private investment is divided into nonresidential and residential investment.

Figure 3.11 shows the results of this alternative model. Similar to the baseline, none of the responses is significant at the 68% level. In terms of the point estimates, their responses are quantitatively and qualitatively different from each other. Nondurable goods and services display similar responses with a hump-shaped pattern. However, durable spending initially falls and then rises sharply over the course of one year. Interestingly, this response is quite similar to that of nonresidential investment. Residential investment increases substantially for 6 quarters and then returns to zero. In considering that people need housing and basic items urgently after a natural disaster and then buy household goods, cars, and other investment goods later, the responses of these components depict well the actual responses by the private sector in the wake of a natural disaster.

Figure 3.11 The effects of components of consumption and investment

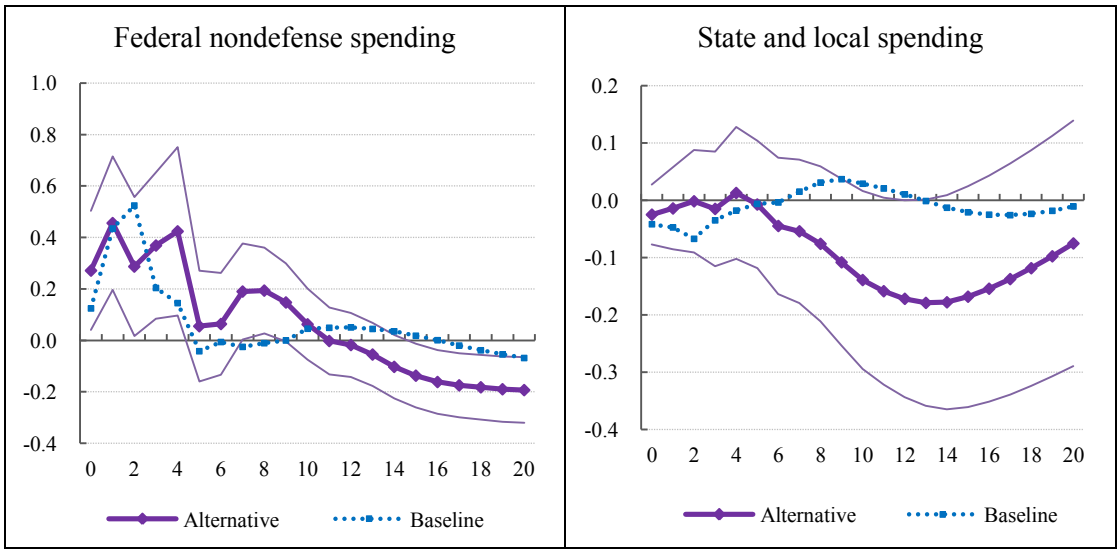


4.3.4. The effects of natural disasters except Hurricane Katrina

As in the previous section in which we analyze the effects of military built-ups excluding the World War II and the Korean War, we analyze the response of macroeconomic variables to natural disaster shocks excluding the biggest natural disaster, Hurricane Katrina, which occurred at the end of August 2005. In considering that the GDP responds positively for 8 quarters in the baseline analysis, we exclude two years from 2005.3q to 2007.2q. Figure 3.12 shows the responses of key variables after total government spending shocks, compared with those of the baseline. The responses of the three components of government spending when excluding Hurricane Katrina are qualitatively similar to the baseline results. Nevertheless, the magnitude of responses is somewhat smaller and the standard error

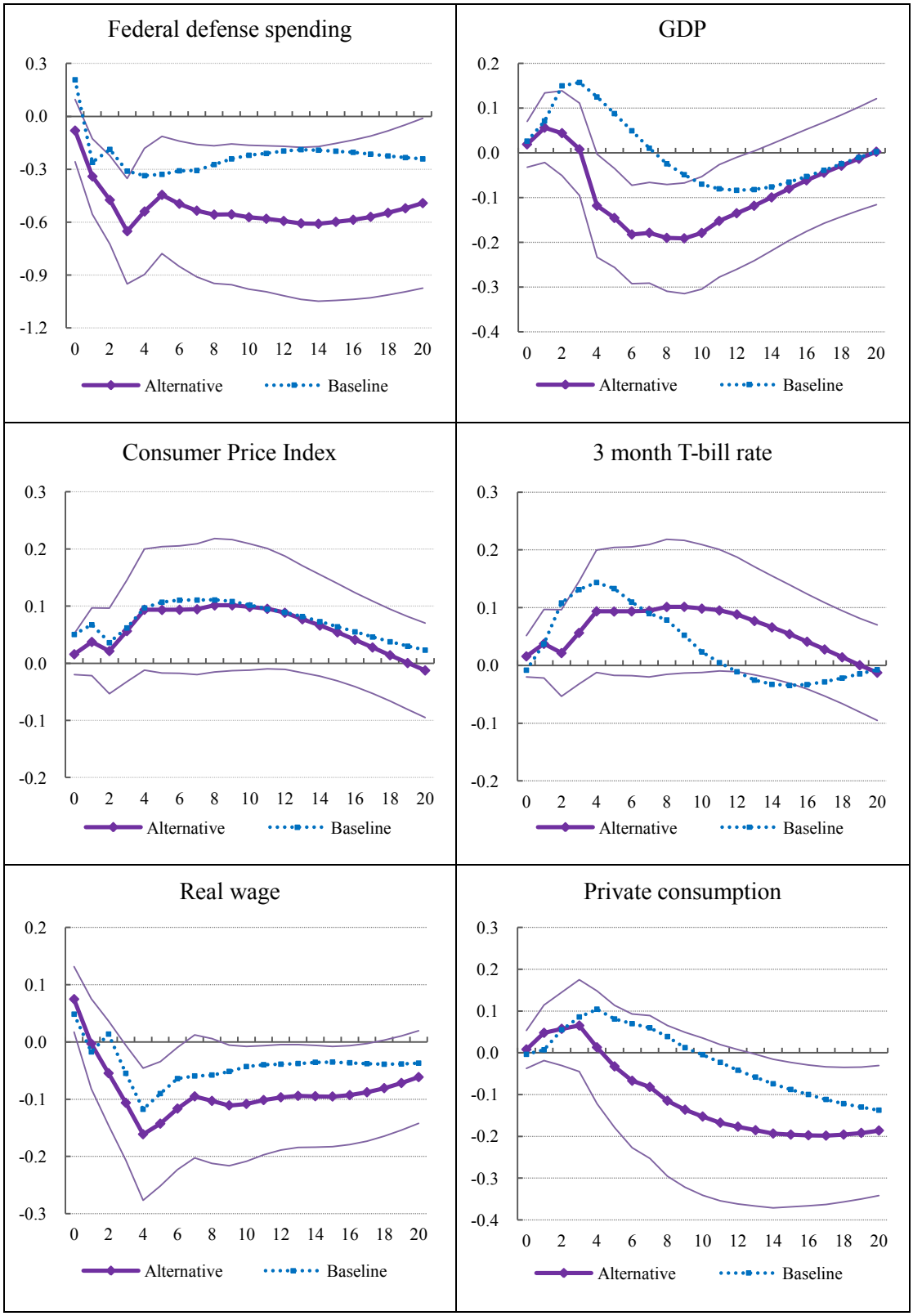
bands are wider when Hurricane Katrina is omitted. The next graph in Figure 3.12 shows the response of GDP which rises for one year and then becomes negative after a natural disaster shock. Although it is not significantly different from zero, the elasticity of the GDP peak with respect to the nondefense spending is 0.1 and the average ratio of GDP to government spending is 4.7 for this period. Therefore, the implied multiplier is 0.47 which is much smaller than 1.41 of the baseline analysis because of the small positive response of GDP. It shows that natural disaster series are also dependent on big disasters just like the military build-ups. However, unlike military build-ups, the responses are qualitative similarity regardless of whether big natural disasters are included. Therefore, natural disasters appear a better instrument for identifying unexpected government spending shocks and their effects. The other graphs of Figure 3.12 also display the responses of key macroeconomic variables when excluding Hurricane Katrina. Along with the response of fiscal variables, the responses of CPI, 3 month T-bill rate, real wage, and private consumption are qualitatively and quantitatively very similar with and without Hurricane Katrina. In particular, the private consumption rises for one year and then decreases just like GDP. Similarly, the magnitude of its response is smaller than with the full sample. It shows that the response of private consumption follows that of GDP because the private consumption is a major component of GDP.

Figure 3.12 The effects of government spending shocks excluding Hurricane Katrina



Note: A thick line displays point estimates while thin lines correspond to 68% confidence interval bands.

Figure 3.12 The effects of government spending shocks excluding Hurricane Katrina (Continued)



Note: A thick line displays point estimates while thin lines correspond to 68% confidence interval bands.

5. Cross-state analysis with 50 states

This section presents the macroeconomic effects of state government response after natural disaster shocks using a panel of all 50 states of the U.S. Since the state government spending can be categorized as nondefense spending, the estimates of the effects can shed further light on the nondefense spending multiplier for typical fiscal stimulus packages. In addition, to the best of our knowledge, this analysis is the first attempt to study natural disasters by state.

5.1. Data description

5.1.1. Fiscal and macroeconomic variables

As Ramey (2011a) argues that timing is very important in identifying government spending shocks, quarterly fiscal data is necessary to obtain precise estimates of the fiscal effect on the economy. However, there are no quarterly fiscal data for all states of the U.S. Therefore, we have to use annual fiscal data. The data on state government expenditure, revenues, and fiscal debts are taken from the U.S. Census Bureau's Economic Statistics on state government finances, which is available from 1977 to 2009 fiscal years. We use the general fiscal data which means that the expenditure includes all cash payments for goods and services including subsidy and the revenues consist of all income including intergovernmental revenues such as assistance grant from the federal government during the fiscal year.[71] For the state government debt, both short and long term debts are included.

As a state-level output variable, we use personal income, instead of the gross state product (GSP), collected from the U.S. Bureau of Economic Analysis (BEA). The reason is that unlike GSP, which is available only at the annual frequency, personal income data are available at the quarterly frequency. The state-level fiscal data are also reported in annual frequency but in fiscal rather than calendar years. We can, therefore, match the quarterly personal income data to the state fiscal years. Another reason is that the GSP data have a break in 1997 because of the switch in

71. General expenditure and general revenues comprises all types of expenditure and revenues excepting special accounts: utility, liquor store, and insurance trust.

industry classification from SIC to NAICS.[72] Other state-level variables that we use include the house price index as a proxy for inflation from the Federal Housing Finance Agency (FHFA), and non-farm payroll employment data from the Bureau of Labor Statistics (BLS). The Coincident Economic Activity Index (CEAI), which is set to match the trend for GSP by including four indicators: nonfarm payroll employment, the unemployment rate, average hours worked in manufacturing, and wages and salary, is taken from the Federal Reserve Bank (FRB). We obtain total midyear state population data from the Census Bureau. The national consumer price index (CPI) for urban consumers is taken from the BLS.[73]

All macroeconomic variables are attributed to the appropriate fiscal year in order to match the fiscal variables. All variables except index variables are in real per capita terms, deflated by the CPI (2005=100). Finally, all variables are expressed in logs.

5.1.2. Properties of the new exogenous instrument

Before using the natural disaster damages series as an instrument for government spending shocks, we check whether these series are unpredicted and exogenous shocks with respect to the state economy and how closely they are associated with discretionary fiscal shocks. First, it can be easily accepted that the occurrence of natural disaster is unexpected and exogenous to a state's economic conditions. Some natural disasters may be expected in disaster-prone areas because they tend to occur during particular times of year. However, this proneness is also irregular and no one can forecast the actual timing and severity of damages.

Second, a possible criticism is that natural disasters affect the supply side of the state economy by destroying physical and human capital. If so, it can distort the estimated effect of government spending on economic output. Therefore, we analyze the relationship between damages and the economic activities in order to check its validity as an instrument. At the same time, we show the effects of natural disasters on the changes of government spending. For this purpose, we perform a series of

72. According to Shoag (2010), the BEA advises researchers to use the personal income series, rather than the GSP series, when the period of analysis includes 1997.

73. Appendix 2. B describes the data sources.

regressions using our disaster series as an independent variable. All dependent variables are regressed on the contemporaneous economic damages along with state fixed effects and a time-trend.

Table 3.4 presents the estimated coefficients. Panel A addresses the relationship between the supply side variables and natural disasters. The coefficients in column (1) and (2) are statistically significant. Interestingly, contrary to the expectation of adverse effects, natural disasters seem to increase personal income. This result can be rationalized by pointing out that personal income includes various transfers from the government which may increase after natural disasters. On the other hand, the coefficient for employment is negative and significant. In column (3), we revisit the positive effect on personal income and consider net-personal income excluding current transfers. The estimate is smaller and statistically insignificant now. Similarly, we observe insignificant effects of natural disasters on GSP and CEAI in column (4) and (5). Therefore, Panel A demonstrate that although natural disasters affect the labour market negatively, the overall relationship between aggregate supply and natural disasters is very weak if any.

Panel B of Table 3.4 shows the relevance of our new exogenous variable as an instrument for government spending shocks. In column (1), government spending is significantly related to natural disasters. Columns (2) and (3) confirm that among the two components of government expenditure, capital expenditure is more affected by natural disasters than current expenditure. This is intuitive, given that much of the government response in the wake of natural disasters is concerned with repair and restorations. Columns (4) and (5) show that revenues also increase following natural disasters. This is mainly due to disaster assistance from the federal government which is categorized as the intergovernmental revenues of state governments.

To sum up, economic damages of natural disasters are a strong and relevant instrument for identifying state government spending shocks while they have little if any impact on the supply side of the state economy.

Table 3.4 The estimated coefficients

Panel A	(1)	(2)	(3)	(4)	(5)
Dependent	PI	Employment	Net-PI	GSP	CEAI
Description	*Personal Income Growth*	*Employment Growth*	*PI minus transfer Growth*	*Gross State Product Growth (1997~2009)*	*Coincident Economic Activity Index Change*
Coef. (%) (S.E)	0.0513*** (0.0192)	-0.0461** (0.0198)	0.0362 (0.0237)	0.0357 (0.0256)	-3.3966 (3.9293)
Panel B	(1)	(2)	(3)	(4)	(5)
Dependent	Gov	Current-Gov	Capital-Gov	Rev	Intergov-Rev
Description	*State government Expenditure growth*	*Current Expenditure Growth*	*Capital Expenditure Growth*	*General Revenues Growth*	*Revenues from other governments Growth*
Coef. (%) (S.E)	0.1329*** (0.0387)	0.1163*** (0.0373)	0.3290** (0.1460)	0.1393*** (0.0454)	0.2829*** (0.0719)

Notes: Dependent data are fiscal year data from 1977 to 2009 except for calendar annual series of GSP (1997~2009). All data are included as a change of the log of real per capita terms except for CEAI as an index and damage series in real billion dollars.
*** significant at 0.01 level, ** significant at 0.05 level, * significant at 0.10 level.

5.2. Empirical Analysis

5.2.1. Methodology

To estimate the macroeconomic effects of government spending shocks related to natural disasters, we formulate a panel vector autoregression (PVAR) model for 50 states of the U.S. during 33 fiscal years from 1977 to 2009. For a given state, the reduced form equation is as follows:

$$Y_{i,t} = A_0 + \sum A_j Y_{i,t-j} + \sum B_j D_{i,t-j} + \theta_i + \gamma_i t + e_t \text{ , } (i : state) \quad (1)$$

where $Y_{i,t}$ = *(Exp, PI, Rev, HPI, Emp)'* is a vector of endogenous variable including government expenditure (*Exp*), Personal Income (*PI*), Revenues (*Rev*), House Price Index (*HPI*), and Employment (*Emp*). D_i stands for economic damages due to natural disaster as the exogenous variable causing fiscal shocks. θ_i is a vector of state fixed effects, γ_i is a vector of state time-trend, and e_t is a vector of reduced form innovation that is assumed to be independently and identically distributed (i.i.d.). Other

variables of interest such as Debt replace Employment one at a time.[74] Similar to other studies on the effects of fiscal shocks such as Burnside et al. (2004) and Ramey (2011a), the main identification assumption for estimation is that natural disasters are exogenous and that among the endogenous variables in the vector $Y_{i,t}$, a variable that comes earlier in the ordering is more exogenous than the ones that appear later.[75] In addition, following Ramey (2011a) who embeds the exogenous variable as an endogenous variable in the VAR, we transform the equation (1) and embed the natural disaster variable in the PVAR, but order it first before the other variables:[76]

$$X_{i,t} = A_0 + \sum A_j X_{i,t-j} + \theta_i + \gamma_i t + e_t, \text{ where } X_{i,t} = (D_{i,t}', Y_{i,t}')' \quad (2)$$

As suggested by Love and Zicchino (2006), before the equation (2) can be estimated, the original variables need to be time-detrended and the state fixed effects also need to be eliminated by forward mean-differencing which is known as the 'Helmet procedure'.[77] To check the stationarity of adjusted variables, several panel unit root tests are performed and the results show that all variables are stationary.[78] As an optimal lag, 2 annual lags are selected based on the SBIC and HQIC criteria.[79]

We estimate the equation (2) by using a generalized method of moments (GMM), and then compute the impulse-response function (IRF) to one standard deviation shock of the natural disaster. Since Holtz-Eakin et al. (1988) proposed to use instrumental variables for estimating Panel VAR models, much literature employing PVAR models has used IV or GMM estimators, which has been a

74. In many analyses of fiscal policy, additional variables such as the interest rate are often included to control for monetary policy. However, in this baseline specification, such a variable is not included because fiscal policy shocks are observed at the state level, not the national level, and the data is also annual.

75. This particular ordering is often known as 'Choleski Ordering'.

76. Ramey (personal communication) argues that the results are similar when the exogenous variable is treated as an exogenous or when it is embedded first in a VAR. We explored both ways with her data and indeed obtained very similar results.

77. According to Love and Zicchino (2006), as the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure would create biased coefficients. However, forward mean-differencing removes only the forward mean so that it can preserve the orthogonality between transformed variables and lagged regressors.

78. We use 6 kinds of unit test in STATA software: Levin-Lin-Chu test, Harris-Tzavalis test, Breitung test, Im-Pesaran-Shin test, Fisher-type tests, Hadri LM stationarity test.

79. Since there is no standard procedure for lag selection under PVAR in STATA, this selection is determined in Eviews. As a robustness check, 1 or 3 lags are also considered. The results are not affected by the number of lags.

standard strategy for estimating dynamic panel models due to the possibility of bias (see Arellano and Hsiao, 1981; and Arellano and Bond, 1991).[80] Therefore, we follow the methodology and STATA program of Love and Zicchino (2006) for the estimation of PVAR.[81] The confidence interval is 68%, obtained using Monte Carlo simulations which generate the 16th and 84th percentiles of the distribution with 1000 repetitions.[82] All responses are multiplied by 100 so that a growth rate from the change in log variables is expressed in percent (%), as in the previous section.

5.2.2. Baseline Results

Figure 3.13 shows the impulse response functions of fiscal and macroeconomic variables to fiscal shocks. After a natural disaster happens, the government expenditure follows a hump-shaped pattern, with the response peaking in the second year and remaining significantly positive for 8 years. This confirms that natural disasters are followed by increased government expenditure for relief and repair. Personal income also rises on impact and the response remains significantly positive for 5 years. As shown in the previous subsection, this positive response of personal income suggests that there can be only small adverse supply side effect. The twin peaked pattern of the response of personal income, peaking in years 0 and 2, has two possible interpretations. One is that personal income includes relief transfer to the victims of disasters from the various governments (federal, state and local). This transfer is temporary and short-lived. Subsequently, personal income is positively impacted by the capital reconstruction expenditure which is more persistent. We revisit this issue using alternative income variables that exclude transfer in the next subsection on robustness checks. The other interpretation is that although annual data do not capture the timing of shocks very well, there can be anticipation effects by the private sectors due to time lags of fiscal policy. It means that relief and repair by the private sector can be carried shortly after the disaster, in expectation of government assistance like the analysis of Korean fiscal policy in Chapter 2.

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80. See, among others, Rousseau and Wachtel (2000), Binder, Hsiao and Pesaran (2005), Love and Zicchino (2006), Chong and Gradstein (2007), Huang et al. (2008) etc. (See also Hayakawa, 2011.)

81. We estimate our model again using OLS estimation by pooling the data across states, which can be justified given that the individual heterogeneity is likely to be relatively small across states of the U.S., and the time period is over 30. The results don't differ much from those of our baseline (See Appendix 2. E.).

82. Results with 95% confidence bands are reported in Appendix 2. F.

In Figure 3.13, while the elasticity of the personal income peak to the government expenditure peak in the second year is 0.30, the cumulative elasticity for the ten years after the shock is 0.17 (Table 3.5). Since the average ratio of personal income to government expenditure from 1977 to 2009 is 8.35, the peak income multiplier is estimated at 2.48, but the cumulative one is estimated at 1.45. Interestingly, these income multipliers fall roughly within the range of 1.5 to 3.0 of the other cross-state analyses[83], and exceed the range of the U.S aggregate multiplier (0.5~2.0) reviewed by Ramey (2011b) and also our federal nondefense spending multiplier (1.41~1.74). [84] Since natural disasters can reduce the productive capacity by destroying physical and human capital, the multiplier we obtained is likely to be underestimated to a certain degree at the state level. However, in the process of the recovery response, private sector such as insurance companies also plays a significant role in financing repair and reconstruction instead of the government. Therefore, part of output growth can be attributed to the private sector. In this case, the government spending multiplier is likely to be overestimated.[85] It is not clear which of these biases is stronger. At any rate, they are likely to partially cancel out.

The next graph shows the response of revenues to the natural disaster shocks. Revenues usually follow the response of output because tax receipts closely depend on the state of the economy. However, in this case, revenues increase on impact, peaking during the first year, i.e. before income peaks. Thereafter, revenues follow a pattern similar to that of personal income and also government expenditure. This suggests that the main source of the change in government revenues (and expenditure) during the first 1~2 years after the disaster is not local taxes, but aid and assistance from the federal government. We explore this further in the analysis of effects on the components of fiscal variables later. Moreover, in the last graph of Figure 3.13, the response of outstanding government debt supports this interpretation.

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83. According to Ramey (2011b), there are around 2 (Shoag, 2010), 0.3~ 3 (Clemens & Miran, 2011), 1.5 (Nakamura and Steinsson, 2011) and 1.88 (Serrato and Wingender, 2011) etc. (See Appendix 2. F).

84. According to Farhi and Werning (2012), when changes in local government spending are financed by outside transfer, a multiplier at the local level is usually larger than that at the national level because the local multiplier is a combination of self-financed and transfer multipliers.

85. To simply estimate pure government expenditure multiplier except the effect from private sector, since the U.S. property damage have been generally estimated by doubling the insured loss reported by the Property Claim Service of the Insurance Services Office, a rough elasticity of personal income to the government expenditure is 0.10(0.16*2/3, peak) or 0.28 (0.42*2/3, cumulative) . In this case, the multiplier can be around between 0.97 ~1.66 and it is likely to be a minimum because it ignores negative effect on output by disasters.

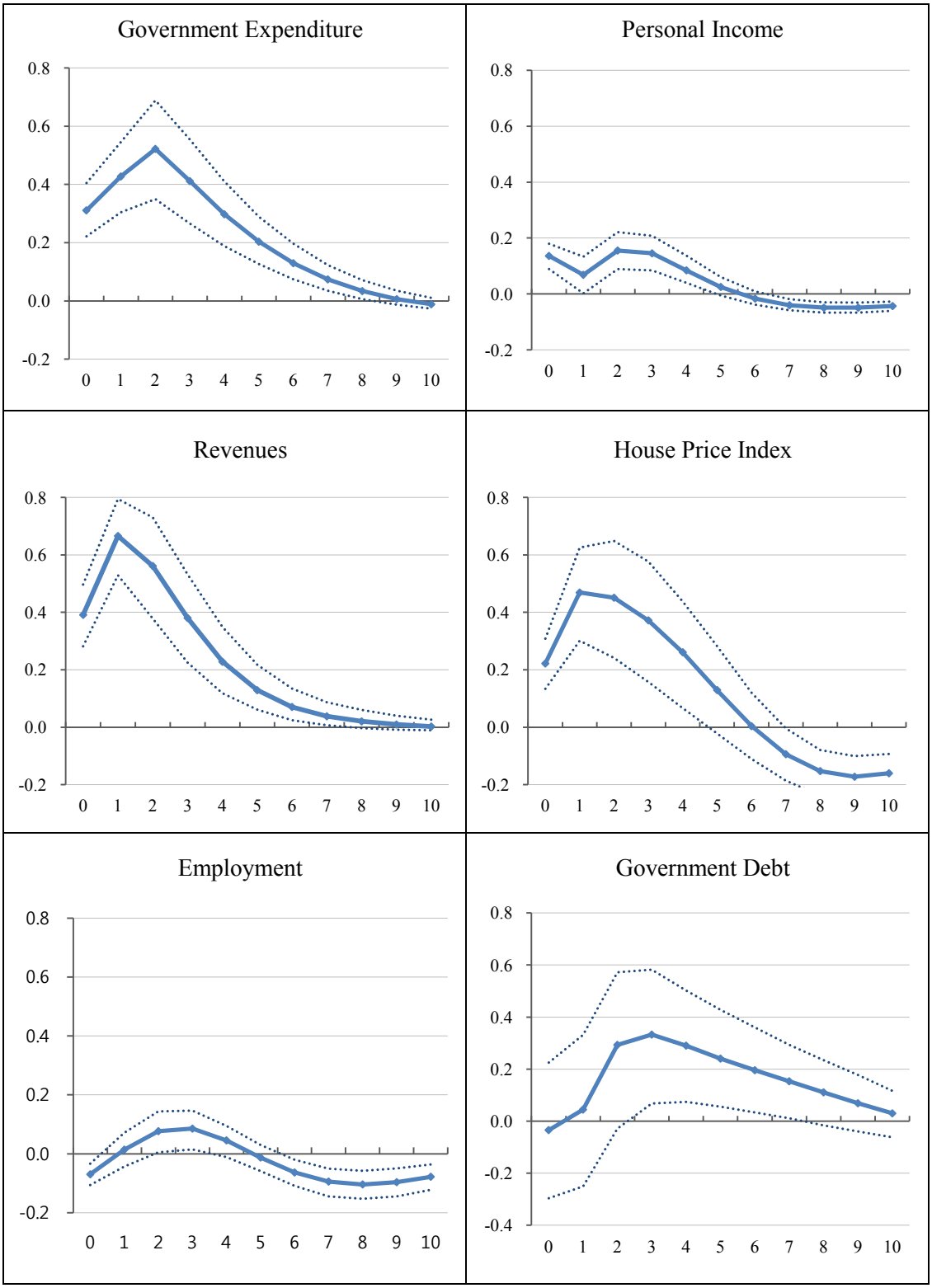
During 1 year after the shocks, debt responds little and insignificantly. After 2 years, the response of debt is consistent with the pattern of government expenditure. This means that the state government is likely to resort to deficit financing at this time. House price index as a proxy for the price level remains positive and significant for 5 years similar to the response of personal income. Employment initially falls significantly at the time of disaster, as shown in the previous sub-section. However, its response turns positive in the second year and remains significantly positive for 2 years as government expenditure increases.

To summarize, the natural disasters cause positive government expenditure shocks. The response of personal income after the shocks of natural disasters is also positive, peaking after 2 years. The estimated government expenditure multiplier of personal income ranges around between 1.5 and 2.5. The responses of personal income and employment indicate that there are only modest adverse supply side effects. In addition, the increase of the state government expenditure for relief and restoration is financed not from tax revenues but from non-tax sources such as federal government assistance and proceeds from issuance of debt.

Table 3.5 Cumulative Impacts and Elasticity

Year	0	2	4	6	8	10
Gov growth rate (A, %)	0.31	1.26	1.97	2.30	2.41	2.41
PI growth rate (B, %)	0.14	0.36	0.59	0.60	0.51	0.42
Elasticity (B/A)	0.44	0.28	0.30	0.26	0.21	0.17

Figure 3.13 Baseline Results: Impulse-Response



Note: The solid lines display point estimates while the dashed lines correspond to 68% confidence interval bands, which is same to all Figures for results below.

5.3. Robustness checks

In this subsection, we examine several alternative models with different variables and verify the robustness of the baseline model regarding the assumptions and the results. First, to examine the relevance of economic damages as an instrument for government expenditure shocks, we investigate more closely the response of components of the government spending to economic damages. Second, in regard to the initial fluctuating response of personal income in the baseline model, we replace it with other alternative variables. Third, in order to investigate the homogeneity of parameters, we divide the 50 states into two groups according to the frequency of natural disasters. Finally, we examine whether annual fiscal data can capture the natural disaster shocks in time or not because timing affects the results shown as argued by Ramey (2011a).

5.3.1. Responses of components of fiscal variables

To gauge better the effect of natural disasters on fiscal variables, we estimate the responses of various fiscal variables to natural disaster shocks. We consider a specification in which government expenditure and revenues are divided into their main components. The other variables are the same as in the baseline model. Therefore, both government expenditure and revenues are replaced with their components one at a time. Government expenditure is divided into current expenditure and capital expenditure.[86] The former accounts on average for 92% of total state expenditure from 1977 to 2009. General revenues are split into net-revenues and intergovernmental revenues, with the former accounting for 72% of revenues during the same period.[87]

Figure 3.14 displays the impulse responses of the components of fiscal variables to one standard deviation shock due to natural disasters. For comparison, the responses of fiscal variables in the baseline model are shown too. Other variables

86. While current expenditure consists of all payment for current operations, transfers, subsides, and interest on debt, capital expenditure includes all expenditure for construction of buildings and other improvement, and the purchase of properties. A more detailed description can be found on the Census website, at http://www2. census.gov/govs/class06/ch_5.pdf.

87. While intergovernmental revenue comprises moneys from other governments, including grants, shared taxes, and financial support, net-revenues are general revenues minus intergovernmental revenue and consist of taxes and current charges. < http://www2.census.gov/govs/class06/ch_4.pdf >

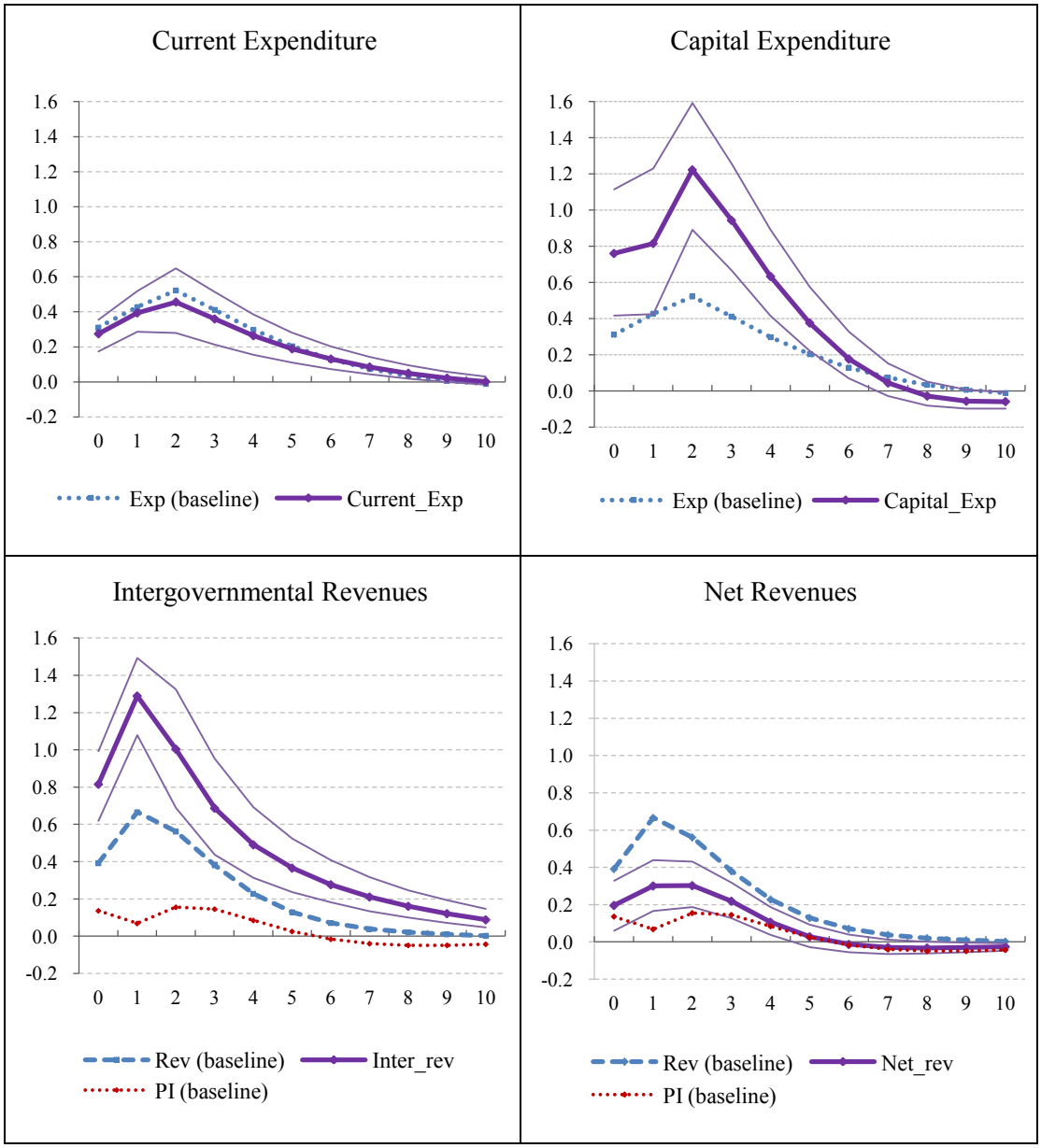
show almost same response as in the baseline model (not shown).

The response of the current expenditure has almost the same size and pattern as total expenditure in the baseline model. It can be attributed the fact that it accounts for the bulk of state expenditure. Comparing the two components of expenditure, current expenditure increases steadily during the first and second year whereas capital expenditure shows a sharp increase only in the second year. This reflects the time lag that applies to the implementation of capital expenditure; current expenditure for emergency relief and assistance, in contrast, is executed shortly after the natural disaster. Therefore, these results show that economic damages from natural disasters are a strong and relevant instrument for identifying government expenditure shocks.

On the revenue side, although intergovernmental revenues make up only 28 percent of state revenues, the response of revenues in the baseline model is consistent more with that of intergovernmental revenues than that of net-revenues. When constructing the damages series, we select major natural disasters based on the Presidential declarations which are followed by emergency assistance from the federal government. Such assistances from the federal government are part of the intergovernmental revenues. The two lower graphs in Figure 3.14 reflect this nicely. The response of intergovernmental revenues peaks in the first year after the natural disaster shock. The response of net revenues mirrors better the response of personal income both in magnitude and pattern rather than that of general revenues, except during the first year. This is because tax revenues are driven mainly the overall economic activities.

In summary, the responses of components of expenditure and revenues depict the process of government response to natural disasters rather well. On the expenditure side, natural disasters are a good and relevant instrument for government spending shocks. In terms of revenues, a large portion of the increased state government expenditure is financed by the federal government support.

Figure 3.14 Response of fiscal components to the natural disaster



Note: A thick line displays point estimates while thin lines correspond to 68% confidence interval bands.

5.3.2. Alternative measures of personal income

In the baseline model, personal income fails to display the expected hump-shaped response to the government spending shock. Instead, it increases only on impact. Then, its growth rate falls, only to increase again and remain positive for 5 years, peaking the second year. To investigate this more closely, we analyze alternative models including other variables instead of personal income.

First, we replace personal income with net-personal income which is personal income minus personal current transfer receipts. Since personal current transfer receipts include urgent disaster relief benefits, personal income could increase significantly in the year of occurrence. In Figure 3.15, the first graph shows the response of net-personal income. The responses of all other variables are nearly identical to those of the baseline model (not shown). Interestingly, net-personal income displays a hump-shaped response, peaking in the second year just like government expenditure. In addition, after 3 years, its response is also almost the same as that of personal income in both magnitude and pattern. From this analysis, it appears that the initial response of personal income right after the natural disaster is mainly due to the direct government assistance. Then, its response can be mostly attributed to the government expenditure for repair and reconstruction.

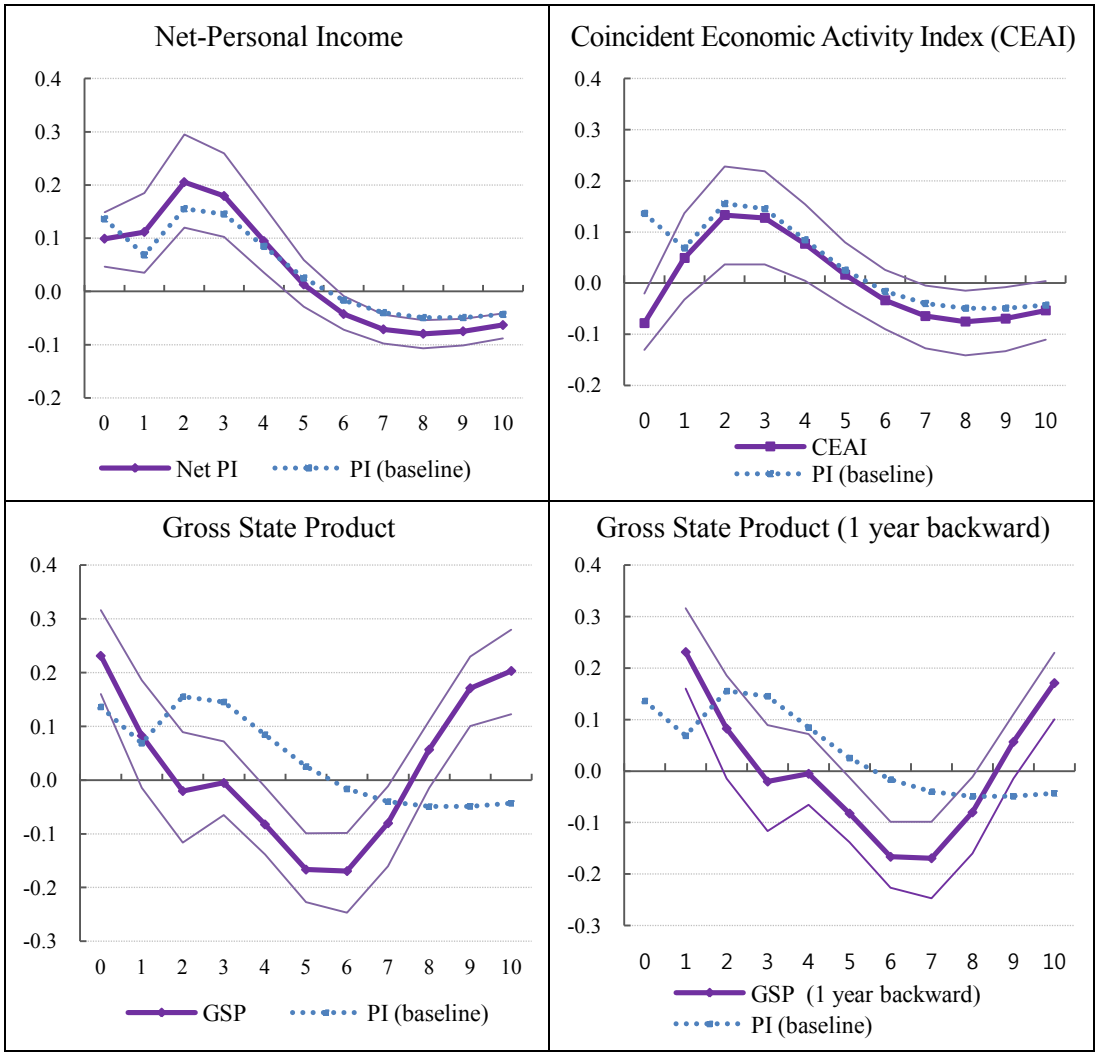
Second, we replace personal income with the Coincident Economic Activity Index (CEAI). As this index is complied as a single summary statistic that tracks the current state of the state economy every month by the Federal Reserve Bank, it can be an excellent substitute for personal income or gross state product. The second graph of Figure 3.15 shows the impulse response of the CEAI. Similarly to the results of the model with net-personal income, responses of all variables except the CEAI are almost the same as those of the baseline model (not shown). As for the CEAI, its response also appears hump-shaped. However, contrary to net-personal income, the response of the CEAI is negative significantly on impact and then increases for 5 years afterwards. Therefore, at the time of the natural disaster, there can be an adverse supply side shock. As the trend for each state's CEAI is set to match the trend for gross state product, the CEAI includes four indicators: nonfarm payroll employment, the unemployment rate, average hours worked in manufacturing, and wages and salaries. These four indicators are all closely related to the situation in the labour market. Not surprisingly then, the response of the CEAI is very similar to that of employment in the baseline model (Figure 3.13). Although the CEAI is likely to be related to the trend of GSP much more than personal income, personal income seems to be better proxy for output when estimating the effect of government expenditure shocks. The reason is that it can make it possible to calculate an output multiplier and to shed light on the transmission process through the decomposition of personal income.

Third, we now use the time series of gross state product instead of personal income as the output variable.[88] As explained in the section on data, using the GSP has some limitations. First, GSP is only available in annual frequency for calendar years. Therefore, it is impossible to match GSP data to fiscal years in which state fiscal variables are reported. Second, there is a break in its series in 1997 because of a change in industry classifications. Therefore, the period from 1997 to 2009 may be too short for PVAR. The bottom graphs of Figure 3.15 shows the results of the model with GSP. The responses of all variables are qualitatively similar to those of the baseline model (not shown). However, the effects are less precisely estimated in the alternative model. This is especially the case of the response of GSP: it peaks on impact after a natural disaster shock and then falls, remaining positive only by the first year, in contrast to the hump-shaped response of personal income. This difference may be attributed to the limitations of GSP series mentioned above, especially the difference between fiscal and calendar years which makes identifying the shocks more difficult. As the last graph shows, when the responses of GSP are shifted by 1 year backward in the alternative model, the patterns of responses across two models are more similar.

To summarize, replacing personal income with net-personal income, the CEAI and GSP helps us understand the initial counterintuitive response of personal income. The response of net-personal income shows that governments spend much of the initial assistance on relief to victims rather than on repair and reconstruction, which only follows with a lag. The response of the CEAI shows that there is a modest negative supply-side effect on impacts, but this turns positive once the government expenditure increases. The response of GSP shows that the personal income can be the better and adequate variable in identifying spending shocks due to some limitations of GSP.

88. In unreported test, we similarly estimate the effects using the private gross state product (PGSP). The results are almost identical to those of the model with GSP.

Figure 3.15 Responses of alternative variables to personal income



Note: A thick line displays point estimates while thin lines correspond to 68% confidence interval bands.

5.3.3. Frequency of natural disasters

In this subsection, we explore the robustness of our results by dividing the 50 states into two groups, a high frequency group including states that experienced major natural disasters in more than 15 years during 33 years and a low frequency group with the remaining states. 20 states belong to the high frequency group and 30 states are included in the low frequency group. Table 3.6 reports the summary statistics for natural disasters according to frequency groups. The frequency of year in the high group is more than two times often than in low group and the average damage is more than three times larger. Therefore, while the baseline model includes 50 states, this subsection focuses on 20 states which are in the high frequency group.

Table 3.6 Average statistics for disaster per state across frequency groups

	Disaster years	Number of events	Annual damage (million, $)
Total average (50 states)	13.1 (6.50)	22.7 (16.30)	632.1 (1120.69)
High frequency (20 states)	19.5 (3.49)	38.0 (13.33)	1,189.9 (1614.12)
Low frequency (30 states)	8.9 (4.14)	12.5 (7.98)	260.9 (242.51)

Note: ( ) means standard deviation and annual damage denotes the average total damage per state computed only from disaster incidence year, excluding 'no disaster year'.

Table 3.7 shows the impulse response of key variables to natural disasters in the high frequency group. When comparing the results with the baseline model of all 50 states, the responses display qualitatively same patterns. However, the magnitudes are much larger than those of the baseline model. This implies that the results obtained in the baseline model are driven largely by natural disasters in the high-frequency group: not surprisingly, given that few natural disasters imply few government spending shocks related to natural disasters. The peak elasticity of personal income to government expenditure is 0.29 and the cumulative elasticity for ten years is 0.09 in the high-frequency group. As the average ratio of personal income to government expenditure from 1977 to 2009 for these 20 states is 8.98, the peak multiplier is estimated to be 2.62 and cumulative multiplier is 0.83. The range of this multiplier is thus a little wider than that of the baseline model (1.45~2.48).

Table 3.7 Response to the natural disaster and fiscal shocks

	0 yr	2 yrs	4 yrs	6 yrs	8 yrs	10 yrs	Peak
High frequency groups (20 states)							
Exp	0.52*	0.83*	0.35*	0.05	-0.04	-0.04	0.83* (2 yrs)
PI	0.22*	0.24*	0.07	-0.09*	-0.11*	-0.09*	0.24* (2 yrs)
Rev	0.62*	0.91*	0.30*	0.03	0.00	0.01	1.07* (1 yr)
Emply	-0.12*	0.10	-0.02	-0.24*	-0.28*	-0.20*	0.10 (2 yrs)
Base line (50 states)							
Exp	0.31*	0.52*	0.30*	0.13*	0.03*	-0.01	0.52* (2 yrs)
PI	0.14*	0.16*	0.08*	-0.02	-0.05*	-0.04*	0.16* (2 yrs)
Rev	0.39*	0.56*	0.23*	0.07*	0.02*	0.00	0.67* (1 yr)
Emply	-0.07*	0.08*	0.05	-0.06*	-0.10*	-0.08*	0.09* (3 yrs)

Note: An asterisk (*) indicates that 0 is outside 68% confidence interval bands.

5.3.4. Timing of natural disasters

As Ramey (2011a) argues, the timing is very important in identifying fiscal policy shocks. The narrative approach is regarded to have an advantage in regards to the timing if the instrumental variable used is exogenous, unexpected and closely related to government spending. In the baseline analysis, although the natural disaster damage is a strong and relevant instrument, it is hard to identify the government shocks in a timely way because we only have annual fiscal data. Therefore, we explore this issue by considering the timing of natural disasters. First, we transform the natural disaster damage series into a half-fiscal year dataset. Then, we estimate the effects of half yearly data of damages one at a time, replacing the annual damages data in the baseline model. Natural disasters occurring during the first half of a year are more or less certain to cause government expenditure shocks in the current year. However, those in the second half year may not do so because of the fiscal time lag. In this case, it is possible that the government expenditure increases only during the following the year. Table 3.8 depicts the average statistics for half yearly damage data. The 50 states have similar frequency of major disasters in the first and second half year. However, the average damage, which reflects on the size of government expenditure shocks, it is over two times larger during the first half than in the second half. Therefore, if most large disasters occur during the first half of the fiscal year, the response of government expenditure in the alternative model with the first half-year damage should closely resemble the response of government expenditure in the baseline model well.

Table 3.8 Average statistics for the first and the second half yearly damages

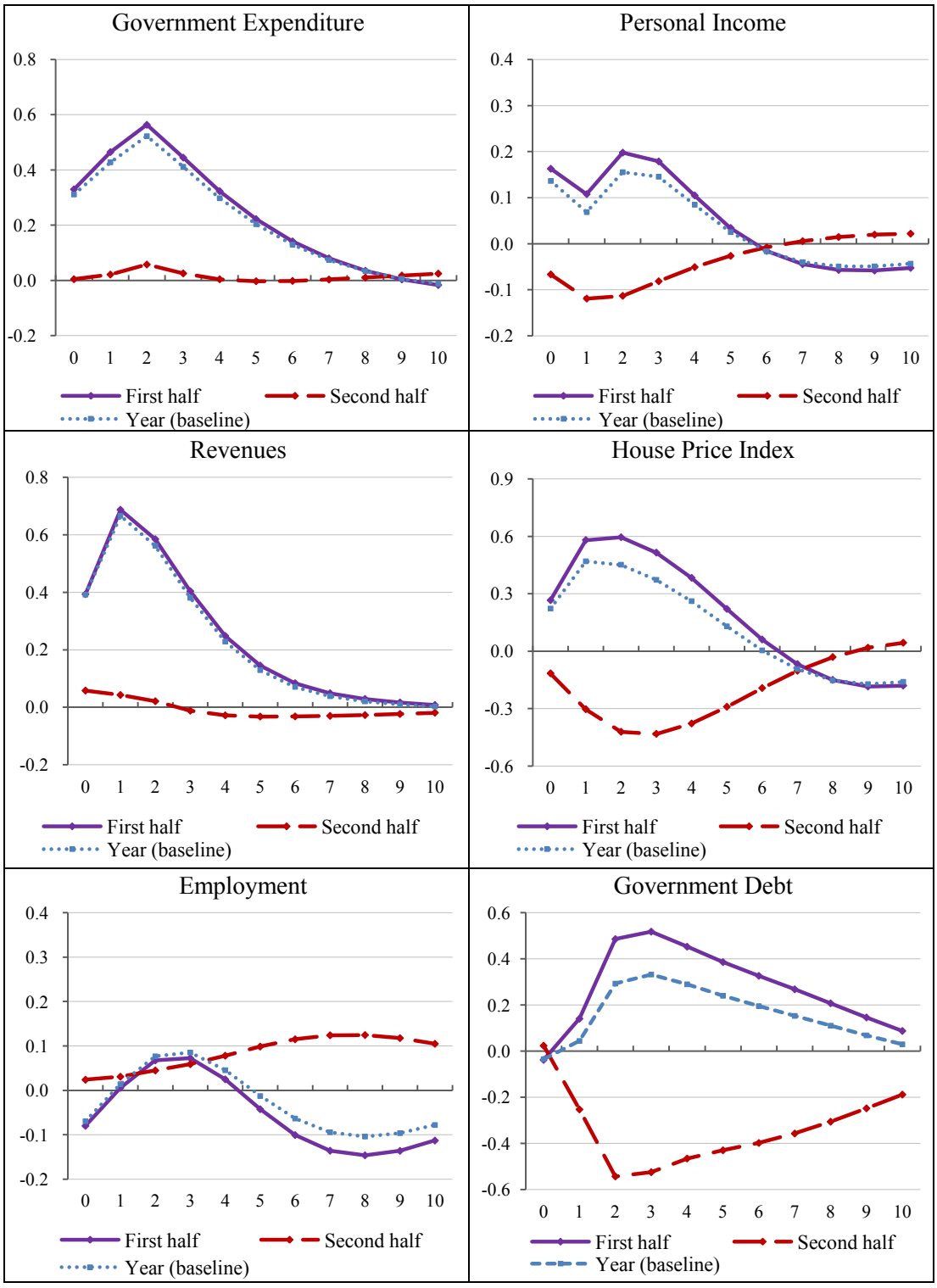
	Frequency (year)	Annual damage (million, $)
Fiscal year	13.1 (6.50)	632.1 (1120.69)
The first half year	7.5 (4.69)	671.2 (1411.22)
The second half year	9.2 (5.64)	290.3 (393.97)

Note: ( ) means standard deviation. All damages cost is deflated in chained 2005 dollars.

Figure 3.16 shows the responses in the two alternative models along with those of the baseline model. As expected, the responses obtained with the first half year damages are closely consistent with those of baseline model. On the other hand, the

responses with the second half-year damages are quantitatively and qualitatively different from those of the baseline model. This mirrors the results obtained with the high and low frequency groups of states: given that large disasters tend to occur during the first half of fiscal year, our results are mainly driven by those observations.

Figure 3.16 Alternative models with the first and the second half yearly damages



To summarize, in order to check natural disaster's timing for government expenditure shocks, we estimate the effects with two half-yearly damages data each other. As a result, the responses to the first half yearly damages are consistent with those of fiscal year damages. Therefore, it shows that our damage data catch the timing for government expenditure shocks even in annual fiscal data.

6. Conclusions

This chapter investigates the effects of government spending shocks on key macroeconomic variables. Many previous empirical studies use military build-ups as an instrument for identifying government spending shocks and estimating the government spending multiplier. However, military build-ups are limited to several events and their effect is largely restricted to the defense sector. Therefore, it is hard to accept that the multiplier obtained with military build-ups represents a general government-spending multiplier.

In order to assess the effect of fiscal policy, it is therefore necessary to have a nondefense spending multiplier. We use natural disasters instead of military build-ups as an instrument for identifying nondefense spending shocks. When a natural disaster happens, government responds by spending resources for relief and repair which are more similar to the general government expenditure than the spending associated with military build-ups. We collect data on natural disasters and the associated economic damages in the U.S. as a new exogenous narrative variable and analyze the response of macroeconomic variables to natural disasters and the corresponding government spending shocks. We carry out this analysis both at the national and state level.

This chapter establishes two novel results. First, we show that economic damage due to natural disasters is a strong and relevant instrument for identifying nondefense spending shocks. It matches government spending shocks in time as well as scope, covering general government activities such as housing, construction, education, safety, and welfare transfers. In the analysis of the responses of components of fiscal variables, natural disasters can shed light on the transmission process of government spending. In addition, unlike the military build-ups, it has the

advantage that it can be applied easily in other countries.

Second, we calculate two kinds of nondefense multiplier: for federal nondefense spending with as the range of 1.41 to 1.74, and for state government spending with the range of 1.45 to 2.48. These figures fall within the range of multipliers obtained in the previous literature for non-defense spending, while they exceed the defense multipliers such as 0.6~1.2 of Ramey (2011a) and 0.6~0.9 of Barro and Redlick (2011). Assuming that federal nondefense spending and state government spending have similar functions, the nondefense multiplier ranges from 1.4 to 2.5.

This chapter has several limitations. At the state level, as there is no quarterly data, we have to use annual data. Therefore, it is possible that the timing of government spending shocks is not accurate. Furthermore, while we analyze the effects of government spending shock at the state level, macroeconomic variables of interest such as private consumption and the real wage are not available. These are important from the point of view of differentiating between Neoclassical and New Keynesian theory. As a result, we cannot use our results to confirm the validity of these theoretical models. Further work is needed in order to explore and address these limitations.

Appendix 2

A. The economic damages of natural disasters in the U.S

(Billion, $)

Quarter	Damage	Dam/GDP (%)	Quarter	Damage	Dam/GDP (%)	Quarter	Damage	Dam/GDP (%)
77.1q	1.00	0.02	88.1q	0.06	0.00	99.1q	1.89	0.02
77.2q	1.49	0.03	88.2q	0.03	0.00	99.2q	2.57	0.02
77.3q	0.90	0.02	88.3q	0.00	0.00	99.3q	3.03	0.03
77.4q	0.27	0.00	88.4q	0.11	0.00	99.4q	7.41	0.07
78.1q	1.96	0.04	89.1q	0.00	0.00	00.1q	0.65	0.01
78.2q	0.00	0.00	89.2q	0.60	0.01	00.2q	2.35	0.02
78.3q	0.49	0.01	89.3q	0.79	0.01	00.3q	1.44	0.01
78.4q	0.33	0.01	89.4q	19.79	0.25	00.4q	2.81	0.02
79.1q	0.00	0.00	90.1q	0.24	0.00	01.1q	3.11	0.03
79.2q	2.61	0.04	90.2q	0.76	0.01	01.2q	8.47	0.07
79.3q	6.14	0.10	90.3q	0.00	0.00	01.3q	0.02	0.00
79.4q	0.59	0.01	90.4q	0.05	0.00	01.4q	0.05	0.00
80.1q	0.87	0.01	91.1q	5.58	0.07	02.1q	0.46	0.00
80.2q	3.49	0.06	91.2q	0.90	0.01	02.2q	2.19	0.02
80.3q	6.28	0.11	91.3q	3.88	0.05	02.3q	2.14	0.02
80.4q	0.00	0.00	91.4q	3.91	0.05	02.4q	2.26	0.02
81.1q	0.00	0.00	92.1q	1.32	0.02	03.1q	0.51	0.00
81.2q	0.96	0.02	92.2q	0.25	0.00	03.2q	6.60	0.06
81.3q	0.98	0.02	92.3q	39.37	0.47	03.3q	4.20	0.04
81.4q	0.24	0.00	92.4q	3.31	0.04	03.4q	2.55	0.02
82.1q	0.71	0.01	93.1q	7.43	0.09	04.1q	0.00	0.00
82.2q	1.75	0.03	93.2q	1.56	0.02	04.2q	1.25	0.01
82.3q	0.12	0.00	93.3q	15.56	0.18	04.3q	39.65	0.32
82.4q	1.28	0.02	93.4q	0.87	0.01	04.4q	7.09	0.06
83.1q	1.72	0.03	94.1q	31.15	0.36	05.1q	1.35	0.01
83.2q	1.50	0.02	94.2q	0.82	0.01	05.2q	0.37	0.00
83.3q	3.93	0.06	94.3q	0.61	0.01	05.3q	128.32	1.01
83.4q	1.04	0.02	94.4q	1.47	0.02	05.4q	16.45	0.13
84.1q	0.19	0.00	95.1q	3.71	0.04	06.1q	0.52	0.00
84.2q	5.48	0.08	95.2q	5.27	0.06	06.2q	2.03	0.02
84.3q	0.76	0.01	95.3q	1.31	0.01	06.3q	1.02	0.01
84.4q	0.00	0.00	95.4q	4.52	0.05	06.4q	0.36	0.00
85.1q	2.24	0.03	96.1q	1.74	0.02	07.1q	0.90	0.01
85.2q	1.36	0.02	96.2q	0.27	0.00	07.2q	1.20	0.01
85.3q	2.39	0.03	96.3q	5.02	0.05	07.3q	0.59	0.00
85.4q	7.40	0.11	96.4q	0.26	0.00	07.4q	1.90	0.01
86.1q	0.79	0.01	97.1q	3.46	0.04	08.1q	1.43	0.01
86.2q	0.05	0.00	97.2q	6.10	0.06	08.2q	3.31	0.02
86.3q	1.26	0.02	97.3q	0.52	0.01	08.3q	2.66	0.02
86.4q	0.00	0.00	97.4q	0.03	0.00	08.4q	14.85	0.12
87.1q	0.00	0.00	98.1q	3.24	0.03	09.1q	0.48	0.00
87.2q	0.28	0.00	98.2q	3.53	0.03	09.2q	0.73	0.01
87.3q	0.26	0.00	98.3q	8.05	0.08	09.3q	0.23	0.00
87.4q	0.57	0.01	98.4q	2.37	0.02	09.4q	0.13	0.00

Note: Damages are expressed in real terms using the CPI (2005=100).

B. Data Appendix

1. Natural disaster

Data	Source	Website
Disaster list	Emergency Disaster Database (CRED)	http://www.emdat.be
Federal disaster declaration list	Federal Emergency Management Agency (FEMA)	http://www.fema.gov/disasters
Billion $ disaster list	National Climate Data Center	http://www.ncdc.noaa.gov/billions
Disaster damages report	National Hurricane Center	http://www.nhc.noaa.gov
Disaster damages report	National Weather Service	http://www.weather.gov
Disaster damages report	Storm prediction Center	http://www.spc.noaa.gov
Storm Events Database	National Climate Data Center	http://www.ncdc.noaa.gov/stormevents

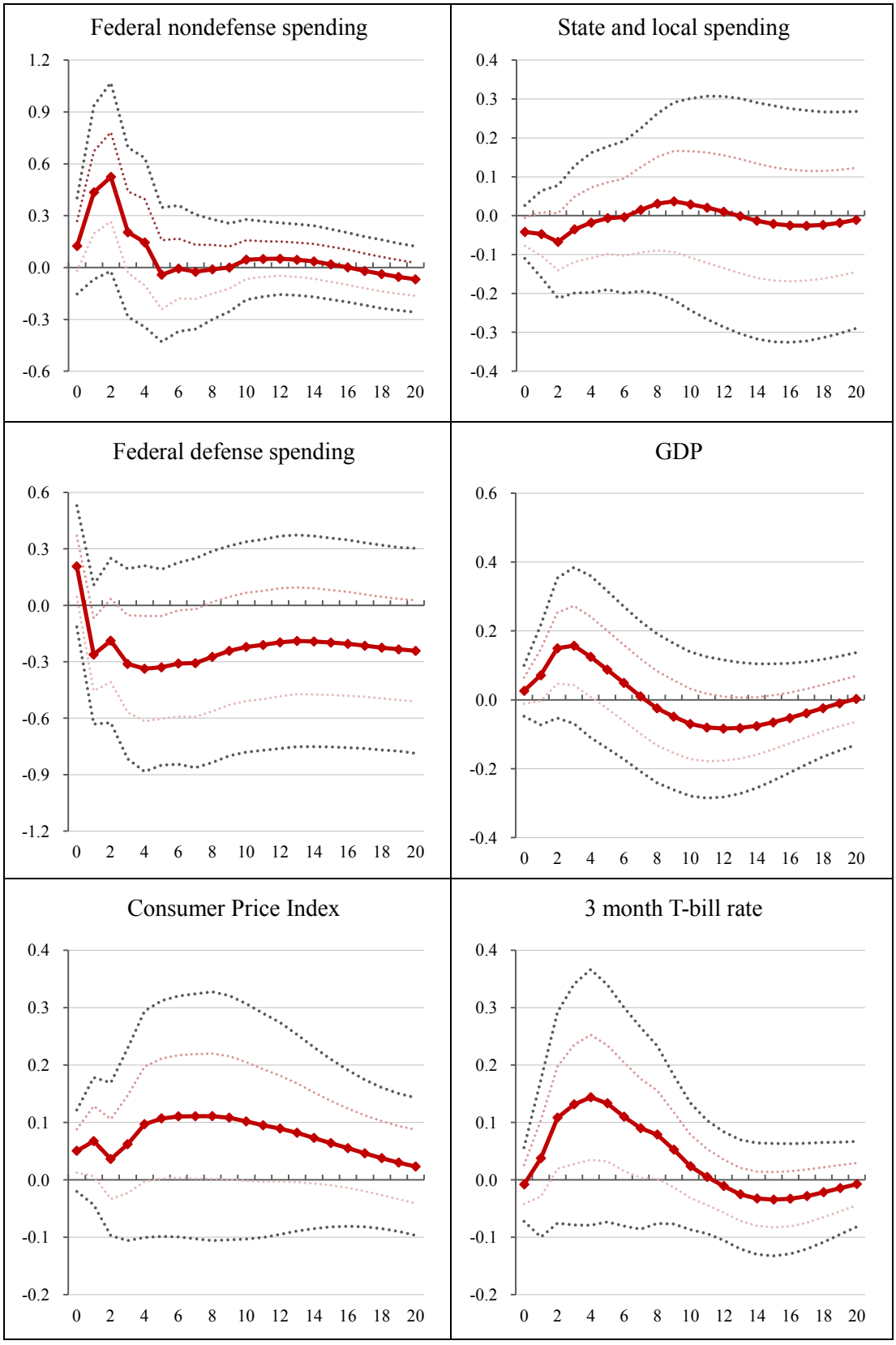
2. Macroeconomic variables at the national level

Series	Source	Description
Government spending	NIPA Table 1.1.5. (BEA)	Nominal series deflated by GDP deflator
GDP, Consumption, Investment	NIPA Table 1.1.6. (BEA)	Real series, chained (2005) dollars
Consumer Price Index	Price database (BLS)	All urban consumer and all items (1982-84=10)
3-month Treasury Bill	Economic data (FRB)	Seasonally adjusted using X-12 ARIMA
Hours worked	Productivity database (BLS)	All person in nonfarm business sector, index (2005=100)
Real wage	Productivity database (BLS)	Real hourly compensation in nonfarm business sector, index (2005=100)
Population	NIPA Table 2.1 (BEA)	Mid-period and seasonally adjusted

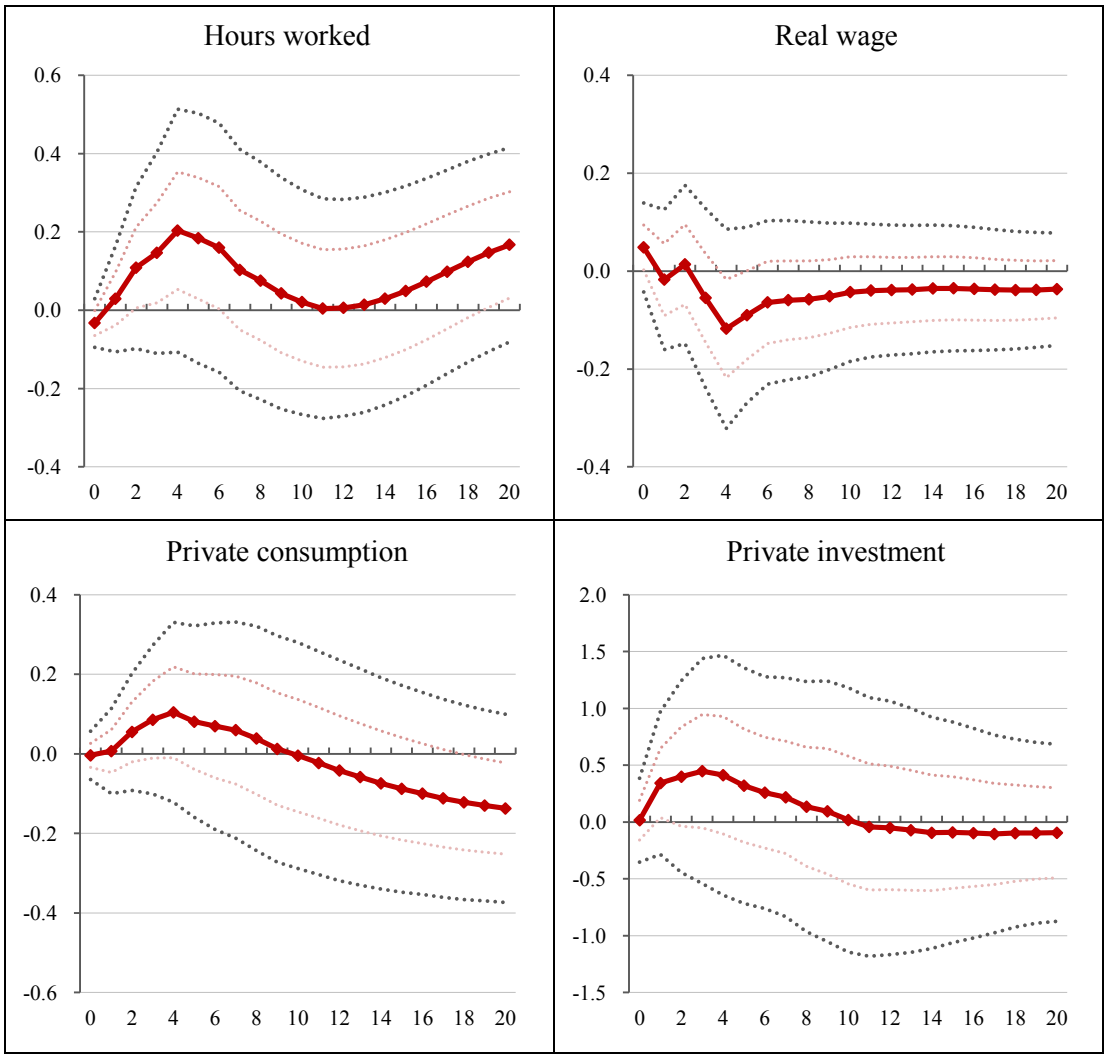
3. Macroeconomic variables at the state level

Series	Source	Description
Government expenditure	State government finance (CB)	Nominal series deflated by CPI
Revenues	State government finance (CB)	Nominal series deflated by CPI
Personal income	Regional data (BEA)	Nominal series deflated by CPI
House price index	State HPI data (FHFA), Economic data (FRB)	Index (2005=100)
Employment	Employment database (BLS)	Non-farm payroll, Quarterly data
Government debt	State government finance (CB)	Nominal series deflated by CPI
Gross state product	Regional data (BEA)	Real series, chained (2005) dollars
Coincident Economic Activity Index	U.S. regional data (FRB)	Index (1992=100)
State population	Population estimates (BEA)	Midyear, historical data

C. 68% and 95% confidence bands of the results at the national level



C. 68% and 95% confidence bands of the results at the national level (continued)

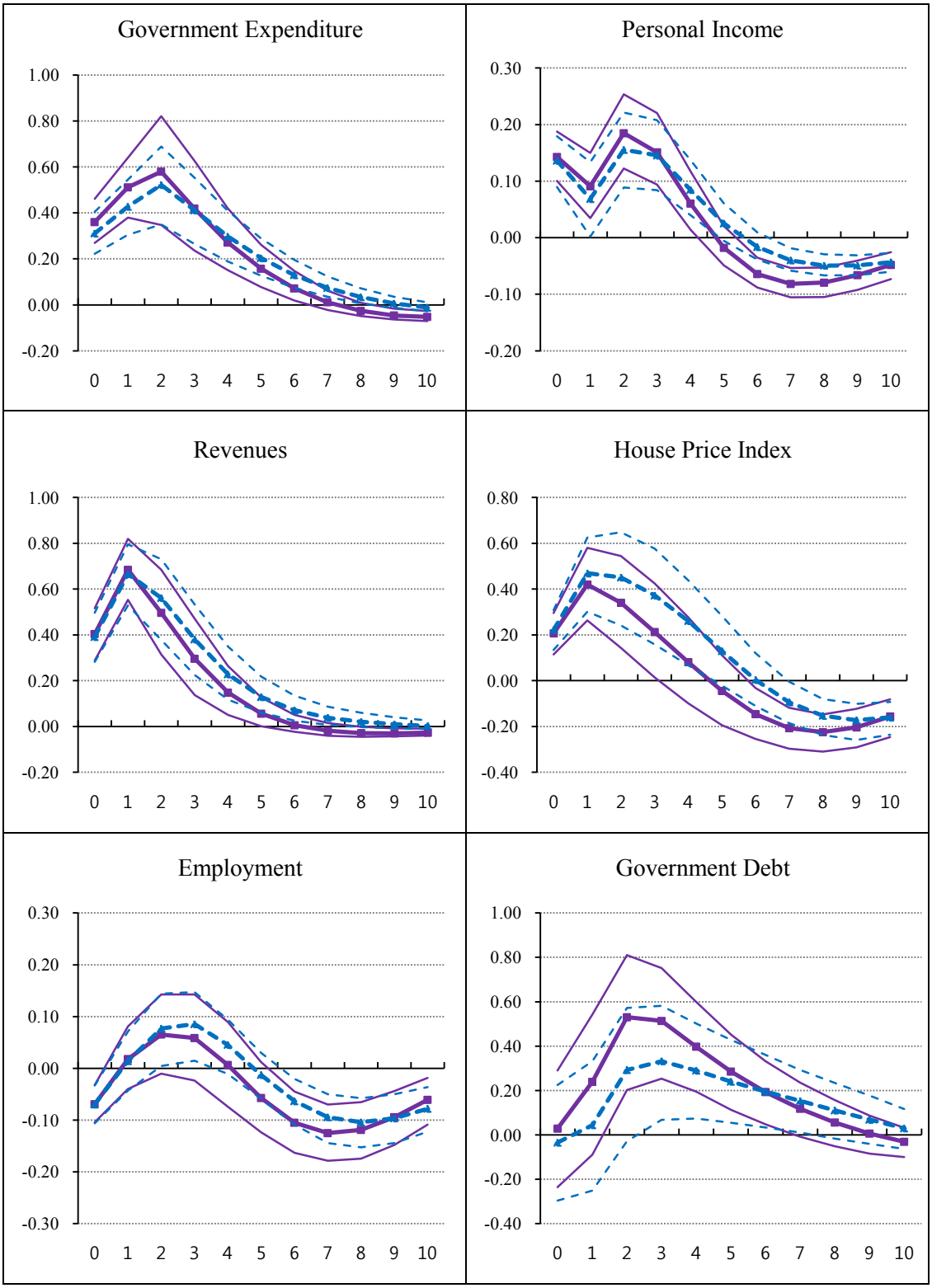


D. Examples of government spending multiplier at the national level of the U.S.

Paper	Data	Identification	Multiplier (GDP)
Rotemberg -Woodford (1992)	Quarterly, 1947~1989	Residuals from regression of military spending	1.25
Ramey – Shapiro (1998) Edelber et al. (1999) Eichenbaum-Fisher (2005)	Quarterly, 1947~1990s or 2000s	Narrative approach with military build-ups	0.6~1.2 (cumulative or peak)
Blanchard - Perotti (2002)	Quarterly, 1960~1997	SVAR	0.9~1.29
Mountford - Uhlig (2009)	Quarterly, 1955~2000	Sign restrictions on a VAR	0.65
Romer-Bernstein (2009)	Quarterly	FRB/US model and a private forecasting firm model	1.57
CBO (2010)	Quarterly	Macro econometric models	1.0~2.5 (nondefense)
Fisher - Peters (2010)	Quarterly, 1960~2007	VAR using shocks to the excess stock returns of military contractors	1.5 (cumulative)
Ramey (2011a)	Quarterly, 1939~2008	Narrative approach with military news	0.6~1.2 (peak, depending on sample)
Barro-Redlick (2011)	Annual, 1917~2006	Using military spending or military news	0.6~0.9 (defense)
Auerbach - Gorodnichenko (2012)	Quarterly, 1947~2008	A regime switching VAR model (STVAR) with dynamic response across the states of economy	Expansion: 0.57 (peak) -0.33 (cumulative) Recession: 2.48 (peak), 2.24 (cumulative)
Baum et al. (2012)	Quarterly, 1965~2011	A threshold VAR model with dynamics variables across regimes	Expansion: 1.0~1.3 (cumulative) Recession: 1.2~1.7 (cumulative)
Cantore et al. (2013)	Quarterly	DSGE model with deep habit and a constant elasticity of substitution (CES)	1.6~2.0 (peak)
This thesis	Quarterly, 1977~2009	Narrative approach with natural disasters	1.41 (peak), 1.74 (cumulative) (nondefense)

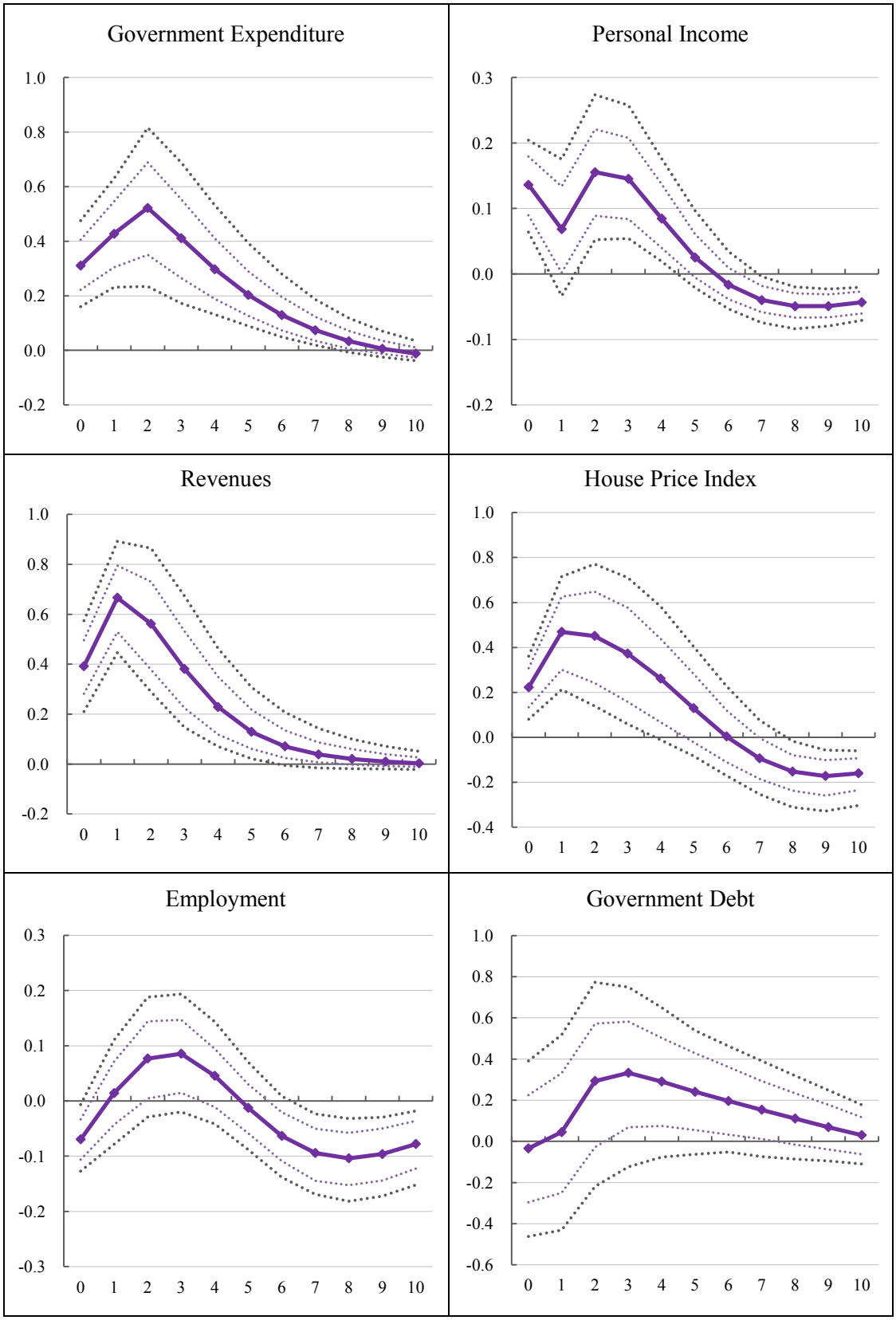
Note: A great part of this table is cited from the Table 1 of Ramey (2011b).

E. The comparison of the responses from OLS and GMM estimator in Panel VAR



Note: The solid lines display the responses using OLS estimator in PVAR without fixed effects and the dash lines display the responses using GMM estimator in PVAR (baseline). While the thick lines are point estimates, the thin lines correspond to 68% confidence interval bands.

F. 68% and 95% confidence bands of the results at the cross-state level



G. Examples of government spending multiplier at the cross-state level of the U.S.

Paper	Type of Data	Identification	Multiplier (Personal Income)
Fishback-Kachanovskaya (2010)	Various types of New Deal spending, Panel of states, 1930~1940	Interaction of swing voting and government spending	-0.57 ~ 1.67 (type of spending)
Shoag (2010)	State government spending, Panel of states, 1987~2008	Changes in state spending by excess returns to state pension fund	Around 2
Clemens – Miran (2011)	State government outlays, Panel of states, 1988~2004	Interaction of state balanced budget rules with business cycle	0.3~3 (specification)
Nakamura – Steinsson (2011)	Military prime contracts, Panel of states, 1966~2006	Sensitivity of state military procurement spending to aggregate changes in military spending	1.5
Serrato - Wingender (2011)	Allocation of Federal spending on local area, Panel of counties, 1970~2009	Variation in allocation of federal spending on counties caused by updates of population	1.88
Clemens and Miran (2012)	Spending cuts made by states to respond deficit shocks, Panel of states, 1988~2004	Variation induced by states' fiscal institutions such as balanced budget requirements and rainy day funds	Around 0.4 (on-impact)
This thesis	Federal disaster assistance to state Panel of states, 1977~2009	Changes of state government spending including federal assistance after natural disasters	1.45~2.48 (cumulative or peak)

Note: A great part of this table is cited from the Table 2 of Ramey (2011b).

Chapter 4

Macroeconomic effects of fiscal adjustment: A tale of two approaches

1. Introduction

The recent global economic and financial crisis, and the associated austerity reforms, have resulted in a renewed interest in the dilemma between fiscal sustainability and economic growth. The reason is that after the expansionary fiscal response following the global crisis of 2008, many countries have been suffering from fiscal imbalances due to large increases in government deficits and debt. As a result, many governments, most notably the peripheral countries of the Eurozone, have undertaken large spending cuts and tax hikes for fiscal sustainability. Even in countries with relatively positive fiscal outlook, such as the U.S. and U.K., fiscal adjustment has been at the forefront of academic and policy discussions alike.

Although there is a widespread agreement that a reduction of deficit and debt has important benefits in the long term, there is less consensus regarding the short-term effects of fiscal adjustment. In the 1980s, Denmark and Ireland experienced improved growth performance after periods of strict fiscal austerity.[89] This result is in contrast to the conventional Keynesian theory which predicts negative short-run economic effects of restrictive fiscal policy. Subsequently, Giavazzi and Pagano (1990), Alesina and Perotti (1997), Alesina and Ardagna (1998, 2010) and others investigated this issue and sought to find examples of similar expansionary fiscal adjustments and identify the conditions under which it prevails. As a result, some argue that fiscal adjustment can stimulate economic growth even in the short term, a phenomenon referred to as 'Non-Keynesian effects' or 'expansionary fiscal contraction'.

Many studies developed theory that can explain the existence of expansionary fiscal contractions as well as explored their determinants empirically. Most rely on changes in the cyclically adjusted primary balance (CAPB) to identify fiscal adjustment episodes. The CAPB is an indicator of fiscal policy that reflects discretionary fiscal policy and other noncyclical factors by excluding the automatic effects of business cycle fluctuations on the budget (transfer, tax system, and interest

89. According to Giavazzi and Pagano (1990), the sharp fiscal contractions (primary fiscal deficit cut equal to 10% of GDP) for 1983-1986 in Denmark and (primary fiscal deficit cut equal to 7% of GDP) for 1987-1988 in Ireland were accompanied by revived growth of average 3.6% and 3.7% in real GDP respectively with the improvement in the primary budget.

payments).[90] However, Guajardo et al. (2011) were the first to apply the narrative approach whereby they use historical documents to identify fiscal adjustments episodes in OECD countries. They fail to identify any expansionary fiscal adjustments and argue that the CAPB measure is methodologically flawed by comparing the CAPB-based approach with their narrative approach.

This chapter also explores the short-term effects of fiscal adjustment on economic activity in 20 OECD countries so that its scope is similar to Guajardo et al. (2011). However, we use the CAPB instead of the narrative approach, but modify the CAPB measure to take account of several problems that Guajardo et al. (2011) point out. Among the several alternative measures of CAPB, we follow the method suggested by Blanchard (1993) (see also Alesina and Perotti, 1995, and Alesina and Ardagna, 1998, 2010, and 2012). However, contrary to those studies, we construct the CAPB measure so that it reflects fluctuations in asset prices which strongly affect revenues and takes into account the heterogeneity of fiscal policy for each country. Using this new measure of fiscal adjustment, we obtain results that are very similar to those that Guajardo et al. (2011) obtain with a narrative approach.

This chapter makes three main contributions. First, it develops and refines the measurement of CAPB. The resulting measure, as we show, is a good indicator of fiscal policy despite the disadvantages associated with its use compared with the narrative approach. Second, this chapter assesses the existence of Non-Keynesian effects empirically and concludes that the Non-Keynesian effect is a very unusual phenomenon. Third, we confirm that spending-based fiscal adjustments can have more beneficial macroeconomic effects than tax-based fiscal adjustments, which is in line with previous theoretical and empirical evidence.

This chapter is organized as follows. Section 2 reviews the theoretical and empirical literature on the effects of fiscal adjustments. Section 3 analyzes and compares fiscal adjustment episodes identified by the two types of approaches: those of Alesina and Ardagna (2010, 2012) and Guajardo et al. (2011). Then, in section 4, we explain our new measure to identify fiscal adjustments and list the fiscal adjustment episodes that we identify. Section 5 outlines the empirical framework and

90. The CAPB is usually calculated by taking the actual primary balance (balance minus net-interest payment) and subtracting the estimated effects of business cycles on the budget.

presents the results. Section 6 examines the robustness of our results. Finally, section 7 concludes.

2. Related literature

2.1. Theoretical considerations

There is a general agreement that reducing government debt via active fiscal consolidation contributes to long–run economic growth. However, Keynesian economics advocates the use of automatic or discretionary countercyclical fiscal policies to lessen the impact of the business cycle. On the other hand, others favour a laissez-faire fiscal policy. In practice, the pro-cyclical fiscal policy is often observed in developing countries due to various reasons such as imperfections in international credit markets that constrain developing countries from borrowing in recessions (Gavin and Perotti, 1997: Kaminsky et al., 2004) or political distortions that intensify the competition of common resources and rent-seeking in booms (Tornell and Lane, 1999; Alesina et al., 2008). Even in advanced countries, pro-cyclical policies such as 'austerity in recession' and 'budgetary expansions during boom' became common. In this context, there is no consensus regarding the short-run effects of fiscal adjustment. A standard Keynesian model such as the IS-LM framework predicts that a cut in government spending or an increase in taxes reduces the aggregate demand and income directly, which leads to negative multiplier effects on the output indirectly in the short term. In this case, the government debt ratio also may not be reduced as much as expected because both output and tax revenues fall due to contractionary effects of the fiscal adjustment.

However, in the Neoclassical model, fiscal adjustments aimed at reducing the government budget deficit can stimulate the economy with an increase in private consumption and investment through several transmission mechanisms even in the short term, which helps reduce the government debt ratio. These mechanisms can be explained by both demand and supply side effects. First, on the demand side, wealth effects or credibility effects are suggested to be at work. Blanchard (1990) proposes a model in which a consumer reacts to two kinds of effects. One is the intertemporal tax redistribution effect by non-Ricardian agents in a Keynesian model where an

increase in taxes decreases consumption. The other is that in the presence of deadweight loss of distortionary taxes, an increase in taxes can eliminate the need for larger and disruptive adjustment above the critical level in the future. As a result, people can expect to increase their permanent income due to the future reduction in the deadweight loss and increase their consumption. He argues that if people exhibit little myopia and the fiscal adjustment is made from a high debt level, consumption can react positively. Bertola and Drazen (1993) present an optimizing model and demonstrate that if a change of fiscal policy induces sufficiently strong expectation of future policy change in the opposite direction, it can cause a nonlinear relationship between private consumption and government spending. If a cut in government spending induces expectation of significantly lower future taxes, it may induce an increase in current private consumption. Similarly, Sutherland (1997) uses a model that links current fiscal policy and future expected taxes. However, his model emphasizes the dynamics of government debt and considers consumers with finite horizons. At low levels of debt, fiscal policy has the usual Keynesian effects because people expect the debt stabilization programme as something distant from their perspective. On the other hand, at high levels of debt, as a major fiscal consolidation is imminent, people react to government spending in a non-Keynesian way, expecting that they will have to pay more taxes shortly. In other words, when the debt ratio is near the threshold level, an increase in taxes delays reaching the threshold and the associated major stabilization programs, so that it can induce people to expect higher permanent income and to increase their consumption. In these models, the positive wealth expectation effects can be at work especially when fiscal adjustment occurs with a high and rapidly growing debt-to-GDP ratio. Other mechanisms include credibility effects, which means that fiscal adjustment can improve the credibility of government finances by reducing the default and inflation risk via the decline in interest rates (Feldstein, 1982). When a high level of government debt affects the interest rate risk premium, a reliable fiscal adjustment can reduce the premium and in turn, the reduction of interest rate contributes to raise people's permanent income. In addition, lower interest rate can also lead to the appreciation of financial assets which triggers higher consumption and investment. As another mechanism, expansionary fiscal adjustment may take place on the supply side via the labour market and investment (Alesina et al, 2002). If fiscal adjustment is performed through a cut in public spending, especially in the area of public

employment, rather than an increase in taxes, it can lead to a reduction of overall wage pressure in the economy and stimulate private employment and investment.

2.2. Empirical considerations

There has been a large empirical literature studying expansionary fiscal adjustment (Non-Keynesian effects) since Giavazzi and Pagano (1990) demonstrated, based on examples of Denmark and Ireland in the 1980s that large and decisive fiscal adjustment could stimulate private consumption. In the bulk of empirical studies, fiscal adjustment is defined in terms of improvement of CAPB. The individual adjustment episodes are, correspondingly, identified according to how large the fiscal adjustment is over a given period or according to how long is the period over which fiscal adjustment is performed. Two strands of empirical studies have evolved in verifying the above-discussed theoretical views on the possibility of an expansionary fiscal adjustment. One focuses on the factors that are associated with expansionary or successful fiscal adjustment.[91] The other sets out to analyze the effects of fiscal adjustment in terms of macroeconomic outcomes rather than fiscal outcomes such as government debt.

The former seeks to classify the episodes according to the definition of expansionary or successful fiscal adjustment and then to perform a descriptive analysis of the characteristics of fiscal components and other related macroeconomic variables such as GDP and interest rate before, during, and after the fiscal adjustment period (Alesina and Perotti, 1995, 1997; Alesina and Ardagna 1998, 2010, 2012; McDermott and Westcott, 1996; and Giudice et al., 2007). These studies tend to find that fiscal consolidations based on spending cuts rather than on tax increases are more likely to be expansionary or successful. Some other papers use mainly binary dependent variable model such as logit and probit to analyze which factors determine the success of fiscal consolidation (McDermott and Westcott, 1996; Afonso et al., 2006) and its expansionary effects (Alesina and Ardagna, 1998; Giudice et al., 2007). McDermott and Westcott (1996) argue that the success in reducing the debt ratio can be attributed to the size and composition of fiscal adjustments. They show that fiscal adjustment based on spending cuts is more likely to be successful than tax-based one

91. In general, successful fiscal adjustment means a sustained reduction in the debt-to-GDP ratio.

and also the greater the magnitude of fiscal adjustment, the more likely it is to succeed. Moreover, they show that fiscal adjustment is more likely to fail in a global recession. Afonso et al. (2006) use logit model to assess fiscal consolidation in Central and Eastern European countries and suggest that spending-based consolidation tends to be more successful. With probit regression analysis, Giudice et al. (2007) conclude that fiscal consolidation is more likely to promote economic growth during periods of below potential output and in case the fiscal adjustment is based on spending cuts.

The latter strand is relatively rare compared with the former. Using panel data of industrial and developing countries, Giavazzi et al. (2000) analyze the general relationship between fiscal policy and national savings and conclude that their relationship can be nonlinear when fiscal impulse is sufficiently large and persistent, similar to previous studies for fiscal policy and private consumption (Giavazzi and Pagano 1990, 1995). Ardagna (2004) also studies the determinants and channels through which fiscal adjustment affect GDP growth. She shows that whether a fiscal adjustment is expansionary depends largely on the composition of fiscal policy, and that spending cuts can lead to higher GDP growth rates via the labour market rather than through agent's expectation. On the other hand, Burger and Zagler (2008) analyze the relation between U.S. growth and fiscal adjustments in the 1990's and argue that non-Keynesian effects prevail through an increase in consumption because of improved consumer confidence and an increase in investment via the labour market and financial market. Afonso (2010) assesses expansionary fiscal adjustment in European countries and finds that fiscal consolidations tend to have long-term expansionary effects, but no significant effects in the short-run.

Although there are some differences among these empirical studies in the factors affecting expansionary fiscal adjustment such as the size, composition, and also initial conditions, overall, the empirical literature provides more evidence in favour of the non-Keynesian effects with the fiscal adjustment episodes identified by the changes in the CAPB based on multiple countries and years or with several case studies.

On the other hand, several papers take issue with the results of empirical studies on the expansionary fiscal adjustment. First, there can be a selection bias or

measurement error with respect to identifying fiscal consolidation episodes using the CAPB. Other possibilities are spurious correlations and simultaneity issues in the links between fiscal policy and economic activity. Using the same panel data as Giavazzi et al. (2000), Kamps (2006) refutes their finding that non-Keynesian effects are a general and easily exploitable phenomenon by showing that the nonlinear effect cannot be robust if cross-country heterogeneity is taken into account. Song and Park (2010) and Hernández de Cos and Moral-Benito (2011) raise the possibility of endogeneity of the fiscal consolidation decision to GDP and find fiscal adjustment has negative effects on GDP when taking endogeneity problem via exogenous instruments into account. Especially, IMF (2010), Guajardo et al. (2011) and its companion paper, Devries et al. (2011) suggest an alternative way of identifying fiscal consolidations instead of the CAPB. They choose the episodes of discretionary fiscal changes motivated by the desire to reduce the budget deficit following the narrative approach based on historical documents similar to Romer and Romer (2010). They then compare their episodes with those of Alesina and Ardagna (2010) and show that their episodes have contractionary effects on GDP, while the CAPB-based episodes are associated with a rise in GDP. Hence, using the CAPB is likely to lead to a bias toward supporting for non-Keynesian effects. They identify a number of problems related to using the CAPB. First, using a statistical concept such as the CAPB can result in including non-policy related changes caused by other development affecting economic activity such as a boom in the stock market.[92] Second, the CAPB method is likely to ignore the motivation behind fiscal changes. For example, the rise of CAPB can reflect deliberate fiscal policy for restraining economic overheating, not for reducing the budget deficit.[93] In addition, it can omit some episodes of fiscal adjustment followed by an adverse shock and discretionary fiscal stimulus.[94] Third, the CAPB data cannot exclude some cases of offsetting positive changes in the CAPB caused by large one-off accounting operation in the previous year such as the capital transfer of Japan in 1998 and of Netherlands in

92. They use an example of Ireland in 2009 when a collapse in stock and house prices due to sharp recession induced a decrease of CAPB in 2009 in spite of fiscal consolidation.

93. For example, in responding to the rapid domestic demand growth in Finland in 2000, the government adopted a spending cut to stabilize economy.

94. They explain this using the example of Germany in 1982. Although deficit-reduction packages were implemented in 1981, countercyclical stimulus measures were introduced during 1982 because of sudden economic recession.

1995 which is unrelated to fiscal adjustment measures.[95] Based on their new dataset, they conclude that fiscal adjustments have contractionary effects on economic activity, and argue that large spending-based fiscal consolidation cannot be expansionary. On the other hand, Alesina and Ardagna (2012) re-estimate the effect again with new episodes identified based on the persistence criterion of CAPB rather than on their size criterion of CAPB in Alesina and Ardagna (2010). Then, they make a somewhat intermediate conclusion that results of two different approaches are not different in that spending-based adjustment cause smaller recession than tax-based one. They also argue that even an expansionary fiscal adjustment is possible when it is combined with monetary policy.

In fact, most of literature using the CAPB like Alesina and Ardagna (2010, 2012) usually identify the expansionary fiscal adjustment episodes on the basis of ex-post criteria at first and then analyze the characteristics of fiscal and macro variables. Hence, the results of these studies do not necessarily mean that fiscal consolidation generates economic growth. Fiscal adjustment may affect the economic activity and vice versa. In addition, a country which considers fiscal adjustment for reducing debt –to-GDP ratio may be in a situation of comparatively better economic growth. Therefore, expansionary fiscal adjustment can be a result of self-selection so that the decision to implement fiscal adjustment is endogenous. Despite being cyclically adjusted, the CAPB can be biased toward overstating expansionary effects as Guajardo et al. (2011) speculate. Moreover, as many theoretical studies argue, if wealth effects and expectations are the main channels by which the fiscal adjustment may affect economic activity, the episodes identified by the narrative approach based upon announced plans for deficit cuts can capture the fiscal adjustment and its effects better and more correctly than those identified by the CAPB based on actual fiscal outcomes. The main advantages of CAPB for identifying fiscal adjustments are its simple and easy application. Therefore, if the criteria of CAPB are improved to reflect the problems pointed out by the narrative approach, the CAPB can nevertheless be a useful indicator of fiscal policy.

95. For example, one-time capital transfers to the Japan National Railway in Japan in 1998 and to the social housing subsidy in Netherlands in 1995 caused large increase in the CAPB in the following year.

3. Comparison of the two approaches

This section investigates and compares the fiscal adjustment episodes identified by the two approaches and presents basic results in order to assess which one can capture discretionary fiscal adjustment more accurately. Firstly, we use the episodes identified by Alesina and Ardagna (2010, 2012) – henceforth AA (10) and AA (12) – based on the changes in the CAPB. These are identified based on the size criteria and persistence criteria, respectively.[96] Secondly, the episodes of Guajardo et al. (2011) – henceforth IMF (11) – are used as ones identified by the narrative approach because they are the refined version of IMF (2010) constructed using the same methodology. While AA (10) identify 107 instances (years) of fiscal adjustment in 21 OECD countries from 1970 to 2007, AA (12) find 159 fiscal adjustments in 21 OECD countries from 1970 to 2010. On the other hand, IMF (11) identifies 173 instances in 17 OECD countries from 1978 to 2009.[97] All fiscal and macroeconomic data are from the OECD Economic Outlook database No.88. In addition, in order to consider the political and institutional determinants of fiscal adjustments, we collected also data on elections, federal system, and presidential system from the Comparative Political Data Set I of the Institute of Political Science at the University of Bern.

3.1. Endogeneity of the fiscal adjustment

The first main issue in assessing fiscal adjustment episodes is whether these episodes are indeed exogenous with respect to the state of the economy. Both approaches are based on the assumption that the discretionary changes in fiscal policy are exogenous. However, as Alesina and Ardagna (2010) admit, the decision on fiscal adjustment might not be exogenous to the developments in the economy. Especially, although the cyclically adjusted fiscal variables should, by definition, be free of the effects of the business cycle, the methodology cannot be perfect. For example, an increase in the CAPB to GDP ratio may be due to the fall of the denominator so that it may be unrelated to discretionary fiscal policy. Moreover, even in the narrative approach, which identifies the episodes based on the motivation

96. AA (10) identify fiscal adjustments as large changes in CAPB (at least 1.5 % of GDP) in a given year. AA (12) consider only multi-year adjustments in order to include small but lasting changes in the CAPB.

97. Appendix 3.A shows the list of fiscal adjustment periods identified by the two approaches.

of fiscal policy, fiscal adjustment itself also can be endogenous because a country which decides to implement fiscal adjustment to reduce the budget deficit is likely to be relatively less concerned about economic growth. Therefore, in comparing the two approaches, we need to test whether the decision on fiscal adjustment depends on economic activity.

Much of the relevant literature uses binary dependent variable models with the dummy for fiscal adjustment as the dependent variable in order to find determinants of expansionary or successful fiscal consolidations. Our methodology is akin to this. However, we try to find the determinants of the implementation of fiscal adjustment directly. To do this, we run a logit model of the fiscal adjustment dummy with value equal to one when the adjustment episodes are identified in a given year, and zero otherwise, on GDP growth and other variables of interest.[98] The logit model takes the following form,

$$FA_{i,t} = \begin{cases} 1, \text{if a fiscal adjustment is identified in a given year,} \\ 0, \text{if a fiscal adjustment is not identified in a given year,} \end{cases}$$

$$FA_{i,t} = \log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 E_{i,t} + \beta_2 F_{i,t} + \beta_3 S_{i,t} + e_{i,t},$$

where $P_{i,t}$ is the probability that a fiscal adjustment is implemented in country i during a given year t. On the right hand side of our model, three sets of explanatory variables are included. $E_{i,t}$ = (GDP growth, GDP gap, inflation, long-term interest rate)′ is a vector of macroeconomic variables, and $F_{i,t}$ = (primary balance, gross debt) is a vector of fiscal variables. The last set, $S_{i,t}$ = (Election, Federal system, Presidential system) is a vector of political dummy variables.[99] $e_{i,t}$ denotes the error term. In this simple analysis, if macroeconomic variables play a significant role in the decision to implement a fiscal adjustment, we can argue that the episodes are likely to be endogenous. When fiscal authorities decide on what type of fiscal policy to pursue, they usually consider the conditions that are expected to prevail as well as

98. As another binary dependent model, a probit model also is used but the results are almost same to those of the logit model.

99. If the election of the national parliament occurs in a given year, the dummy variable is equal to 1 and is 0 otherwise. Similarly, if a country has a federal system, the dummy variable takes the value 1 and is 0 otherwise, and if a country has a presidential system, the dummy variable is equal to 1 and is 0 otherwise.

the past state of economy. As a result, the decision on a fiscal adjustment can be correlated with the past and future states of the economy. Therefore, the expected GDP growth rate (T) after a fiscal adjustment should be included in a vector of macroeconomic variables, but as this is not available, we include the actual GDP growth rate (T) instead. For the past economic conditions just before the decision, we include a lag of GDP growth, GDP gap, inflation, and long-term interest rate. However, including contemporaneous GDP growth (T) can potentially introduce the reverse endogeneity of GDP growth in fiscal adjustment. Therefore, we analyze also alternative models that only control for contemporaneous GDP growth (T) or the lagged GDP growth (T-1).

Table 4.1 shows the results obtained with the fiscal adjustment episodes of AA (10), AA (12) and IMF (11), respectively. First, among macroeconomic variables, the impact of growth is different across the approaches. In fiscal adjustment episodes of AA (10) and AA (12), the contemporaneous growth or a lagged growth has significantly positive coefficients. Hence, the decision on fiscal adjustment could be affected by economic growth. If so, the assumption of exogeneity of fiscal adjustment is invalidated as Guajardo et al. (2011) and Hernández de Cos and Moral-Benito (2011) argue. On the other hand, for the episodes of IMF (11), the coefficients estimated for economic growth are never significant. For the other macroeconomic variables which capture the initial conditions, there is little difference across the three approaches. In particular, the long-term interest rate has the expected positive coefficient, which means that as the long-term interest rates go up, the government becomes more likely to adopt fiscal adjustment because of the increased burden of interest payments. Therefore, the episodes identified with the narrative approach appear much more exogenous than those based on the CAPB.

As for the fiscal variables, the previous level of the primary balance and the debt to GDP ratio also affect the decision on fiscal adjustment significantly with the expected signs in all the specifications. The probability of fiscal adjustment is likely to decrease as the level of primary balance increases. The positive coefficient of the lagged debt-to-GDP ratio also is consistent with the finding of previous literature that a country with high level of debt is more likely to implement fiscal adjustment to improve the fiscal sustainability. Tuning to the variables relating to the political

systems, holding an election reduces the probability of fiscal adjustment, but insignificantly in the specification using IMF (11). On the other hand, there is no common significant result across the specifications for the variables reflecting the nature of the political system.

Table 4.1 Logit estimation for the determinants of fiscal adjustment

Approach	AA(10)			AA(12)			IMF(11)		
Marginal effects	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GDP growth (T)	0.026*** (0.008)	0.021*** (0.006)	-	0.048*** (0.015)	0.057*** (0.015)	-	0.017 (0.017)	0.016 (0.013)	-
GDP growth (T-1)	-0.009 (0.008)	-	0.009 (0.007)	0.017 (0.014)	-	0.051*** (0.014)	-0.001 (0.021)	-	0.013 (0.016)
GDP gap (T-1)	0.011 (0.008)	0.006 (0.007)	-0.006 (0.008)	-0.017 (0.013)	-0.008 (0.010)	-0.047*** (0.014)	0.004 (0.019)	0.004 (0.015)	-0.007 (0.015)
Inflation (T-1)	0.001* (0.001)	0.001* (0.001)	0.001 (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.003** (0.001)	0.005** (0.002)	0.005** (0.002)	0.005** (0.002)
Interest rate (T-1)	0.013*** (0.005)	0.013*** (0.005)	0.009* (0.005)	0.029*** (0.010)	0.029*** (0.010)	0.021** (0.009)	0.049*** (0.016)	0.049*** (0.016)	0.045*** (0.015)
Primary balance (T-1)	-0.018*** (0.005)	-0.018*** (0.005)	-0.016*** (0.005)	-0.024*** (0.008)	-0.024*** (0.008)	-0.021*** (0.008)	-0.053*** (0.011)	-0.053*** (0.011)	-0.051*** (0.011)
Gross Debt (T-1)	0.002** (0.001)	0.001** (0.001)	0.001* (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)
Election (T)	-0.054** (0.022)	-0.054** (0.022)	-0.059** (0.024)	-0.040 (0.035)	-0.036 (0.034)	-0.048 (0.036)	-0.032 (0.051)	-0.032 (0.051)	-0.031 (0.051)
System (Federal)	-0.065** (0.031)	-0.066** (0.030)	-0.076** (0.030)	0.009 (0.081)	0.014 (0.081)	-0.029 (0.077)	0.150* (0.079)	0.150* (0.079)	0.145* (0.078)
System (Presidential)	-0.043 (0.034)	-0.044 (0.033)	-0.053 (0.033)	0.080 (0.135)	0.079 (0.132)	0.052 (0.122)	0.117 (0.116)	0.117 (0.116)	0.116 (0.113)
Observations	593	601	593	593	601	593	463	463	463
No. Country	20[1」]			20			17		
Period	1970-2009			1970-2009			1978-2009		

Note: 1」 Alesina and Ardagna (2010, 2012) include 21 OECD countries. However, Gross debt and the interest payment data for Greece are not available in OECD Economic Outlook Database for the sample period. Therefore, we include 20 OECD countries excluding Greece. Standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

In summary, our results of the logit analysis show that the episodes of fiscal adjustment based on the CAPB are less exogenous than those identified by the narrative approach in regard to the relation between economic growth and the decision to undertake a fiscal adjustment. Therefore, the narrative approach appears to capture discretionary fiscal adjustment more precisely.

3.2 Non-Keynesian effects?

In this subsection, we estimate the effects of fiscal adjustment on economic growth under the two approaches to see whether we can detect any evidence of non-Keynesian effects. In order to compare the results of the two approaches, we re-estimate the same specification as Guajardo et al. (2011) and Alesina and Ardagna (2012):

$$\Delta Y_{i,t} = C + \sum_{j=1}^{2} \alpha_j \Delta Y_{i,t-j} + \sum_{j=0}^{2} \beta_j \Delta FA_{i,t-j} + \mu_i + \lambda_t + \nu_i$$

where $Y_{i,t}$ is the logarithm of real GDP and $\Delta FA_{i,t-j}$ is the fiscal adjustment: the dummy variables for AA (10) and AA (12) and the dummy and the size of fiscal adjustment in percent of GDP for IMF (11) respectively.[100] The term μ_i denotes country-fixed effects to take account of differences among countries and λ_t denotes year-fixed effects to consider global shocks. ν_i is a reduced form innovation. The estimation is conducted by a panel OLS over the entire sample period.

Table 4.2 presents the results from estimating the models. Columns (1) and (2) report the coefficient estimates based on fiscal adjustment identified by AA (10) and AA (12) respectively. Although the coefficient of current fiscal adjustment has a positive sign in case of AA (10), the effect on economic growth is not statistically significant at conventional levels in any specification. On the other hand, the column (3) and (4) show the results for the fiscal adjustment based on the narrative approach. Although we use two types of fiscal adjustment variables: dummy and the size in percent of GDP, respectively, both results are almost same. As the current fiscal

100. Although Alesina and Ardagna (2010, 2011) use the changes in the CAPB in their regression, they do not provide the detailed data for the size of changes in the CAPB except for the list of years of fiscal adjustment. However, in a similar manner, Ramey and Shapiro (1998) also use a dummy variable which identifies discretionary government spending shocks in estimating the effects of government spending on the economic activity.

adjustment appears with significantly negative coefficient, the results show the typical Keynesian effects that the fiscal adjustment produces a negative effect on growth in the short term. This result also is in line with the finding of Guajardo et al. (2011). In addition, the fact that the results in columns (3) and (4) are almost the same implies that the effect of fiscal adjustment on growth depends on its timing and implementation itself rather than its size.

Table 4.2 The effects of fiscal adjustment on the GDP growth

Fiscal adjustment	AA10 (Dummy)	AA12 (Dummy)	IMF (11) (Dummy)	IMF (11) (Size, % of GDP)
	(1)	(2)	(3)	(4)
GDP growth (-1)	0.366***	0.362***	0.502***	0.502***
	(0.039)	(0.039)	(0.046)	(0.046)
GDP growth (-2)	-0.050	-0.046	-0.094**	-0.099**
	(0.039)	(0.039)	(0.047)	(0.047)
FA	0.003	-0.059	-0.424**	-0.317***
	(0.197)	(0.204)	(0.167)	(0.104)
FA (-1)	0.190	0.435*	-0.253	-0.139
	(0.195)	(0.238)	(0.183)	(0.115)
FA (-2)	-0.184	-0.075	0.170	0.217**
	(0.196)	(0.204)	(0.165)	(0.109)
Constant	4.017***	3.993***	-3.920***	1.891***
	(0.392)	(0.390)	(0.365)	(0.383)
Observations	740	740	510	510
R-squared	0.527	0.529	0.657	0.658
No. Country	20	20	17	17

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

To sum up, the episodes of fiscal adjustment using the changes in the CAPB do not provide significant evidence of non-Keynesian effects, whereas the episodes based on the narrative approach show that the fiscal consolidation has negative effect on real growth. Therefore, as Guajardo et al. (2011) suggest, the narrative approach appears superior in identifying fiscal adjustment episode, compared to using the CAPB. However, the CAPB has advantages in terms of methodological simplicity and convenience. Therefore, the following section seeks to improve the criteria and definitions of fiscal adjustment within the CAPB-based approach.

4. Data and identification of fiscal adjustment episodes

4.1. Data

We use an unbalanced panel of OECD countries covering the period from 1970 to 2009. All fiscal and macroeconomic data are obtained from the OECD Economic Outlook No.88.[101] The sample includes 20 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, and United States for which we have data on 20 years or more. Appendix 3. B describes the fiscal and macroeconomic data employed in more detail.

As explained in the previous section, we use cyclically adjusted primary fiscal variables to identify the instances of discretionary fiscal adjustment. First, as usual, we use primary fiscal variables which exclude interest payments because the fluctuations in interest payments cannot be regarded as discretionary. Then, to make the cyclical correction, we follow the method proposed by Blanchard (1993). His method has also been used by Alesina and Perotti (1995, 1996) and Alesina and Ardagna (1998, 2010 and 2012). It is simpler and more transparent than the more complicated official measures such as those of OECD and IMF which rely on the potential output and fiscal multipliers (Alesina and Ardagna, 1998 and 2010). The basic principle of this method is that since the government spending can be negatively related to GDP due to unemployment benefits and the revenues can be positively related to GDP due to tax receipts, the changes in the cyclically adjusted fiscal variables can be calculated from the difference between the value which would prevail if unemployment had not changed from the previous year and the actual value in previous year.

In the process of this simple procedure, especially for cyclically adjusted revenues, the unemployment rate is the only indicator of the state of the economy in the previous year. However, the CAPB can also be affected crucially by sharp changes in asset prices. The asset price fluctuations can therefore bias the correlation between cyclically-adjusted fiscal variables and economic activity. For example, a

101. More recent OECD Economic Outlook data cover a more limited period. For example, the data for Germany is available only from 1991 onward from Outlook No. 89.

stock market boom could not only increase cyclically-adjusted tax revenues because of capital gains, but also raise private consumption and investment. As a result, it can lead to an upward-biased estimate of the effect of fiscal consolidation on output. This is one of the problems that Guajardo et al. (2011) identify with respect to using the CAPB: they bring up the examples of Finland in 2000 and Ireland in 2009. In addition, the importance of asset price changes to fiscal policy outcomes has recently received a lot of attention in the literature. Morris and Schuknecht (2007) and Price and Dang (2011) find that the changes in asset prices are a major factor behind unexplained changes of fiscal revenues in cyclically adjusted balances. Tagkalakis (2011a, 2011b) finds that financial markets have quite a significant impact on the fiscal positions and suggests that higher asset prices improve fiscal balances and contribute to initiating a successful fiscal adjustment.[102]

In this context, we use a share price index as an additional variable determining the CAPB. The impact on fiscal balance, especially tax revenues, can be different according to the types of asset price and tax systems (Morris and Schuknecht, 2007; Tagkalakis, 2011a). Therefore, when considering asset price variables as a business cycle factor, it would be ideal to include other types of asset prices such as equity and property prices. We use only the share price index due to data availability and its particular relevance to tax revenues. This can be deemed a limitation of our methodology, but we believe this index is representative of the way other asset prices behave.[103]

Our measure for the changes in the CAPB is implemented like the process of Alesina and Ardagna (1998). First, to get the cyclically adjusted spending as a ratio to GDP, we regress primary spending on a time trend and the unemployment rate (U_t) for each country in the sample:

$$G_t = \alpha_0 + \alpha_1 Trend + \alpha_2 U_t + e_t \qquad (1)$$

Then, with the estimated coefficients ($\hat{\alpha}_1, \hat{\alpha}_2$) and the residuals ($\hat{e}_t$) and the

102. There are many studies that show that the financial market variables have significant impact on fiscal primary balance, particularly through government revenues (Eschenbach and Schuknecht, 2002; Tujula and Wolswijk, 2007; Reinhart and Rogoff, 2009; Tagkalakis, 2012, etc.)

103. For robustness, we use the house price index as an asset price index instead of the share price index, although the number of observations gets less. However, the result is quite similar, which is provided in the following robustness section.

unemployment rate (U_{t-1}) in t-1, we calculate the value of the cyclically adjusted primary spending:

$$G^*_t(U_{t-1}) = \hat{\alpha}_0 + \hat{\alpha}_1 Trend + \hat{\alpha}_2 U_{t-1} + \hat{e}_t \quad (2)$$

In addition, the changes in discretionary spending are calculated as $G^*_t(U_{t-1}) - G_{t-1}$. A similar procedure is applied to compute the cyclically adjusted revenues. However, this time, the asset price index is added to the regression.

$$R_t = \alpha_0 + \alpha_1 Trend + \alpha_2 U_t + \alpha_3 Assetprice_t + e_t$$

$$R^*_t(U_{t-1}, Assetprice_{t-1}) = \hat{\alpha}_0 + \hat{\alpha}_1 Trend + \hat{\alpha}_2 U_{t-1} + \hat{\alpha}_2 Assetprice_{t-1} + \hat{e}_t$$

Finally, the changes in discretionary fiscal policy are constructed as follows

$$\Delta CAPB = [R^*_t - R_{t-1}] - [G^*_t - G_{t-1}]$$

Guajardo et al. (2011) criticizes the CAPB using the example of Ireland in 2009. In that instance, the CAPB to GDP ratio, used by Alesina and Ardagna (2010), fell because of the decline in tax receipts due to the sharp fall in stock and house prices. They argue that this shows the inaccuracy of the CAPB. However, our new measure that takes account of fluctuations in asset price has the CAPB improving by 1.3% of GDP.

4.2. Definition of fiscal adjustment

In the literature using the CAPB, it is common to identify fiscal adjustment episodes as large and long lasting changes in the CAPB. However, Table 4.3 shows that the criteria of size and persistence are considerably different across the various studies, and a little arbitrary. In addition, although these studies impose different thresholds, only one threshold is applied to all countries to determine a fiscal adjustment episode. In other words, they do not allow for the country-specific heterogeneity in discretionary fiscal shocks and the private sector responses to them. Since the expectations and confidence of the private sector are key factors for the transmission of fiscal shocks, past fiscal record should be considered. For example, for a country which has seldom shown large changes in discretionary fiscal policy, a small fiscal adjustment can send a strong signal of the government's willingness to

reduce the budget deficit. However, for a country that has shown large fluctuations of fiscal policy in the past, a similarly sized fiscal adjustment can be too weak to elicit any response from the private sector. As a result, while Burger and Zagler (2008)[104] and Guajardo et al. (2011) identify several episodes in the U.S., Alesina and Ardagna (2010, 2012) identify no fiscal adjustment episode in that country. Therefore, when identifying episodes of fiscal contractions, one should consider the idiosyncrasy of fiscal policy in each country. For this reason, we consider the average (μ_i) and standard deviations (σ_i) of the changes in the CAPB for each country (i).

Table 4.3 Criteria examples for the definition of fiscal adjustment

Study	Criteria for the change in the improvement of CAPB
Alesina and Perotti (1995), Alesina and Ardagna (2010)	The change is at least 1.5% p of GDP in 1 year
Alesina and Perotti (1996)	The change is at least 1.5% p of GDP in 1 year or at least 1.25% p of GDP per year in both two consecutive years
McDermott and Wescott (1996)	The change is at least 1.5 % p of GDP over 2 years with the improvement of each year
Alesina and Ardagna (1998), Giudice et al. (2007), Ardagna (2007)	The change is at least 2% p of GDP in 1 year or at least 1.5%p of GDP per year in both 2 consecutive years
Alesina and Ardagna (2012)	The cumulative change is at least 2% p of GDP in 2 consecutive years and at least 3% p of GDP in 3 or more years with the improvement of each year
Giavazzi and Pagano (1996)	The cumulative change is at least 5, 4, 3% p of GDP in respectively 4, 3, or 2 consecutive years, or 3% p in 1 year
Giavazzi et al. (2000), Kamps (2006)	The change is at least 1.5% p of GDP per year over a 2 consecutive years
Afonso et al. (2006)	The change is above the average + 2/3 times the standard deviation for all discretionally changes of budget balance in the entire sample
Ahrend et al. (2006), Guichard et al.(2007)	- Starts if the change is at least 1% p of potential GDP in l year or in 2 consecutive years with at least 0.5% p in the first of the two years. - Continues as long as the CAPB improves or deteriorates at most 0.3% p of GDP but is offset in the following year. - Terminates if the CAPB stops increasing or improves by less than 0.2% p of GDP in one year and then deteriorates.

104. This paper focuses on the fiscal adjustment episodes of the U.S. and economic growth. in 1990s.

Our definition rule for identifying fiscal adjustment episodes has 4 criteria, incorporating size, persistence and country-specific heterogeneity, as follows

① A fiscal adjustment occurs in a given year if the CAPB improves by at least the average (μ_i) + standard deviation (σ_i) in that year.

② A fiscal adjustment takes place over a period of multiple years when the CAPB improves by at least $\mu_i + 1/3\sigma_i$ in the first year and the cumulative change is at least $\mu_i + 4/3\sigma_i$ over 2 years or $\mu_i + 2\sigma_i$ over 3 or more years.

③ A spell of fiscal adjustment terminates if the CAPB improves by less than $\mu_i + 1/3\sigma_i$ or deteriorates in one year, except when the change in the CAPB is between $\mu_i + 1/3\sigma_i$ and $\mu_i - 1/3\sigma_i$ in that year, and the cumulative change over the following year is an improvement of at least $\mu_i + 1/3\sigma_i$.

④ A fiscal adjustment does not occur in a given year (T) when the CAPB improves by at least $\mu_i + \sigma_i$ in that year, but in the previous (T-1) or following year (T+1), the CAPB worsens by over $\mu_i + \sigma_i$.

These criteria are chosen for the following reasons. First, as explained already, the different cut-off values are used to reflect the heterogeneity of each country, as embodied in the average (μ_i) and standard deviation (σ_i) of the changes in the CAPB. In fact, the standard deviation (σ_i) during 1970 - 2009 ranges from 3.73% points of GDP in Norway to 0.88% points of GDP in the U.S. (Criterion ① and ②). Second, Criterion ③ ensures that episodes when the CAPB improves less or deteriorates temporary, but this is offset in the following year, are also counted. Third, Criterion ④ excludes cases of sharp increases in the CAPB due to one-off accounting operations such as one-time capital transfers. As in the other literature, there is also an element of arbitrariness in our definition. The multiples (1, 1/3, 4/3, 2) of standard deviation are chosen to include the episodes of Guajardo et al. (2011) as closely as possible during the same period under the assumption that the narrative approach is more accurate. After then, our fiscal adjustment episodes are identified in the extension of countries and period. In the robustness section, we use alternative rules and thresholds in order to check whether the results are sensitive to these values.

4.3. Identifying fiscal adjustment episodes

According to our definition, we identified 199 instances of fiscal adjustment in 20 OECD countries from 1970 to 2009. These consist of 66 episodes, as reported in Table 4.4.[105] These episodes include only those that, once started, lead to a sufficiently large improvement in the CAPB. This list includes several well-known episodes such as Denmark (84~86), Ireland (82~84, 86~88) and identifies the episodes that Guajardo et al. (2011) use to illustrate the discrepancies between the two approaches.[106]

Table 4.4 Episodes of fiscal adjustment

Country (sample period)	Period	No. Episode	No. Year
Australia (70~09)	77- 80, 82- 83, 86- 88, 91- 93, 96- 98	5	15
Austria (70~09)	77- 81, 84, 96- 97, 01, 05- 07	5	12
Belgium (86~09)	87, 93- 98	2	7
Canada (70~09)	81- 83, 86- 87, 91- 97	3	12
Denmark (83~09)	84- 86, 03- 05	2	6
Finland (70~09)	76- 77, 92- 94, 96	3	6
France (80~09)	83- 87, 94, 96- 99, 04- 06	4	13
Germany (70~09)	82- 85, 92- 94, 97- 00, 03- 07	4	16
Ireland (70~09)	75- 77, 82- 88	2	10
Italy (70~09)	82- 83, 86- 88, 92- 97	3	11
Japan (70~09)	79- 87, 06	2	10
Korea (81~09)	93- 94, 98- 99	2	4
Netherlands (70~09)	72- 73, 81- 83, 93, 04- 05	4	8
New Zealand (86~09)	87, 89- 93	2	6
Norway (86~09)	94- 96, 99- 00, 04- 06	3	8
Portugal (88~09)	92, 94- 95, 02- 04, 06- 07	4	8
Spain (85~09)	86- 87, 92- 94, 09	3	6
Sweden (70~09)	81- 87, 94- 97, 04- 05	3	13
United Kingdom (70~09)	76- 77, 79- 84, 96- 00, 05- 06	4	15
United States (70~09)	71- 72, 76- 77, 80- 82, 91, 96- 98, 05- 06	6	13
20 countries		66	199

Note: As fiscal consolidation is identified based on the changes in the CAPB from the previous year, the period for the episodes is shorter by one year than the sample period.

105. Multi-year fiscal adjustment is regarded as a single episode like Alesina and Ardagna (2012) because fiscal adjustments have often multi-year processes. Moreover, it is very difficult to distinguish the episodes and correct timing during years of long-lasting improvement of the CAPB

106. Our list includes the episodes of Germany (1982) and Italy (1993), but excludes the episodes of Finland (2000), Germany (1996), Japan (1999), and Netherlands (1996) just as Guajardo et al. (2011).

As Figure 4.1 shows, most episodes are of short duration. Of 66 episodes, 11 account for only one period, and 19 episodes last for two and three consecutive years. The longest lasting episode is 9 years for Japan from 1979 to 1987. Figure 4.2 shows that the episodes of fiscal adjustment appear more frequently during the 1980's and 1990's. Especially, the concentrated fiscal adjustments which have relatively short duration occur more often in the EU countries. It is likely to be related to the Maastricht treaty in 1992 which set criteria for euro area membership (Guichard et al., 2007).[107]

Figure 4.1 Distribution of fiscal adjustment episodes by the duration

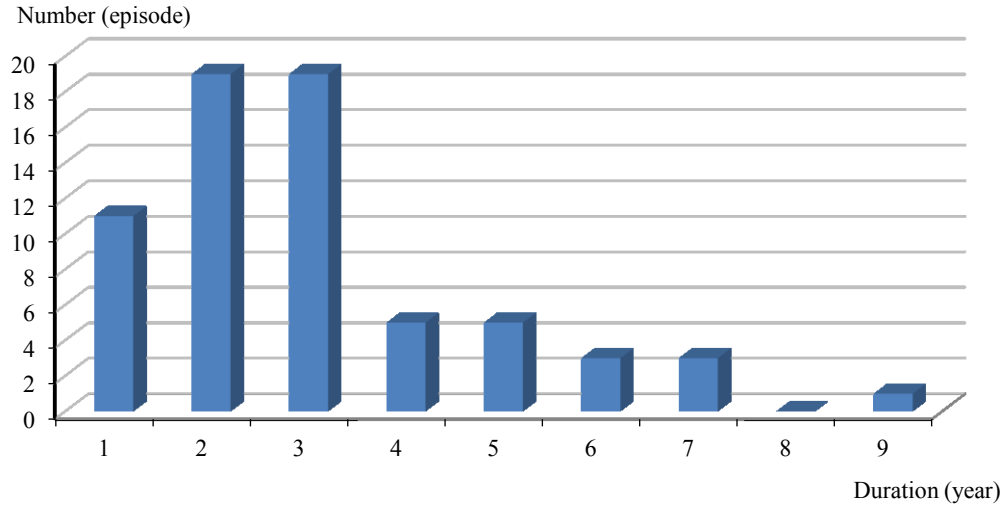
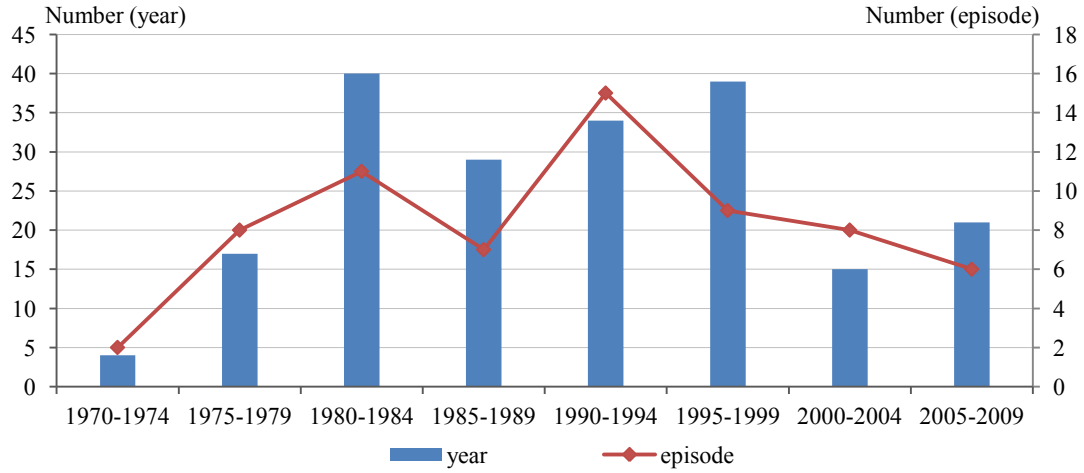


Figure 4.2 Distribution of fiscal adjustment episodes by the period



107. The Maastricht criteria imposed control over inflation, public debt and the public deficit, exchange rate stability, and the convergence of interest rates. Especially, the ratio of government deficit and the ratio of gross government debt to GDP were not to exceed 3 % and 60% of GDP respectively at the end of fiscal year.

4.4. Analysis of factors determining the fiscal adjustment episodes

In this subsection, we analyze the various factors that affect the decision on starting or continuing the fiscal adjustment by means of a binary dependent variable model. The dependent variable is equal to one during periods of fiscal adjustment and zero otherwise. Although the multi-year fiscal adjustments are regarded as a single episode in this chapter, a fiscal authority should decide not only on initiating fiscal adjustment, but also on its continuation in the subsequent years. Therefore, the dummy variable takes value of one for each year during an episode of fiscal adjustment. However, for robustness, we present results with only the first year of each episode coded as financial adjustment, in line with Guichard et al. (2007). Initial conditions such as the economic and policy environments can be related to the decision on fiscal adjustment. Therefore, at the right hand side of our model, explanatory variables are composed of three sets of variables: macroeconomic, fiscal and political variables like in the earlier section comparing the two approaches for identifying the fiscal adjustment.

The probability of fiscal adjustment is estimated by a panel logit model.[108] The results are reported in Table 4.5. As for the variables capturing the state of the economy, the results are similar to those using the narrative approach in the previous section. First, current and lagged growth rates have no significant coefficients in regard to the probability of fiscal adjustment. It suggests that the episodes identified with our definition are less at risk of being endogenous than those of Alesina and Ardagna (2010, 2012). It also suggests that the cyclically adjusted primary balance might be improved compared to the previous literature. However, in the results based on the first year of fiscal adjustment episodes (columns 4, 5, and 6), the decision on undertaking a fiscal adjustment is still moderately affected by growth. Therefore, it shows weaker evidence for exogeneity than narrative episodes of Guajardo et al. (2011).[109]

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108. As another binary dependent variable model, we use the probit model too. However, the choice of model has no impact on the results. According to Afonso et al. (2006), logit model is likely to be preferred because of its statistical advantages in dealing with binary outcomes in the empirical literature.

109. For the endogeneity problem, we check the assumption of exogeneity in the section for robustness.

Furthermore, the output gap in the previous year has a significant coefficient. Although fiscal adjustment is exogenous to contemporaneous output, it can reflect the initial economic conditions. Interestingly, the coefficient of the output gap has a different sign according to the type of dummy variable for fiscal adjustment. In particular, while positive output gap increases the probability of initiating a fiscal adjustment when considering only the first year of each episode (column 4, 5, and 6), the opposite results are obtained with the dummy variables for each fiscal adjustment year, indicating that fiscal adjustments are more likely in bad economic conditions (columns 1, 2, and 3). Therefore, the effect of output gap is not clear.[110] A possible interpretation is that in the first year of episodes, when the output gap is positive, the fiscal authority tends to be less concerned about the contractionary effect of fiscal adjustment on the economy and is more ready to undertake fiscal adjustment in good economic times, but during the periods of fiscal adjustment, the longer an episode lasts with the positive output gap, the less it is necessary to continue the fiscal adjustment due to the reduction of the deficit-and debt-over-GDP ratio from the economic boom. It means that the relationship between the decision on fiscal adjustment and output gap can be non-linear. When we add the square of output gap alongside output gap as a quadratic function in the same logit model, the square of output gap has negative and significant coefficient in both specifications.[111] Therefore, the persistence of a positive output gap is likely to play a significant role in starting and stopping fiscal adjustment.

The inflation rate also has a positive effect on the decision on fiscal adjustment, but only at the 10% significance level. The long-term interest rate plays a significant role in prompting fiscal adjustment at the 1% significance level: high long-term interest rate imposes greater burden in the context of interest payments on government debt, so that it is likely to encourage fiscal adjustment.

As for the fiscal variables, the primary balance of the previous year plays a

110. Literature on role of the initial output gap also show different results. While von Hagen and Stauch (2001) show the positive coefficient (significant) of lagged output gap on the basis of each year of fiscal adjustment episodes, Tagkalakis (2011b) shows negative coefficient (insignificant) of lagged output gap. In the other hand, Guichard et al.(2007) show that there is no evidence of significant role of output gap in triggering fiscal adjustment episodes, but positive output gap increases the likelihood of stopping the episodes on the basis of the first year of episodes.

111. The results are presented in Appendix 3. C.

significant. A rise of the initial primary balance by 1% of GDP decreases the likelihood of deciding a fiscal adjustment policy by 2.2%. Moreover, the effect of fiscal balance is consistent across the specifications. In contrast, the initial debt-to-GDP ratio is only weakly associated with fiscal adjustment. Although the coefficient of gross debt is positive in the columns (1), (2) and (3) of Table 4.5, it is significant only at 10% significance level and the size is very small. This result deviates somewhat from the previous findings, given that the fiscal adjustment is performed for fiscal sustainability. In line with the result for the long-term interest rate, this suggests that it is the interest burden and not the stock of debt that is instrumental for fostering fiscal adjustment.

Finally, most political variables turn out insignificant. Specifically, there is no evidence supporting the 'political budget cycle' story, whereby the incumbent adopts expansionary fiscal policy in an election year to stimulate the economy so as to increase the chances of re-election for himself or his party. The probability of adopting fiscal adjustment does not decrease significantly in the year of general election. This may be because our data are composed of only OECD countries with a higher level of development, democracy and greater transparency.[112] In addition, Table 4.5 shows that federal nations are more likely to undertake fiscal adjustment, at the 10 % significance level when considering only each year of episodes.

In conclusion, when analyzing the factors that lead to a fiscal adjustment, the initial GDP gap, long-term interest rates and the budget balance are found to affect the probability of initiating and continuing a fiscal adjustment significantly. In addition, the results of our analysis show that the episodes identified by our definition are generally exogenous to the previous and current GDP growth.

112. We refer to Shi and Svensson (2006) and Klomp and Haan (2013) as regards the literature and discussion of 'political budget cycle'.

Table 4.5 The probability of fiscal adjustment

Variable (dummy)	Each year of episodes			First year of episodes		
Marginal effects	(1)	(2)	(3)	(4)	(5)	(6)
GDP growth (T)	-0.003 (0.012)	-0.011 (0.010)	-	-0.003 (0.004)	-0.007* (0.004)	-
GDP growth (T-1)	-0.017 (0.015)	-	-0.018 (0.012)	-0.007 (0.005)	-	-0.009** (0.004)
GDP gap (T-1)	-0.038** (0.015)	-0.043*** (0.012)	-0.039*** (0.013)	0.014** (0.005)	0.008* (0.005)	0.016*** (0.005)
Inflation (T-1)	0.002* (0.001)	0.002* (0.001)	0.002* (0.001)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)
Long-term interest rate (T-1)	0.048*** (0.010)	0.048*** (0.010)	0.048*** (0.010)	0.004* (0.002)	0.006* (0.003)	0.005* (0.002)
Primary balance (T-1)	-0.022*** (0.008)	-0.023*** (0.008)	-0.022*** (0.008)	-0.019*** (0.003)	-0.019*** (0.003)	-0.019*** (0.003)
Gross Debt (T-1)	0.002* (0.001)	0.002* (0.001)	0.002* (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Election (T)	-0.038 (0.043)	-0.038 (0.042)	-0.040 (0.043)	-0.012 (0.017)	-0.007 (0.018)	-0.013 (0.017)
System (Federal)	0.108* (0.067)	0.109* (0.067)	0.108* (0.067)	0.024 (0.019)	0.027 (0.020)	0.024 (0.019)
System (Presidential)	-0.026 (0.075)	-0.030 (0.075)	-0.026 (0.075)	0.023 (0.024)	0.024 (0.025)	0.022 (0.024)
Observations	584	597	584	584	597	584
No. country		20			20	
Period		1970~2009			1970~2009	

Note: Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.10

5. Specification and baseline results

In this section, we estimate the effects of fiscal adjustment on the economic activity in the short term, especially focusing on testing the existence of general expansionary fiscal adjustment and its transmission.

5.1. Specification

The following fixed-effects panel model is estimated:

$$\Delta Y_{i,t} = \alpha_0 + \alpha_1 \Delta Y_{i,t-1} + \beta_0 \Delta FA_{i,t} + \beta_1 \Delta FA_{i,t-1} + \mu_i + \lambda_t + \nu_{i,t} \qquad (3)$$

where $Y_{i,t}$ represents the logarithm of real economic activity (GDP, private consumption, private investment, wage, interest, etc.) for country i (i = 1, 2, 3, …..N) in year t (t = 1, 2, …..T). Economic variables are in logs except for unemployment and interest rates. ΔFA denotes the changes in the CAPB in percent of GDP in periods of fiscal adjustment and zero otherwise. The term μ_i indicates country-fixed effects, λ_t denotes year-fixed effects and ν_i is a reduced form innovation. For the lag selection, we started with several lags of the economic activity variables and changes in the CAPB and iteratively reduced the lag length when the longest lag turned out to be insignificant. As a result, we select one lag for ΔY and ΔFA each.[113]

With respect to the estimation, we follow the methodology of Guajardo et al. (2011) and Alesina and Ardagna (2012). First, we estimate equation (3) by ordinary least squares and then compute the estimated cumulative responses of real GDP and its components to a shock of 1% point change in the CAPB-to-GDP ratio for the first three years in order to measure the response on the level of real economic activity variables in the log terms.[114] We calculate the standard errors of the impulse response via the delta method.[115]

5.2. Estimation results

Table 4.6 presents the estimated coefficients of the changes in the CAPB on the economic activity variables in our baseline model. The first column reports that growth responds negatively to contemporaneous changes in the CAPB, but positively to its lagged change. As the negative effect of contemporaneous fiscal adjustment is much larger than the lagged positive effect, the fiscal adjustment is found to have contractionary effect in the short term. It implies that non-Keynesian

113. Guajardo et al. (2011) and Alesina and Ardagna (2012) select 2 lags for similar specifications. For the robustness checks, we also use 2 lags. The coefficients of second lags of growth and fiscal adjustment are small and insignificant so that the results of impulse-responses are not affected.

114. In the fixed-effects dynamic panel model when lagged values of the dependent variable are included as regressors, it is known that ordinary least squares estimates are inconsistent due to the correlation of the lagged dependant variable with the error term. Therefore, in this case, Arellano-Bond estimator (GMM estimator) is usually used. However, according to Roodman (2006), this estimator is designed for situations with "small T, large N" panels, and in case of sufficiently large T panel, the bias is likely to be negligible. In our dataset, T is over 30 years and N is 20 countries; so one does not need to use this estimator.

115. In statistics, the delta method is a method to derive an approximate probability distribution for a function of an asymptotically normal statistical estimator (see Oehlert,1992). We use the 'Nonlinear combination of estimators' using the delta method in the Stata program.

effects, or expansionary fiscal adjustments, are hard to find. The results are very similar to those of Guajardo et al. (2011) with the narrative approach. This finding is supported by the results for the components of GDP. The effects of current and lagged fiscal adjustment on private consumption and investment are very much in line with those on growth (columns 2 and 3). As for the labour market, the coefficient on the real wage is also negative, but insignificantly. On the other hand, the effect on unemployment rate is large and positive at the 1% significance level both for the contemporaneous and lagged coefficients. This shows that fiscal adjustment reduces output and raises unemployment in the short term. The columns (6) and (7) show the impacts of fiscal adjustment on interest rates. Interest rates fall when country's fiscal position improves, which is consistent with the finding of Ardagna (2009).

Table 4.6 The effects of fiscal adjustment on economic activity

Dependent variable	GDP growth (%)	Private consumption (%)	Private investment (%)	Hourly wage (%)	Unemploy-ment rate (%)	Short Interest rate (%)	Long Interest rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged dependent variable (T-1)	0.354***	0.357***	0.378***	0.519***	0.874***	0.719***	0.849***
	(0.040)	(0.040)	(0.040)	(0.036)	(0.017)	(0.029)	(0.020)
ΔFA (T)	-0.289***	-0.305***	-0.814***	-0.059	0.332***	-0.102*	0.004
	(0.066)	(0.075)	(0.197)	(0.081)	(0.031)	(0.056)	(0.029)
ΔFA(T-1)	0.153**	0.154**	0.471**	0.080	0.083***	-0.134**	-0.074***
	(0.065)	(0.073)	(0.193)	(0.080)	(0.032)	(0.053)	(0.028)
Constant	3.602***	0.811	-4.774***	2.088***	1.171***	4.836***	1.962***
	(0.475)	(0.543)	(1.425)	(0.641)	(0.240)	(0.446)	(0.256)
Observations	645	645	645	602	645	612	644
R-squared	0.564	0.420	0.494	0.781	0.904	0.894	0.955
No. country	20	20	20	20	20	20	20

Note: The data on hourly wage is obtained from the OECE. StatExtracts/Labour/Earning dataset-manufacture (index 2005=100). The estimated results are the coefficient estimates. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 4.7 shows the corresponding impulse-responses resulting from the improvement in the CAPB by 1% of GDP for three years following fiscal adjustment, based on the results in Table 4.6. The growth rates are cumulated to obtain the estimated impact of fiscal adjustment on the level of economic activity, following Guajardo et al. (2011) and Alesina and Ardagna (2012). Fiscal adjustment has statistically significant effects on GDP, private consumption and other macroeconomic variables with peak contractionary effect occurring within 1 or 2 years. In particular, a fiscal adjustment equal to 1% of GDP reduces real GDP by about 0.3% in the year of fiscal adjustment. These results are very similar to Guajardo et al. (2011), despite the different definition of fiscal adjustments, different specification and data. Figure 4.3 compares the responses of GDP to fiscal adjustment shock between our baseline and Guajardo et al.'s (2011) baseline. Although the timing of peak contractionary effects is different, both sets of results report negative effects on GDP sustained for three years and diminishing gradually over time.

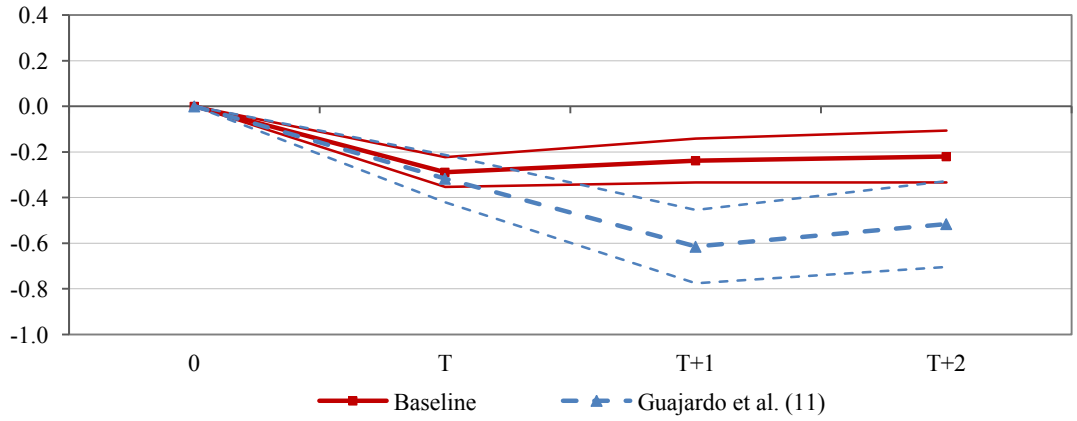
In summary, our results suggest that fiscal consolidation has a significant contractionary effect in the short term. In addition, although Guajardo et al. (2011) raise some issues with respect to using the CAPB, our fiscal adjustment variable, although identified based on the changes in the CAPB under our new criteria, shows results which are very similar to those of Guajardo et al. (2011).

Table 4.7. Macroeconomic responses to fiscal adjustment shock equal to 1% of GDP

Dependent variables	GDP	Private consumption	Private investment	Hourly wage	Unemployment rate (%)	Short Interest rate (%)	Long Interest rate (%)
T	-0.289*** (0.066)	-0.305*** (0.075)	-0.814*** (0.197)	-0.059 (0.081)	0.332*** (0.031)	-0.102* (0.056)	0.004 (0.029)
T+1	-0.238** (0.096)	-0.260** (0.110)	-0.650** (0.293)	-0.010* (0.129)	0.373*** (0.036)	-0.208*** (0.060)	-0.071** (0.033)
T+2	-0.220* (0.114)	-0.244* (0.130)	-0.588* (0.350)	0.016* (0.164)	0.325*** (0.031)	-0.149*** (0.045)	-0.060** (0.029)

Note: The table shows the point estimated responses on the level of GDP and its components in terms of logs and on the interest rate and unemployment in terms of the percentage. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Figure 4.3 Comparison of responses of GDP to a fiscal adjustment shock



Note: Guajardo et al. (2011) select 2 lags order, but our specification uses one lag. T denotes the year of fiscal adjustment. Figure reports point estimates and one standard error bands.

6. Robustness checks

In this section, we present several alternative approaches of our baseline model to test the robustness of the reported results. First, as our measures and criteria for fiscal adjustment in section 4 have an element of arbitrariness, we experiment with different measures. Second, as the discretionary fiscal policy cannot be entirely exogenous to the state of the economy, we try to consider endogeneity in our model. Third, we investigate the role played by composition of fiscal adjustment in terms of tax increases and spending cuts. Fourth, we check the robustness of our finding to the inclusion of other variables in the baseline model to control for monetary or exchange rate policies. Finally, we also investigate the sensitivity of results across country groups.

6.1. Sensitivity analysis with alternative measures and criteria

As section 4 shows, our measures of the changes in the CAPB and the resulting definition of fiscal adjustment are different from other literature using the CAPB-based measures. We develop the measures on the basis of comparison with the narrative approach. However, our cyclical correction and threshold are admittedly arbitrary to some extent. Therefore, additional analysis is necessary to assess whether the changes in our threshold would affect critically the baseline results.

First, we change our thresholds applied to standard deviation variously from

smaller ones to larger ones than 1 used for a single year in our definition. Similarly, we change the thresholds used for multiple years variously. Second, since the average and standard deviation of the changes in the CAPB for each country can be affected by exceptional outliers or time span, we re-apply our rule after dropping the largest positive and negative values of the changes in the CAPB. Third, we replace the share price index with the house price index.[116] Finally, we use the official measures of CAPB from OECD instead of computing them ourselves and we apply our definition to identify fiscal adjustment episodes based on them.[117]

Tables 4.8 and 4.9 show that the baseline results are robust to a series of alternative criteria for the definition of fiscal adjustment and also to alternative CAPB definitions. As Table 4.8 shows, fiscal adjustment has a similarly sized negative on growth when using the alternative criteria, compared with those of the baseline model. As for alternative CAPB specifications, the result obtained when the house price index is used instead of the stock price is not different from the baseline (column 6). The result with the OECD official CAPB measure shows an insignificant negative effect (column 7). This difference is likely to be due to the different assumption and methodology. As Alesina and Perotti (1995), and Alesina and Ardagna (1998) point out, the OECD method depends on measures of potential output which are regarded highly arbitrary and a set of elasticity of taxes and expenditures. In addition, although the OECD also eliminates one-off transactions from the primary fiscal balance, it may still suffer from the potential biases due to problems such as one-off transaction highlighted by Guajardo et al. (2011) because one-off transactions in its methodology are derived simply from the deviation just from trend in net capital transfers, not from individual records. For instance, the Netherlands in 1996 is one of the cases that historical records indicates as having a one-off transaction in the previous year, but is included in the fiscal adjustment episodes according to the OECD CAPB version.[118]

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116. The house price index data (1975~2009) are taken from the International House Price Database of the Federal Reserve Bank of Dallas.

117. We use the CAPB data (Underlying primary fiscal balance) from the OECD Economic Outlook No.88 which are said to eliminate the impact of one-off transactions from the cyclically-adjusted financial balances. These data have been used in much literature such as McDermott and Wescott (1996), Kamps (2006), Guichard et al. (2007).

118. The list of fiscal adjustment episodes identified from the OECD CAPB is presented in Appendix 3. D.

Table 4.9 compares the impulse-responses based on the estimation results. The sharper and stronger the thresholds are, the more negative effect fiscal adjustment has on GDP. When dropping outliers, the negative effects are smaller than even those of threshold 1, but still significant. While the response in case of OECD CAPB is not significant, most estimates indicate a decline of GDP similar to the baseline result for three years.

Table 4.8 The effects of alternative measures on the GDP growth

Alternatives	Criteria for the definition					CAPB version	
	Baseline	Threshold 1	Threshold 2	Threshold 3	Dropping Outliers	House price Index	OECD CAPB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Single year (η)	1	3/4	3/2	2	1	1	1
Multiple years (λ)	1/3, 4/3, 2	1/4, 1, 3/2	1/2, 2, 3	3/4, 2, 3	1/3, 4/3, 2	1/3, 4/3, 2	1/3, 4/3, 2
GDP growth (T-1)	0.354*** (0.040)	0.357*** (0.040)	0.355*** (0.040)	0.352*** (0.040)	0.357*** (0.040)	0.391*** (0.039)	0.418*** (0.043)
ΔFA (T)	-0.289*** (0.066)	-0.274*** (0.065)	-0.320*** (0.070)	-0.302*** (0.068)	-0.264*** (0.065)	-0.214*** (0.057)	-0.071 (0.100)
ΔFA (T-1)	0.153** (0.065)	0.146** (0.064)	0.191*** (0.069)	0.149** (0.067)	0.152** (0.064)	0.078 (0.056)	-0.034 (0.097)
Constant	3.602*** (0.475)	3.665*** (0.479)	3.621*** (0.474)	3.595*** (0.474)	3.618*** (0.478)	2.544*** (0.437)	2.075*** (0.420)
Observations	645	645	645	645	645	620	518
No. FA Year	199	219	157	100	204	240	167
R-squared	0.564	0.563	0.566	0.564	0.562	0.560	0.576
No. Country	20	20	20	20	20	20	19
Period	70-90	70-09	70-09	70-09	70-09	70-09	80-09

Note: The new threshold means the change of multiples (of the standard deviation for identifying fiscal adjustment. η and λ are the multiples for a given year and multi-years respectively. Column 2 has weaker threshold than the baseline. However, Column 3 and 4 have stronger threshold than the baseline. Column (7) uses the underlying government primary balance (a percentage of potential GDP) data for 1980-2009 from OECD Outlook No.88. 19 OECD countries excluding Germany due to the limited period for the CAPB are included. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4.9 Comparison of response of GDP to alternative measures

	Baseline	Criteria for the definition				CAPB version	
		New threshold 1	New threshold 2	New threshold 3	Dropping outliers	House price Index	OECD CAPB
T	-0.289*** (0.066)	-0.274*** (0.065)	-0.320*** (0.070)	-0.302*** (0.068)	-0.264*** (0.065)	-0.214*** (0.057)	-0.071 (0.100)
T+1	-0.238** (0.096)	-0.226** (0.097)	-0.243** (0.099)	-0.259*** (0.098)	-0.206** (0.097)	-0.220** (0.086)	-0.136 (0.158)
T+2	-0.220* (0.114)	-0.209* (0.115)	-0.216* (0.117)	-0.244** (0.115)	-0.185 (0.114)	-0.222** (0.104)	-0.163 (0.192)

Note: The table shows the point estimated responses of GDP to a shock of fiscal adjustment equal to 1% of GDP. T denotes the year of fiscal adjustment. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

6.2. Analysis under the endogeneity of fiscal adjustment

Although various approaches have been followed for identifying the discretionary fiscal adjustment, it is very hard to identify unambiguously exogenous discretionary fiscal policy. While the narrative approach adopted by Romer and Romer (2010) and Guajardo et al. (2011) is regarded as being relatively exogenous, the cyclical correction as per the conventional approach is not fully free from the endogeneity problem. While analyzing the determinants of fiscal adjustment in section 4, we already showed that our fiscal adjustment episodes are not related to current and lagged growth. However, in this subsection, we check the robustness of our results by relaxing the exogeneity assumption. First, we check the assumption of the baseline model that the changes in the CAPB during the periods of fiscal adjustment are exogenous and uncorrelated with those in all other 'normal' periods. Following Alesina and Ardagna (2012), we investigate whether the estimated coefficients of fiscal adjustment change when the changes in the CAPB in normal periods except fiscal adjustment are included as additional terms ($\Delta NFA_{i,t-j}$).

$$\Delta Y_{i,t} = \alpha_0 + \alpha_1 \Delta Y_{i,t-1} + \sum_{j=0}^{1} \beta_j \Delta FA_{i,t-j} + \sum_{j=0}^{1} \gamma_j \Delta NFA_{i,t-j} + \mu_i + \lambda_t + \nu_{i,t}$$

Second, we estimate the effects of fiscal adjustment on growth under the assumption that the decision on fiscal adjustment and its size are endogenous to the state of the economy. In addition, it means that since the cyclical correction cannot remove the automatic changes of fiscal variables in response to output entirely, some of the discretionary fiscal changes are still related to the fluctuation of contemporaneous output. As a result, the current fiscal adjustment variable ($\Delta FA_{i,t-j}$) can be correlated with the contemporaneous error term ($v_{i,t}$) ($E(v_{i,t} | \Delta FA_{i,t-j}) \neq 0$). Therefore, similar to Hernández de Cos and Moral-Benito (2011), who also take the potential endogeneity into consideration, we estimate the effect of fiscal adjustment via two-stage least squares (2SLS).[119] We select the fiscal adjustment based on the narrative approach by Guajardo et al. (2011) as the first instrument because it should be more likely to be exogenous given that the identification is based on historical records. In addition, we use lagged long-term interest rate which shows the significant strong correlation with fiscal adjustment in the logit analysis of section 4 and is predetermined but not strictly exogenous to the contemporaneous error term.

The results are reported in Tables 4.10 and 4.11. First, in the augmented OLS regression including the changes in the CAPB during normal periods, although the magnitude of the coefficient of fiscal adjustment in Table 4.10 and the response of GDP to a fiscal adjustment shock in Table 4.11 are somewhat larger than those of the baseline model, the results change little, showing contractionary effects which are very similar to the baseline. Importantly, the changes in the CAPB that are not associated with fiscal adjustment (NFA) do not have any effect on growth, as expected. This means that the assumption of fiscal adjustment being different from other changes in the CAPB in normal periods is reasonable. Next, when using instrumental variables to control for potential endogeneity of fiscal adjustment, the effect of fiscal adjustment on growth is stronger (more negative) than that of the baseline. This pattern appears regardless of the instruments used. Table 4.12 reports the results of first stage regressions, confirming the validity of the instruments considered. Both instruments have strong relation with fiscal adjustment. However, the test results indicate that the narrative fiscal adjustment of Guajardo et al. (2011)

119. Although some authors such as Biorn and Klette (1999) advocate the use of the GMM estimator to tackle endogeneity, we use 2SLS rather than GMM estimator because our dataset has small number of countries (20) and a large number of time periods (30), as explained earlier.

has more explanatory power than the lagged long-term interest rate. In addition, according to the Durbin-Wu-Hausman test for endogeneity of fiscal adjustment, the null hypothesis that the fiscal adjustment can be treated as exogenous is rejected at the 5% significance level. Therefore, we can conclude that fiscal adjustment identified by the changes in the CAPB is not strictly exogenous to growth. Nevertheless, the results corrected for endogeneity of fiscal adjustment support our baseline results of contractionary effects.

Table 4.10 The effects of fiscal adjustment on GDP growth

Estimated Method	OLS	Augmented OLS	2SLS	
Added Variable / IV	Baseline	$CAPB^{NFA}$	Narrative FA	One lagged long-term interest rate
GDP growth (T-1)	0.354*** (0.040)	0.356*** (0.040)	0.402*** (0.049)	0.244*** (0.071)
ΔFA (T)	-0.289*** (0.066)	-0.297*** (0.066)	-0.581*** (0.186)	-1.259** (0.512)
ΔFA (T-1)	0.153** (0.065)	0.147** (0.065)	0.182** (0.076)	0.345*** (0.122)
ΔNFA (T)	-	0.025 (0.052)	-	-
ΔNFA (T-1)	-	0.087 (0.053)	-	-
Constant	3.602*** (0.475)	3.680*** (0.478)	-4.085*** (0.349)	-3.524*** (0.428)
Observations	645	645	502	644
R-squared	0.564	0.566	0.628	0.399
No. Country	20	20	17	20

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 4.11 The response of GDP to a fiscal adjustment shock of 1 % of GDP

Estimated Method	OLS	Augmented OLS	2SLS	
Added Variable / IV	Baseline	$CAPB^{NFA}$	Narrative FA	One lagged long-term interest rate
T	-0.289*** (0.066)	-0.297*** (0.066)	-0.581*** (0.186)	-1.259** (0.512)
T+1	-0.238** (0.096)	-0.256*** (0.097)	-0.632*** (0.221)	-1.221** (0.476)
T+2	-0.220* (0.114)	-0.241** (0.115)	-0.652*** (0.239)	-1.212** (0.471)

Note: The table shows the point estimated responses of GDP to a shock of fiscal adjustment equal to 1% of GDP. T denotes the year of fiscal adjustment. The Standard errors in parentheses are computed via the delta method, *** p<0.01, ** p<0.05, * p<0.1.

Table 4.12 The first-stage regression of fiscal adjustment in 2SLS

Dependent Variable	$CAPB^{FA}$	
Instrument Variable	Narrative FA	One lagged long-term interest rate
GDP growth (T-1)	-0.082***	-0.103***
	(0.027)	(0.025)
ΔFA (T-1)	0.143***	0.173***
	(0.042)	(0.040)
Instrument Variable	0.560***	0.098***
	(0.065)	(0.027)
Constant	0.004	-0.270
	(0.210)	(0.252)
Observations	502	644
R-squared	0.388	0.251
No. Country	17	20
Summary results for the instrument variable test from the first-stage regressions		
① F test of excluded instruments (F value)[1)]	73.87***	12.62***
② Underidentification test (LM value)[2)]	68.26***	13.20***
③ Weak identification test (F value)[3)]	73.87***	13.11
④ Endogeneity test of endogenous variable (P value)[4)]	0.013	0.023

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
1) Angrist-Pischke Multivariate F test,
2) Anderson canon. Correlation (Ho: equation is underidentified),
3) Cragg-Donald Wald test with Stock-Yogo critical values (Ho: equation is weakly identified),
4) Durbin-Wu-Hausman Test (Ho: OLS estimator of the same equation would yield consistent estimates).

6.3. Does composition of fiscal adjustment matter?

Many studies analyze the effects of fiscal adjustment according to its composition. They generally agree that fiscal adjustment based on the spending side rather than on the tax side is more likely to have expansionary effects on GDP. Therefore, in this subsection, we investigate what role the composition of fiscal adjustment plays in the response of economic growth. First, the fiscal adjustments instances are divided into two types: 'spending-based' ones in which the change in the CAPB is mainly (by at least 50%) due to spending cuts and 'tax-based' ones in which the change in the CAPB is mainly (by at least 50%) due to revenue increase (Guajardo et al., 2011, and McDermott and Westcott, 1996, apply the same criterion). In addition, we split the fiscal adjustments into three types: the 'pure spending-based' ones where the improvement in the CAPB is entirely due to spending cuts, 'pure tax-based' ones which are totally due to revenue increases, and 'mix' cases that combine the two types of adjustment.

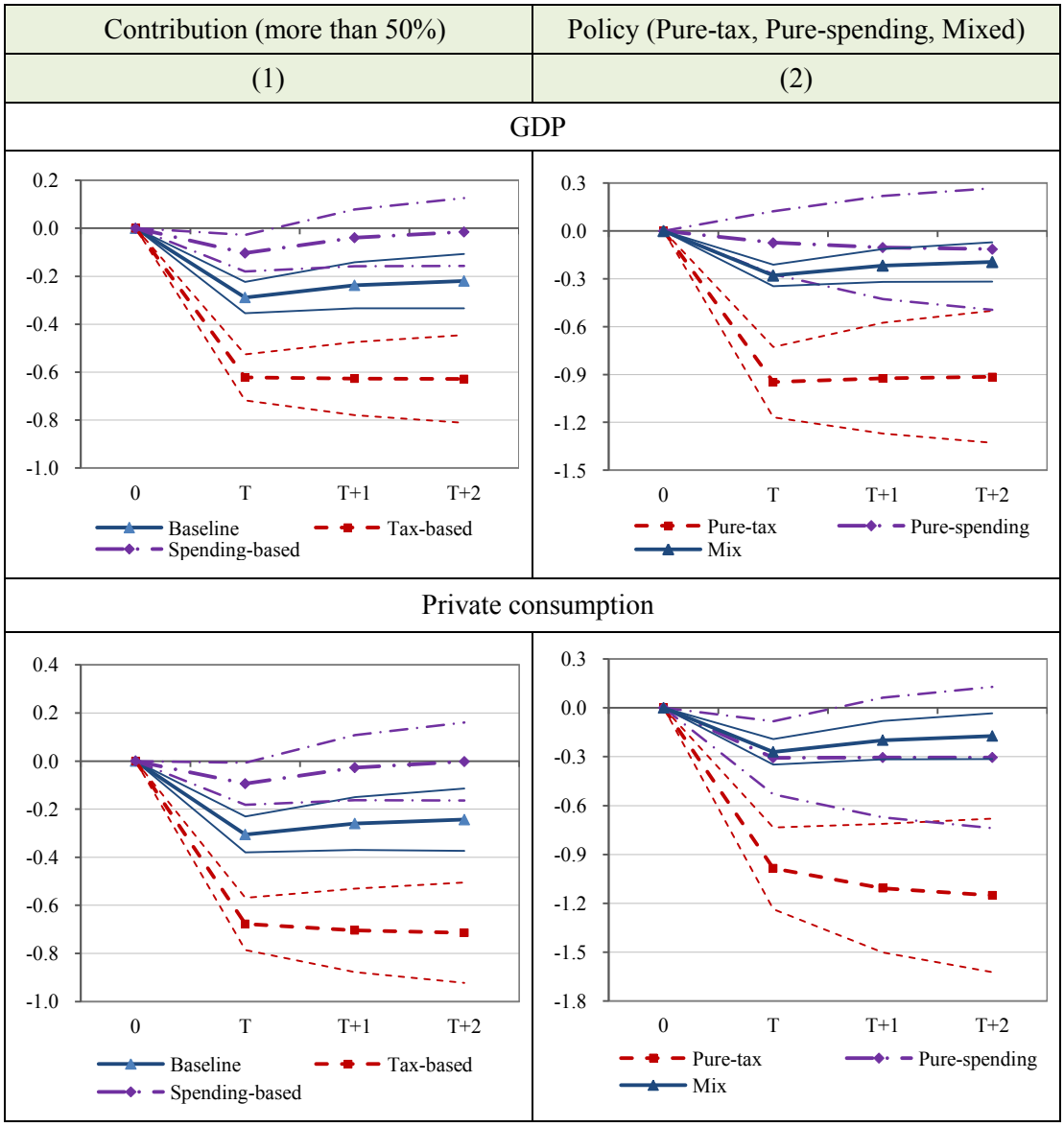
Figure 4.4 shows the estimated effects of fiscal adjustment according to its composition. First, although spending-based adjustments do not have significant expansionary effect, they also do not have significantly negative effect on GDP and private consumption except in the year of fiscal adjustment. When compared with tax-based adjustments, spending-based adjustments are less contractionary and can even offset the large negative effects of tax-based adjustment because the response of the baseline is in between the responses associated with the two types of fiscal adjustment. On this point, this result is consistent with Alesina and Ardagna (2012). On the other hand, a tax-based fiscal adjustment has a contractionary and statistically significant effect on GDP with a peak negative effect of -0.68% and on private consumption with a peak negative effect of -0.71% within three years. When the composition of fiscal adjustment is classified into three types, as shown in column (2) of Figure 4.4, the results do not differ much. While the results for mixed adjustments are almost the same as the baseline, pure tax-based fiscal adjustments decrease GDP significantly and pure spending-based fiscal adjustments appear also contractionary, but not statistically significant even at the year of fiscal adjustment.

An alternative way of investigating the role of compositions is to identify fiscal adjustments based on large changes of fiscal variables rather than by looking at changes of fiscal balance: as an increase in cyclically-adjusted revenues or a decrease in cyclically-adjusted spending. Although this method is different from the conventional method based on fiscal balance, it has a few advantages. First, we can capture some episodes of fiscal adjustment which might be otherwise excluded. This is the case when the fiscal adjustment on spending (revenue) side is offset by counter-balancing change of revenue (spending). Second, we can reduce the risk that the results are driven by a particular threshold (e.g. 50%) chosen to discern tax-based and spending-based adjustments. Therefore, with the same criteria applied to CAPB as for the definition of fiscal adjustment in Section 4, we re-identify fiscal adjustments based on large changes of cyclically-adjusted revenues and spending respectively.[120] The former is denoted as ‘tax side’ and the latter denoted as

120. The definition for a fiscal adjustment on tax (spending) side follows 4 criteria in Section 4, but uses changes of cyclically-adjusted revenues (spending) instead of changes of CAPB. For example, as the criterion for a fiscal adjustment of a given year, tax (spending)-side adjustment is defined when the cyclically-adjusted revenue increases (decreases) by at least the average + standard deviation of the changes of cyclically-adjusted revenue (spending) for each country in 1 year.

'spending side'. Then, we replace ΔFA in the baseline specification with these two types of fiscal adjustments to estimate their effects on GDP and private consumption.

Figure 4.4 The effects of the composition of fiscal adjustment

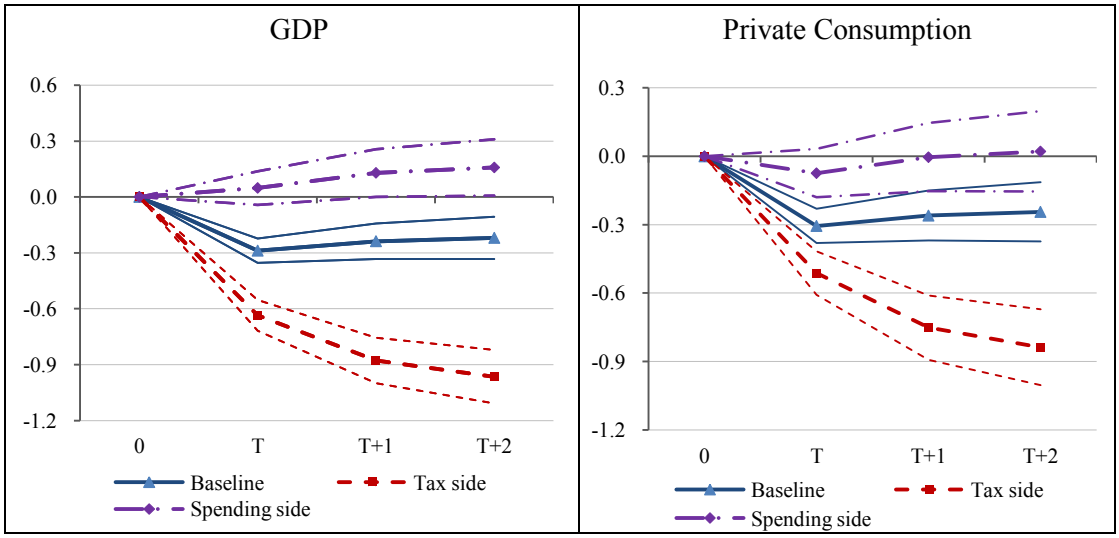


Note: T denotes the year of fiscal adjustment. Figure reports point estimates and one standard error bands. Tax-based means that the improvement in the CAPB for fiscal adjustment is by more than 50% due to the tax hikes. On the other hand, pure-tax indicates the improvement in the CAPB is totally due to the tax hikes.

Figure 4.5 shows the estimated effects of fiscal adjustment according to its composition. While fiscal adjustment based on an increase in revenues has a largely contractionary and statistically significant effect on GDP and private consumption, fiscal adjustment based on a decrease in spending has a small expansionary but not statistically significant effect on GDP and negligible effects on private consumption. Therefore, we still cannot find any firm evidence of expansionary effects even in the

case of fiscal adjustment based on large spending-cuts. However, this shows that spending-based adjustments are less contractionary than tax-based ones, which is consistent with the previous results of compositions of fiscal adjustment based on the CAPB.

Figure 4.5 The effects of composition of fiscal adjustment:
Based on the changes in cyclically-adjusted revenues and spending

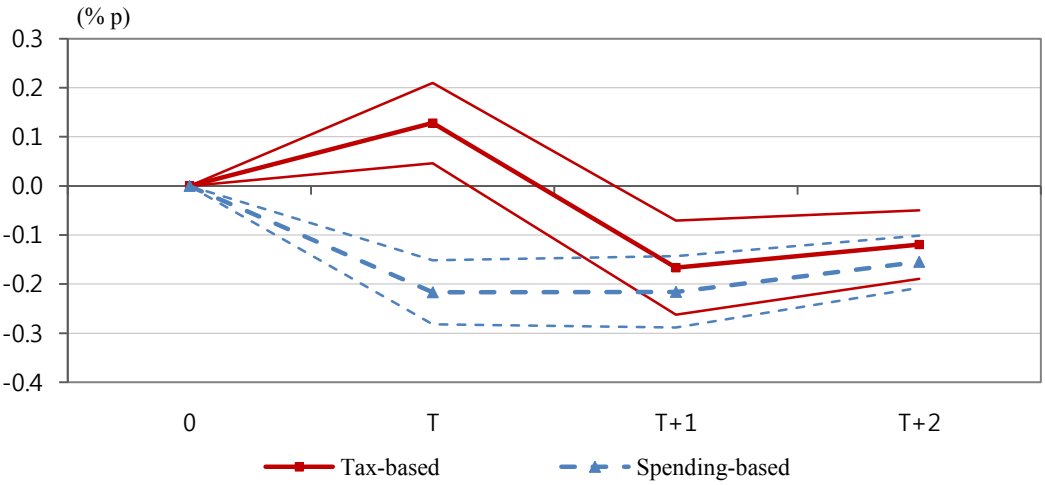


Note: T denotes the year of fiscal adjustment. Figure reports point estimates and one standard error bands. 'Tax side' means the fiscal adjustment based on large increases in cyclically-adjusted revenues and 'spending side' indicates the fiscal adjustment based on large decreases of cyclically-adjusted spending.

Guajardo et al. (2011) argue that a possible reason for the different effects depending on the compositions of fiscal adjustment is that monetary policy is more favourable with spending cuts. They suggest that central banks conduct monetary stimulus more actively following spending cuts than tax hikes so that the policy rate increases in response to tax hikes and decreases in response to spending cuts.[121] Therefore, we investigate the response of short-term interest rate to the two types of fiscal adjustment. As Figure 4.6 shows, the response of the short-term interest rate is significantly different according to the two types of fiscal adjustment only in the year of fiscal adjustment. After the second year, the short term interest rate falls significantly in both cases. Therefore, this result can partially support the argument of Guajardo et al. (2011) that the different effects depending on the composition of fiscal adjustment are ascribed to different monetary policy stances.

121. Guajardo et al. (2011) contend that central banks prefer spending-based, rather than tax-based, fiscal adjustment because they interpret the former as a signal for a stronger commitment to fiscal discipline, but they are averse to an increase in taxes such as the indirect tax because of the possibility of subsequent high inflation, inducing the Central Bank to raise interest rates.

Figure 4.6 Response of short-term interest rate to two compositions of fiscal adjustment



Note: T denotes the year of fiscal adjustment. Figure reports point estimates and one standard error bands

6.4. The role of economic environment

Much of the literature studying the factors determining the effect of fiscal adjustments investigates what role the macroeconomic environments play. Therefore, we check the robustness of our finding by including the short-term interest rate and the real effective exchange rate among the regressors of the baseline model.[122] These two additional control variables are aimed at accounting for monetary policy and exchange rate policy respectively.

Table 4.13 and Figure 4.7 show the results. The fit of the regression improves when we include variables relating to the economic policy. The coefficients of fiscal adjustment, as well as that for tax-based adjustment, remain significantly negative, although they are smaller than those without controlling for policy variables. Similarly, spending-based fiscal adjustment has a smaller negative coefficient, but is still statistically insignificant. The change of effects can be attributed to monetary policy in that the short-term interest rate has the significantly negative effect on growth, as expected, but the exchange rate is not significant. Figure 4.7 confirms that fiscal adjustments have less contractionary effects on GDP when we control for monetary policy than in the baseline. Therefore, monetary policy can affect the response of GDP to fiscal adjustment shocks. If the short-term interest rate falls, it

122. Nominal short term interest rate is obtained from OECD Economic Outlook No.88. Real effective exchange rate is drawn from international finance statistics of the Bank for International Settlement. When using real interest rate calculated by GDP deflator, the result is not affected.

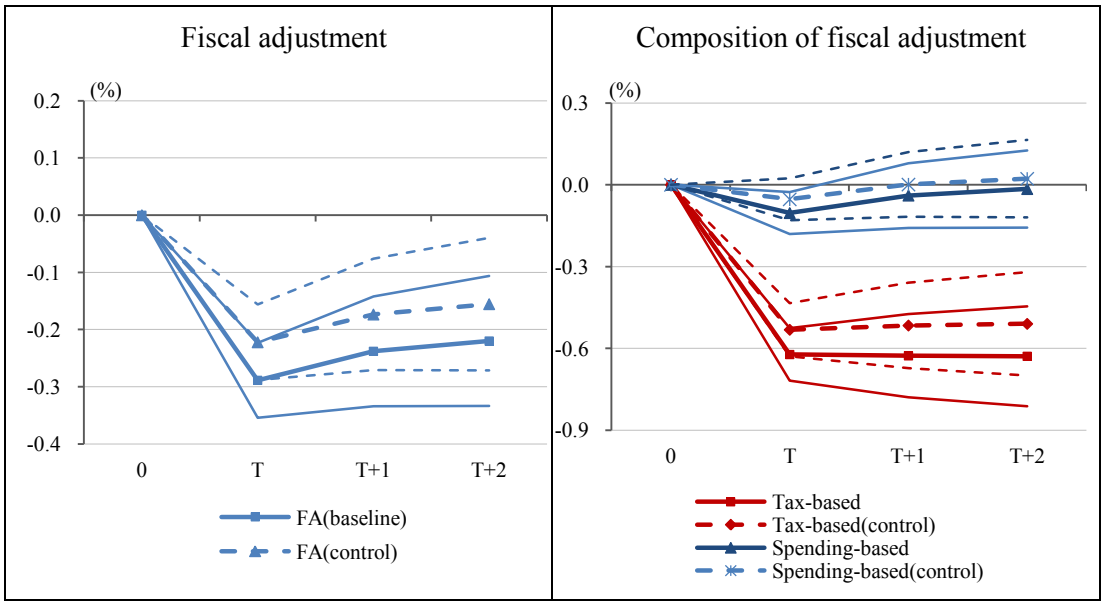
leads to an increase in GDP. Therefore, if fiscal adjustment coincides with a large reduction in the short-term interest rate, this may stimulate the economy in the following periods. However, even in this case, this result is to be attributed not to the fiscal adjustment, but to the lax monetary policy. In regard to the effects of composition of fiscal adjustment, Figure 4.7 shows that the response of GDP is somewhat larger in tax-based fiscal adjustments than in spending-based ones. Therefore, as Figure 4.6 in the previous subsection shows, if the discretionary monetary policy responds differently according to the type of fiscal adjustment, this could help account for the different effects depending on the composition of fiscal adjustment. However, it cannot be a decisive factor, contrary to the argument of Guajardo et al. (2011), in that when in control for the short-term interest rate, there is still a large difference between the effects of tax-based and spending-based fiscal adjustment on GDP.

Table 4.13 The effects of fiscal adjustment on GDP growth

Variables	GDP growth	GDP growth	GDP growth	GDP growth
GDP growth (T-1)	0.354***	0.374***	0.373***	0.389***
	(0.040)	(0.040)	(0.042)	(0.041)
FA (T)	-0.289***		-0.222***	
	(0.066)		(0.066)	
FA (T-1)	0.153**		0.131**	
	(0.065)		(0.063)	
Tax-based (T)		-0.622***		-0.532***
		(0.096)		(0.098)
Tax-based (T-1)		0.228**		0.222**
		(0.100)		(0.099)
Spending-based (T)		-0.104		-0.053
		(0.077)		(0.077)
Spending-based (T-1)		0.103		0.075
		(0.073)		(0.070)
Short- term interest rate			-0.124***	-0.102***
			(0.035)	(0.035)
Real effective exchange rate			0.019	0.018
			(0.012)	(0.012)
Constant	3.602***	3.786***	4.521***	4.320***
	(0.475)	(0.469)	(0.545)	(0.539)
Observations	645	645	615	615
R-squared	0.564	0.580	0.600	0.613
No. country	20	20	20	20

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Figure 4.7 The effects of fiscal adjustment on GDP



Note: T denotes the year of fiscal adjustment. Figure reports point estimates and one standard error bands.

Furthermore, there can be other omitted factors that are likely to influence the effects of fiscal adjustment on economic activity. The omission of some variables can bias the response of output in estimating the effects of fiscal adjustments. Therefore, we add some possible variables into the baseline model one by one to control the effects of the potential factors. First, the initial government debt is considered because a high debt level is argued to make the expansionary fiscal adjustment via the wealth effects in theoretical approach, although it leads to raised borrowing costs. International factors such as exchange rate regime and financial openness can be taken into account as another potential factor. As Ilzetzki et al (2010) find that the degrees of exchange rate flexibility and openness are critical determinants of the size of fiscal multiplier; exchange rate regime and the extent of openness in capital account transactions can have an impact on economic activity via net exports and international borrowing. Therefore, we include the exchange rate regime and financial openness index as control variables.[123] Table 4.14 and 4.15 show the results for estimating the effects of fiscal adjustment to control for the impact of these potential factors. The results are similar to the baseline.

123. For exchange rate regime, we use the IMF official classification from Ilzetzki et al. (2009) to determine the exchange rate regime of each country in every year and construct a binary variable that takes the value of 1 for the fixed regime and 0 for the flexible regime, following Ilzetzki et al. (2011). For financial openness index, we use the KAOPEN index based on restrictions on cross-border financial transactions from Chinn and Ito (2008).

Table 4.14 The effects of fiscal adjustment on GDP growth in control of other factors

Additional control variable	Baseline	Gross Debt	Exchange rate regime	Financial openness
GDP growth (T-1)	0.354*** (0.040)	0.387*** (0.042)	0.348*** (0.040)	0.355*** (0.040)
ΔFA (T)	-0.289*** (0.066)	-0.280*** (0.066)	-0.302*** (0.066)	-0.290*** (0.066)
ΔFA (T-1)	0.153** (0.065)	0.146** (0.065)	0.142** (0.065)	0.150** (0.065)
Gross Debt (T-1)		-0.001 (0.004)		
Exchange rate regime (Fixed)			-0.436** (0.218)	
Financial openness				0.148 (0.100)
Constant	3.602*** (0.475)	-0.117 (0.550)	3.890*** (0.495)	0.526 (0.529)
Observations	645	609	645	639
R-squared	0.564	0.593	0.567	0.567
No. Country	20	20	20	20

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 4.15 The response of GDP to a fiscal adjustment shock of 1 % of GDP

Additional control variable	Baseline	Gross Debt	Exchange rate regime	Financial openness
T	-0.289*** (0.066)	-0.280*** (0.066)	-0.302*** (0.066)	-0.290*** (0.066)
T+1	-0.238** (0.096)	-0.241** (0.100)	-0.264*** (0.097)	-0.243** (0.097)
T+2	-0.220* (0.114)	-0.226* (0.120)	-0.251** (0.114)	-0.226** (0.114)

Note: The table shows the point estimate responses of GDP to a shock of fiscal adjustment equal to 1% of GDP. T denotes the year of fiscal adjustment. The standard errors in parentheses are computed via the delta method, *** p<0.01, ** p<0.05, * p<0.1.

Aside from the variables considered, regulatory reform such as labour and product market institutions, and structural reforms should be considered as significant and relevant factors influencing the estimated effects of fiscal adjustment on economic activity. Several studies investigate interactions between fiscal adjustment and these market institutions and structural reforms and show that these regulatory policies can play a significant role in initiating fiscal adjustment and determining its success (Tagkalakis, 2009; Guichard et al. 2007, and Hauptmeier et

al. 2006).[124] However, when these are controlled for, the qualitative effects on economic activity of fiscal adjustment does not change (Hernández de Cos and Moral-Benito, 2011; Alesina and Ardagna, 2012). Although we do not address the effects of labour and product market institutions and structural reforms during the fiscal adjustment episode in this chapter, they can affect the responses of output to fiscal adjustment in the long term as well as quantitatively via employment and investment behaviour.

6.5. Effects of fiscal adjustment across country groups

The effects of fiscal adjustment on the economic activity may be different according to the sensitivity of private agents formed based on the past trajectory of fiscal policy and the confidence in government policy. In this subsection, we explore this issue by dividing the 20 countries into two groups on the basis of two criteria: the frequency of fiscal adjustments and the volatility of discretionary fiscal policy. For the first criterion, high and low frequency groups include 10 countries respectively according to the frequency ratio.[125] Similarly, for the second standard, high and low fluctuation groups consist of each 10 countries according to the standard deviation of changes in the CAPB.[126]

Table 4.16 reports the estimated responses of GDP and private consumption to a fiscal adjustment shock. Interestingly, for the high group in terms of both frequency and fluctuation, economic activity displays a significantly negative response only in the year of fiscal adjustment. On the other hand, the low groups in frequency and fluctuation alike show the opposite results. This finding supports the notion that economic agents respond more sensitively to unexpected or unusual shocks. When fiscal policy undergoes frequent changes, the agents become accustomed to such changes and their responses get negligible.

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124. Tagkalakis (2009) shows that a reduction in the unemployment benefit replacement rate, weak bargaining coordination and centralization of union increase the likelihood of initiating and of successfully concluding a fiscal adjustment, but more flexible employment protection legislation and product market regulation work in the opposite direction.

125. The frequency ratio indicates the ratio of the number of fiscal adjustment year to the sample period for each country. This ratio and list of groups are presented in Appendix 3. D.

126. The standard deviation of changes in the CAPB per country and the list of groups are presented in Appendix 3. E.

Table 4.16 The effects of fiscal adjustment across country groups

Variable	GDP					Private consumption				
Group	Baseline	Frequency		Fluctuation		Baseline	Frequency		Fluctuation	
		High	Low	High	Low		High	Low	High	Low
T	-0.289*** (0.066)	-0.151* (0.081)	-0.413*** (0.115)	-0.166** (0.081)	-0.571*** (0.125)	-0.305*** (0.075)	-0.137* (0.085)	-0.493*** (0.139)	-0.097 (0.085)	-0.737*** (0.155)
T+1	-0.238** (0.096)	-0.071 (0.122)	-0.414** (0.165)	-0.130 (0.128)	-0.450** (0.170)	-0.260** (0.110)	-0.085 (0.134)	-0.522*** (0.190)	-0.006 (0.137)	-0.682*** (0.212)
T+2	-0.220* (0.114)	-0.046 (0.143)	-0.414** (0.195)	-0.112 (0.161)	-0.427** (0.187)	-0.244* (0.130)	-0.064 (0.163)	-0.531** (0.216)	0.042 (0.176)	-0.670*** (0.233)
Observations	645	336	309	330	315	645	336	309	330	315
R-squared	0.564	0.605	0.586	0.627	0.576	0.420	0.478	0.443	0.559	0.374
No. Country	20	10	10	10	10	20	10	10	10	10

Note: T denotes the year of fiscal adjustment. Standard errors in parentheses are computed via the delta method, *** p<0.01, ** p<0.05, * p<0.1.

7. Conclusions

This chapter investigates the short-term macroeconomic effects of fiscal adjustment in 20 OECD countries over the period 1970-2009. This issue has been studied in many previous contributions already. Recently, it has become more central in academic and policy circles again due to the rising fiscal deficits and public debts during the current global crisis. Much of the literature argues that fiscal adjustment can promote economic output even in the short term. However, after identifying fiscal adjustment episodes from historical documents, Guajardo et al. (2011) conclude that fiscal adjustment is always contractionary. They also criticize the CAPB-based measures used in the rest of literature as being imprecise and biased towards overstating the potential expansionary effects of fiscal adjustments. This chapter reconsiders the CAPB-based measure in order to identify the fiscal adjustment episodes more accurately, taking into account the problems identified by Guajardo et al. (2011).

The main features of our new measure of fiscal adjustment are as follows. First,

we consider the fluctuation in asset prices related to the changes in revenues when making a cyclical correction of the fiscal balance. Second, our criteria for selecting fiscal adjustment episodes allow for the heterogeneity of individual countries in fiscal policy, contrary to the uniform approach in the previous literature. Third, our criteria eliminate temporary one-off transactions which can undermine the accuracy of the CAPB. Finally, we consider the fiscal adjustment episodes which can be excluded due to changes in the CAPB by temporary adverse shocks during a period of multiple years of fiscal adjustments. Although Guajardo et al. (2011) argue that the CAPB is an unreliable guide regarding fiscal adjustment, our new criteria can identify fiscal adjustment episodes that largely overlap with their narrative- based ones.

Based on the fiscal adjustments identified, we estimate the effects of fiscal adjustment on economic activity, and seek to find evidence of expansionary fiscal adjustment. Our key result is that a fiscal adjustment has contractionary effects on economic activity in the short term. This provides little support for the expansionary fiscal adjustment hypothesis. Therefore, so-called 'Non-Keynesian effects' are very limited and probably occur only under specific conditions, not generally. This is consistent with the results of Guajardo et al. (2011). As for the role of the composition of fiscal adjustment, spending-based fiscal adjustments lead to smaller reductions of output than tax-based fiscal adjustments. This finding is in line with most of the literature regardless of the approach used.

Further work could explore in more depth the effects of fiscal adjustments. First, as for the reasons behind the different effects of tax-based and spending-based adjustments, more detailed disaggregation of fiscal spending and taxes could be used for the analysis. Second, most of the literature on fiscal policy has studied developed countries such as the OECD because of data limitations. However, since the data for developing countries have become more available lately, the fiscal adjustment in developing countries also needs to be investigated for the comparison with our results. Another possible extension is about anticipation effects by private agents through comparing the narrative data mainly based on announced plans with the CAPB-based data based on actual outcomes. However, to capture the accurate timing of fiscal adjustment for the anticipation effects, quarterly rather than annual data may be required.

Appendix 3

A. Episodes of fiscal adjustment in literature

Country	AA10 (70~07)	AA12 (70~10)	IMF 11 (78~09)
Australia	87, 88		85, 86, 87, 88, 94, 95, 96, 97, 98, 99
Austria	84, 96, 97, 05	96, 97	80, 81, 84, 96, 97, 01, 02
Belgium	82, 84, 87, 06	73, 74, 84, 85, 86, 87, 88, 89, 90, 93, 94, 95, 96, 97, 98, 99, 00, 01	82, 83, 84, 85, 87, 90, 92, 93, 94, 96, 97
Canada	81, 86, 87, 95, 96, 97	86, 87, 88, 89, 93, 94, 95, 96, 97, 98, 99	84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
Denmark	83, 84, 85, 86, 05	83, 84, 85, 86, 04, 05	83, 84, 85, 86, 95
Finland	73, 76, 81, 84, 88, 94, 96, 98, 00	88, 89, 93, 94, 96, 97, 98	92, 93, 94, 95, 96, 97
France	79, 96	94, 95, 96, 97, 98, 99, 00, 01	79, 87, 89 91, 92, 95, 96, 97, 99, 00
Germany	96, 00	96, 97, 98, 99, 00, 03, 04, 05, 06, 07	82, 83, 84, 91, 92, 93, 94, 95, 97, 98, 99,00, 03, 04, 06, 07
Greece	76, 86, 91, 94, 96, 05, 06		
Ireland	76, 84, 87, 88, 89, 00	83, 84, 86, 87, 88, 89, 96, 97, 98	82, 83, 84, 85, 86, 87, 88, 09
Italy	76, 80, 82, 90, 91, 92, 97, 07	76, 77, 82, 83, 88, 89, 90, 91, 92, 93, 95, 96, 97	91, 92, 93, 94, 95, 96, 97, 98, 04, 05, 06, 07
Japan	84, 99, 01, 06	79, 80, 81, 82, 83, 84, 85, 86, 87	79, 80, 81, 82, 83, 97, 98, 03, 04, 05, 06, 07
Netherlands	72, 73, 83, 88, 91, 93, 96	71, 72, 73, 82, 83, 85, 86, 87, 88, 96, 97, 98, 99, 00, 04, 05	81, 82, 83, 84, 85, 86, 87, 88, 91, 92, 93,04, 05
New Zealand	87, 89, 93, 94, 00	91, 92, 94	
Norway	79, 80, 83, 89, 96, 00, 04, 05	78, 79, 80, 82, 83, 88, 90, 99, 00, 04, 05	
Portugal	82, 83, 86, 88, 92, 95, 02, 06	94, 95, 02, 03, 06, 07	83, 00, 02, 03, 05, 06, 07
Spain	86, 87, 94, 96	83, 84, 86, 87, 94, 95, 96, 97	83, 84, 89, 90, 92, 93, 94, 95, 96, 97
Sweden	81, 83, 84, 86, 87, 94, 96, 97, 04	75, 76, 83, 84, 86, 87, 93, 94, 95, 96, 97, 98, 04, 05	84, 93, 94, 95, 96, 97, 98
Switzerland		03, 04, 05, 06, 07, 08	
United Kingdom	77, 82, 88, 96, 97, 98, 00	84, 85, 86, 87, 88, 94, 95, 96, 97, 98, 99, 00	79, 80, 81, 82, 94, 95, 96, 97, 98, 99
United States			78, 80, 81, 85, 86, 88, 90, 91, 92, 93, 94, 95, 96, 97, 98

B. Data description

Variable	Original Series Name	Source	Definition or additional notes
Government Spending	Total disbursements of general government (%, of GDP)	OECD	
Government Revenues	Total receipts of general government (%, of GDP)	OECD	
Net interest Payment	Net government interest payments (%, of GDP)	OECD	Interest paid for government debt - interest received for government assets
Government Debt	General government gross financial liabilities (%, of GDP)	OECD	
GDP	Gross domestic product	OECD	Chained volume series expressed in a reference year
Private Consumption	Private final consumption expenditure	OECD	Chained volume series expressed in a reference year
Private Investment	Gross fixed capital formation	OECD	Chained volume series expressed in a reference year
GDP Gap	Output gap of the total economy	OECD	Percentage difference between the Levels of actual GDP and estimated potential GDP
OECD CAPB	Underlying government primary balance, (%, of potential GDP)	OECD	Eliminates one-off transaction and net interest payment from cyclically-adjusted fiscal balances
Inflation rate	Gross domestic product deflator	OECD	Growth rate from the index
Unemployment	Unemployment rate	OECD	
Hourly wage	Hourly earnings (manufacturing, index 2005=100, SA)	OECD	Monthly Economic Indicators
Long term Interest rate	Long-term interest rate on government bonds (%)	OECD	10-year benchmark government bonds
Short term Interest rate	Short-term interest rate (%)	OECD	3-month money market rates
Real effective Exchange rate	BIS effective exchange rate (CPI-based, Narrow indices, 2010=100)	BIS	Differenced in the logarithm
Share price Index	Share prices (Index 2005=100)	OECD	Annual average from monthly data
House price Index	International House Price Database (Real term, 2005=100)	FRB of Dallas	Annual average from quarterly data
Election	Date of election of national parliament (Lower house)	IPS	Dummy variable equal to one if there is an election in a year, zero otherwise
Federalism	Federalism Coded 0 = no, 1 = weak, 2 = strong	IPS	Dummy variable equal to one if Federalism code 1 or 2, zero otherwise
President system	Presidential system. Coded 0 = parliamentary, 1 = president or collegial executive	IPS	Dummy variable equal to one if Presidential system code 1, zero otherwise

NOTE: **OECD**: Economic Outlook No.88 or OECD StatExtracts.com, **BIS**: Statistics of Bank for International Settlements, **FRB of Dallas**: Data of Globalization & Monetary Policy Institute in Federal Reserve Bank of Dallas, **IPS**: Comparative Political Data Set I (23 OECD Countries) of Institute of Political Science in University of Bern.

C. The probability of fiscal adjustment using the square of output gap

Variable (dummy)	Each year of episodes			The first year of episodes		
Marginal effects	(1)	(2)	(3)	(4)	(5)	(6)
GDP growth (T)	-0.000 (0.012)	-0.010 (0.009)	-	-0.003 (0.004)	-0.007** (0.004)	-
GDP growth (T-1)	-0.019 (0.014)	-	-0.019 (0.012)	-0.007 (0.005)	-	-0.009** (0.004)
GDP gap (T-1)	-0.049*** (0.015)	-0.059*** (0.013)	-0.049*** (0.014)	0.010* (0.006)	0.004 (0.005)	0.012** (0.005)
Square of GDP gap (T-1)	-0.006* (0.003)	-0.006* (0.003)	-0.006* (0.003)	-0.003* (0.001)	-0.003* (0.001)	-0.003* (0.001)
Inflation (T-1)	0.003** (0.001)	0.003** (0.001)	0.003** (0.001)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)
Long-term interest rate (T-1)	0.049*** (0.010)	0.050*** (0.010)	0.049*** (0.010)	0.005* (0.003)	0.006** (0.003)	0.005* (0.003)
Primary balance (T-1)	-0.023*** (0.008)	-0.024*** (0.008)	-0.023*** (0.008)	-0.018*** (0.003)	-0.019*** (0.003)	-0.019*** (0.003)
Gross Debt (T-1)	0.001 (0.001)	0.002* (0.001)	0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Election (T)	-0.037 (0.042)	-0.036 (0.042)	-0.037 (0.042)	-0.011 (0.016)	-0.005 (0.017)	-0.012 (0.016)
System (Federalism)	0.092 (0.064)	0.092 (0.065)	0.093 (0.064)	0.021 (0.018)	0.024 (0.019)	0.021 (0.018)
System (President)	-0.016 (0.073)	-0.022 (0.073)	-0.016 (0.073)	0.024 (0.023)	0.026 (0.025)	0.024 (0.023)
Observations	584	597	584	584	597	584
No. country		20			20	
Period		1970~2009			1970~2009	

Note: Reported coefficients for the logit model are the marginal effects. Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.10.

D. Episodes of fiscal adjustment from OECD underlying primary fiscal balance

Country (sample period)	Period	No. episode	No. year
Australia (80~09)	84, 85, 86, 87, 88 / 94, 95, 96, 97, 98 / 02	3	11
Austria (80~09)	81 / 84 / 92 / 96, 97 / 01	5	6
Belgium (86~09)	82, 83, 84, 85, 86, 87 / 93 / 96, 97, 98	3	10
Canada (80~09)	81 / 86, 87, 88 / 94, 95, 96, 97	3	8
Denmark (80~09)	83, 84, 85, 86 / 04, 05	2	6
Finland (80~09)	81 / 84 / 88 / 93, 94, 95, 96, 97, 98 / 99, 00	4	11
France (80~09)	83, 84 / 87 / 94, 95, 96, 97, 98, 99 / 04, 05, 06	4	12
Ireland (80~09)	82, 83, 84, 85, 86, 87, 88	1	7
Italy (80~09)	82, 83 / 90, 91, 92, 93, 94, 95, 96, 97 / 06, 07	3	12
Japan (80~09)	81, 82, 83, 84, 85, 86, 87 / 05, 06, 07, 08	2	11
Korea (87~09)	93, 94, 95 / 00	2	4
Netherlands (80~09)	81, 82, 83 / 91 / 93 / 96, 97 / 04, 05	5	9
New Zealand (86~09)	87 / 92, 93, 94 / 00 / 02	4	6
Norway (80~09)	94, 95, 96, 97 / 99, 00 / 04, 05, 06, 07	3	10
Portugal (81~09)	82, 83, 84 / 92 / 06, 07	3	6
Spain (80~09)	86, 87 / 92, 93 / 96, 97	3	6
Sweden (80~09)	81, 82, 83, 84, 85, 86, 87 / 96, 97 / 04, 05	3	11
United Kingdom (80~09)	81, 82 / 88 / 94, 95, 96, 97, 98, 99	3	9
United States (80~09)	81 / 87, 88, 89 / 93, 94, 95, 96, 97, 98 / 05, 06	4	12
19 countries		60	167

Note: Fiscal consolidations are identified based on the OECD underlying primary fiscal balance with our definition rule.

E. High and low groups according to two standards

Standard	Order	Frequency		Fluctuation	
		Country	Frequency ratio	Country	S.D. of CAPB
High group	1	France	0.448	Norway	3.738
	2	Germany	0.410	Ireland	2.980
	3	United Kingdom	0.385	Finland	2.530
	4	Australia	0.385	Germany	2.504
	5	Portugal	0.381	Netherlands	2.477
	6	Norway	0.348	Sweden	2.440
	7	Sweden	0.333	Japan	1.974
	8	United States	0.333	New Zealand	1.938
	9	Canada	0.308	Portugal	1.925
	10	Austria	0.308	United Kingdom	1.910
Low group	11	Belgium	0.292	Spain	1.834
	12	Italy	0.282	Belgium	1.805
	13	New Zealand	0.261	Italy	1.777
	14	Ireland	0.256	Denmark	1.766
	15	Japan	0.256	Korea	1.550
	16	Spain	0.250	Austria	1.338
	17	Denmark	0.222	France	1.314
	18	Netherlands	0.205	Australia	1.179
	19	Finland	0.154	Canada	1.117
	20	Korea	0.143	United States	0.883

Chapter 5

Conclusions

This thesis investigates the macroeconomic effects of fiscal policy, highlighting several methodological innovations for identifying discretionary fiscal shocks. The main conclusion of this thesis could be summarized as follows.

First, in Chapter 2, we seek to compare and reconcile the two alternative approaches for identifying government spending shocks: the SVAR and the narrative approaches. To this effect, we propose a new instrument for the narrative approach: economic damages due to natural disasters and the subsequent government relief spending. We propose that our new instrument is not only plausible alternative, but also superior to military build-ups in that the relief spending is more similar to general government activity in scope and it can be easily applied to countries other than the U.S. The empirical results obtained with the two approaches for Korean fiscal shocks are similar: GDP, private consumption, and real wage all increase for a considerable time after government spending shocks. This is consistent with the New Keynesian model and contrasts with the previous empirical literature which finds different results depending on the identification approach used. In addition, offering a compromise of the two approaches, we show that the timing in identifying fiscal shocks is very crucial due to the 'anticipation effects' by private sector. This result suggests that anticipation of future changes in fiscal policy can lead to different consequences in both the direction and the magnitude of effects of fiscal policy.

Second, in Chapter 3, we re-examine the military build-ups of the U.S. as an instrument for the narrative approach. We argue that military build-ups like the World War II and the Korean War cannot be representative of general fiscal policy shocks because of their nature as infrequent and abnormal events with an atypical increase in defense spending. Correspondingly the multiplier based on military build-ups captures the defense-spending multiplier. Instead of military build-ups, we apply our instrument proposed in Chapter 2 at both the state and national level of the U.S. to estimate the nondefense spending multiplier as well as to confirm the general applicability of our method. We find that natural disasters serve as a powerful instrument for identifying government spending shocks and that the nondefense spending multiplier obtained using natural disasters is higher than the defense spending multiplier estimated using military build-ups.

Third, in Chapter 4, we show that fiscal adjustment typically has contractionary

short-term effects on economic activity with lower output and higher unemployment. This finding provides little support for the expansionary austerity hypothesis. We use the traditional approach based on changes in the CAPB, but improve the measurement of CAPB and the definition of fiscal adjustment in order to capture episodes of fiscal adjustment more accurately. As a result, our estimation results are consistent with the results based on the narrative approach. In addition, we argue that fiscal adjustment is more costly when it relies on tax hikes than spending cuts, which is in line with the findings of most of the previous literature. Furthermore, we find that economic agents respond more sensitively to unexpected fiscal adjustment, but become more unresponsive as fiscal policy changes frequently and sharply. This finding suggests that the effects of fiscal adjustment on economic activity can be different, depending on the confidence of private agents in government policy.

Finally, the empirical literature on the effects of fiscal policy lacks unanimity as regards the response of some variables according to the chosen identification approach, which also has influenced theoretical modelling of fiscal policy. However, we find that what is important for the analysis is not the identification method, but the instrument used. As we show in Chapters 2, 3, and 4, using a strong and more relevant instrument which can capture unexpected general fiscal shocks stands a chance of reconciling the conflicting evidences and theories and can have more accurate prediction of the economic reality.

The relationship between economic growth and fiscal policy is complex and is of critical importance for policymakers. In particular, the various types of feedback loops between fiscal policy and economic growth both in the short and long run make it more complex. In addition, in the absence of an independent exchange rate or monetary policy in euro area countries or in the environment with interest rates at an already very low level in advanced countries, the critical role of the discretionary fiscal policy is undergoing a revival. In this context, the policy implications of this thesis are as follows. First, the standard Keynesian view that fiscal policy has an important role to play in mitigating the business cycle as an effective stabilization tool is re-evaluated, which is in line with recent ‘stimulus packages’ for global crisis. Second, the fiscal adjustments to reduce budget deficits will improve economic performance and stabilize the public debt in the long term. However, unless other

policies such as monetary policy and fiscal reform are used in conjunction to support economic growth at the same time, front-loaded fiscal adjustment is likely to slow down economic growth in the short term, which eventually would delay improvements in fiscal indicators such as deficits and debt. Third, in line with recent findings in the literature (Ramey 2011a, Tenhofen and Wolff, 2010), 'anticipation effect' by private agents has a significant role in the effects of fiscal shocks because fiscal policy is subject to implementation lags. It is also the same case for the confidence of private agents in government policy as shown in Chapter 4. Therefore, it is very important to gain the confidence in the government fiscal policy via consistent and reasonable fiscal policy in normal times in order to strengthen the effects of fiscal policy on economic activity in crisis.

This thesis has several limitations. First, when we use natural disaster as an instrument for identifying government spending shocks, we assume that relief expenditure is exogenous to the state of the economy. As we show in Chapter 2, the adverse supply shocks due to natural disaster such as destruction of capital stocks and loss of lives are relatively modest and limited to the affection regions in Korea. However, if damages associated with natural disaster are severe and occur all over the nation, the assumption of exogeneity would be weak as well as it would be very difficult to distinguish between the direct effects of natural disaster and the effects of government spending shocks on economic activities. Second, in Chapter 3, we seek to correctly estimate the nondefense spending multiplier which is of much relevance at present of the fiscal stimulus packages implemented recently. However, as natural disaster shocks are too small to affect the total government expenditure, our estimation displays not the total nondefense multiplier, but only the federal one.[127] Lastly, just as a large empirical literature shows fiscal policy is pro-cyclical, in developing countries in contrast to high-income countries where it is countercyclical (Gavin and Perotti, 1997; Talvi and Végh, 2005), similarly, the effects of fiscal adjustment on economic activity also could be different. However, in this thesis, we have to deal with the episodes of fiscal adjustment in OECD countries as in most literature because of data availability and for the sake of comparison with previous studies.

127. For the period from 1977 to 2009, average ratio of the federal spending and the federal non-defense spending to the total government spending are 0.39 and 0.12 respectively.

Therefore, further work is needed to explore and develop our findings and to address the limitations. First, to confirm the validity of our identification method and its general applicability as an instrument for identifying exogenous fiscal shocks, we can apply it to an international sample. In this case, it is necessary to include only the countries in which there are localized natural disasters with modest damages. Second, Romer and Romer (2010) and Cloyne (2011) use historical records to identify tax changes as exogenous shocks for the U.S. and the U.K. respectively. To achieve a more comprehensive analysis, it would be interesting to apply the narrative approach on the tax side to other countries or to find a relevant instrument for the tax changes similar to our method. Third, if the role of anticipation effects highlighted by Ramey (2011a) is important, it is also interesting to explore a new method to explicitly model anticipation in an SVAR framework to compare the results of the narrative approach using our instrument in Chapter 2 or to investigate the anticipation effects between narrative data and CAPB-based data for fiscal adjustments. In addition, as the fiscal data for developing countries have been extended increasingly in both its period and subjects, it is possible to explore the effects of fiscal policy across country groups by extending the sample into developing countries.

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