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Abstract

We investigate the macroeconomic effects of government spending shocks in Korea. We compare results obtained with two alternative approaches: the narrative approach and Structural Vector-Autoregressive model (SVAR). We propose a new methodology for identifying exogenous and unexpected fiscal shocks under the narrative approach: natural disasters and the associated government emergency spending in the wake of such disasters. Our results suggest that when government spending increases, the responses of GDP, private consumption, real wage and investment are all positive, which is in accord with the New Keynesian model. Similar results are obtained with both approaches. However, comparing the two approaches suggests that the timing is very important in identifying government spending shocks due to the anticipation effects of fiscal policy.

JEL-Code: E130, E220, E620.

Keywords: exogenous fiscal shocks, natural disaster relief expenditure, narrative approach, structural vector-autoregressive model.

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1. Introduction

The effect of fiscal policy in an economy is an issue that has always been high on the mind of academics and policymakers alike. This is especially so in recent times, given the role that fiscal policy has played in the attempts to mitigate the economic downturn during the current global crisis and the fiscal crisis afflicting many European economies. It has been widely recognized that fiscal stimulus has contributed to the economic recovery, although the debate continues about the size of the effect and the transmission mechanisms at work. However, at the same time, these fiscal stimulus packages have contributed to the rapid increase in government debt-to-GDP ratios in most countries, which threaten the sustainability of public finances in the long term. As a result, the debate on the effectiveness of fiscal policies in stimulating the economy has been going on with renewed rigor.

However, the effect of fiscal policy interventions is also one of the most contentious areas of economics. Two main theoretical views prevail. 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 labor supply so that wages fall. In the New Keynesian model, by contrast, the stimulus boosts aggregate demand and labor demand so that consumption rises and wages rise too. Both views thus predict rising output, either because of the aggregate demand effect or because of increased labor input. However, the responses of private consumption and wages are opposite in the two cases.

It falls, therefore, upon empirical analysis to reconcile these two views. However, fiscal policy will generally have different effects depending on whether it is expected or unexpected. A fiscal stimulus announced well in advance will affect the behavior 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, ideally, one needs to identify true fiscal shocks: changes to fiscal policy that are both unexpected and exogenous.

To date, the most promising method relies on identifying fiscal shocks with military build-ups (see Ramey and Shapiro, 1998; Ramey, 2011; and Barro and Redlick, 2011). Wars are, to some extent, exogenous and unpredictable events. They are also associated with massive increases in government purchases. The US, the subject of most of these studies, furthermore has an additional advantage that all of its recent wars were extra-territorial.[1] Therefore, the adverse supply side effects due to the destruction and loss of life resulting from wars are limited. Focusing on military build-ups has an added advantage in that the timing of the shock can be identified more precisely in this way.

Nevertheless, this approach also has a number of drawbacks. First, few other countries have been involved primarily in extra-territorial conflicts, so the application of this approach remains limited to the US and possibly a few other cases. Second, participation in wars and

[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. The World War II was in part fought on US territory, Hawaii, which constitutes a tiny fraction of the US economy.

the associated military build-ups are not entirely unexpected in that they are typically preceded by, often lengthy, periods of rising tensions and posturing.[2] Third, even when they are extra-territorial, wars often have non-negligible supply side effects: conscription removes a potentially large number of men in prime age from the labor 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 general government purchases, and it is therefore questionable whether one really learns much about the effect of shocks to general government spending from the economy's response to military purchases.

We, therefore, propose an alternative approach for identifying government spending shocks: emergency response in the wake of natural disasters. By their very nature, natural disasters are unexpected: acts of God rather than man-made. The government response typically involves spending 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.

Natural disasters do have supply side effects: they cause damage to buildings and infrastructure and may 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. Finally, natural disasters can even have a positive effect on the economy because the older physical assets tend to be less robust and thus more prone to be damaged: Crespo, Hlouskova and Obersteiner (2008) argue that in this way, natural disasters can help 'cull' old fixed assets, which are then replaced by newer and more efficient ones.

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) 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 shocks to fiscal policy based on Korean data. We use Korean data because the data on emergency spending is readily available. Moreover, 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. It also describes the data and the methodology related to the specification and identification. Section 5 presents the empirical results of government spending shocks in the narrative approach and the comparison with the result of the SVAR approach. Section 6 runs a variety of robustness checks and finally, section 7 concludes.

[2] For example, the attack on Pearl Harbor was surprising mainly in that the US expected that the Japanese aggression would be initially directed against the Philippines, a US dependency at the time, rather than Hawaii.

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 shows often widely different results regarding the responses of some variables to government spending shocks, and the estimated multipliers differ in their size across countries and periods.

The existing empirical studies can be divided mainly into two groups[3]: 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 hands, those produced with the narrative approach find results consistent with the neoclassical model: consumption and wages fall when the government spending increases.

Below, the theoretical background and the two main empirical approaches are discussed in turn.

2.1 Theory

Two macroeconomic models have evolved with two 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 labor demand, real wages, private consumption and GDP in turn. 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 with the habit-persistence parameter. 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 high interest rate. This causes consumption to decrease and labor supply to increase which in turn leads to a fall in real wages. Baxter and King (1993) show that an

3 Another is a sign restrictions approach by Mountford and Uhlig (2009). They use only the macroeconomic time series by imposing sign restrictions on impulse responses with the orthogonality restrictions for the identification of fiscal shocks and non-fiscal shocks (business cycle shocks and monetary policy shocks). They find that the response of consumption does not change significantly in response to government spending shocks while the real wages have a negative response on impact.

increase in government spending financed by non-distortionary taxes reduces the representative agent's wealth, which leads to an increase in the labor 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 fear of a post-war depression into the neoclassical model. They show that these simple modifications can account for high labor 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 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 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 the same method 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. Blanchard and Perotti (2002) formulate a three-variable VAR model, which includes 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, which is consistent with the theory. They conclude that the multiplier is small: GDP increases in response to a one dollar shock of government spending peaks by 1.29 dollars after almost four years. In a four-variable VAR model, which includes the components of GDP, consumption responds positively to but investment is crowded out by government spending shocks. This approach is also 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 that the estimated effect of fiscal policy on GDP turns out to be small. The effect of government spending shocks on private consumption is found to be 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 of government spending is relatively small and fades away quickly. The response of private consumption is again positive. Using Spanish data, De Castro and de Cos (2006) 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.

2.3 The 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) apply this approach to identify fiscal policy shocks in an application of methodology that Romer and Romer (1989) used to study monetary policy. They identify major military build-ups (Korean war, Vietnam war, and Carter-Reagan buildup) that happened independently of the state of the domestic economy. Ramey and Shapiro use a univariate autoregressive model which relates each variable of interest to lags of itself and the current and lagged military build-ups dummy. They find that government spending has a positive effect on GDP. The response of GDP to a military shock remains positive during three years while the shock lowers consumption and real wages which is consistent with the neoclassical framework. Edelberg et al (1999) use a multivariate VAR model with Ramey and Shapiro's dummy and 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 real wage decline in response to an expansionary shock in government purchases while GDP and hours worked increase. The findings obtained with the narrative approach thus are in line with the neoclassical model.

The recent literature seeks 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 have 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, and discusses the reason for the different results under the two approaches. He argues that the differences are due to two restrictions of the narrative approach. First, it is assumed that the built-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 (2011) compares the two sets of results and argues that a 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 the New Keynesian results. In addition, Ramey (2011) constructs new variables which are richer than the original military build-ups dummy: she used news sources to measure quantitative information about

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

anticipation of fiscal-policy shocks. She finds that the analysis with the new variables produces similar results: consumption and wage fall in response to an increase in government spending and the multipliers range from 0.6 to 1.2.

An advantage of the VAR 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 in the SVAR approach depends on assumptions such as time lags and the elasticity of the fiscal variables with respect to the macroeconomic variables. Moreover, in case of long implementation lags, the results can be distorted by 'anticipation effects' which means the fiscal policy can be anticipated by the private sector before the 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 were 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 US because of the availability of military built-up data constructed by Ramey and Shapiro (1998). There are so far only relatively few studies on the macroeconomic effects of fiscal policy in Korea. These use the SVAR approach; to the best of our knowledge, no studies on Korean fiscal policy have been undertaken on the basis of the narrative 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 (2002)'s 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, using the SVAR approach with the quarterly consolidated government finance data for the period 1994-2006. He shows that spending shocks decrease output, inflation rate and interest rate, while tax-cuts increase output and interest rate but decrease the inflation rate. These results go against the conventional wisdom. He ascribes these results to too short 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).

A novel feature of our analysis, therefore, is that 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-US data. As we argued above, the absence of studies using the narrative approach in the context of countries other than the US reflects the availability of Ramey and Shapiro's military build-ups data for the US, which is not the case for other countries, which is mainly because not many other countries have 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 a similar analysis to that of Ramey and Shapiro (1998) and their followers.

A crucial contribution of our paper, therefore, is that we propose a new instrument for identifying fiscal shocks that allows us to extend the analysis of the effects of fiscal policy beyond the US. In particular, we use natural disasters (instead of military build-ups) as a novel source of exogenous variation in fiscal policy, which means that our method has wider applicability over a broader range of countries. We use both the timing and the intensity of natural disasters, using estimated economic damages as a measure of the latter. Having constructed the new exogenous series, we then use it to consistently estimate the macroeconomic effects of government spending shocks in Korea. While we apply this identification strategy to Korea, economic damages from natural disasters can clearly be used to identify fiscal shocks in other countries as well.

We find that economic damages from natural disaster are a powerful instrument for indentifying government spending shocks. When comparing the results from the two approaches, the timing is an important factor due to 'anticipation effects'. This finding is similar to that of Ramey (2011). When the timing of the narrative approach is adjusted to eliminate the period subject to the 'anticipation effect', the two approaches produce very similar responses. Moreover, even in the narrative approach, positive government spending shocks cause consumption and the real wage to increase, which is consistent with the New Keynesian model.

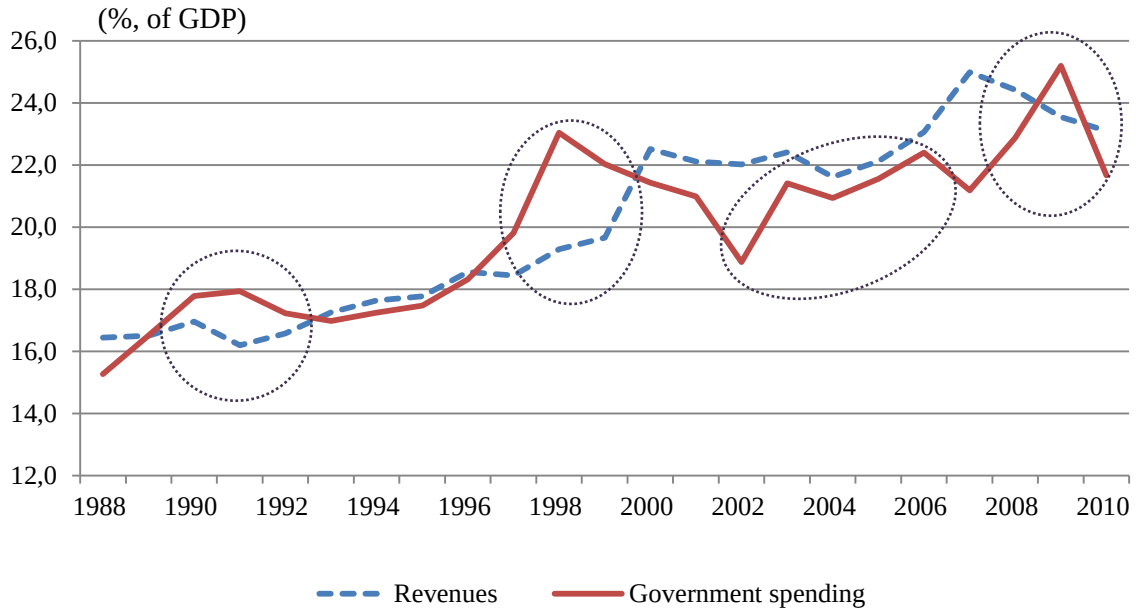
3. Recent trends in Korean fiscal policy

This section presents briefly the main aspects of the Korean government's fiscal policy. Figure 1 shows the annual time series of 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 macro-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 fluctuation has increased because of active use of counter-cyclical fiscal policy (Lee, Rhee and Sung, 2006).

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 Korea's sound fiscal position, the Korean government could implement an expansionary fiscal policy to provide stimulus to the economy, which helped the Korean economy to recover rapidly from these economic crises (Hong, 2010). In Figure 1, there are four noticeable episodes of fluctuations in government

spending. Two rises of 1998~1999 and 2009 are mainly because of the stimulus packages to counter crises as explained above. In 1990~1991, the government set to reverse the retrenchment of the 1980s to stimulate social and economic development. During the period of 2003 and 2006, the large changes of government spending are attributed to the redemption of public funds [5] which were used for financial restructuring during the crisis of 1997. Therefore, except for responding to the two economic crises, the Korean government maintained a sound fiscal position. Finally, since 2010, the Korean government has tried to cut spending and increase tax revenues to improve the fiscal position.

Figure 1. Government spending and revenues in the consolidated government finance



Figures 2 and 3 show the time series of Korea's government budget balance and government debt as percentages of GDP. The consolidated budget balance stays between -2.0% and 3.0% except for the periods of two crises. The adjusted budget balance, [6] which is defined as the consolidated budget balance minus the social security balance plus redemption of public funds, is 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.

Korean government debt also had been kept low, at around 10% of GDP, until 1997. However, the fiscal debt-to-GDP ratio has been increasing rapidly since 1998. This rapid rise

5 From 1998 to 2000, the government issued 102 trillion won in bonds, and these Public Funds were used for financial restructuring such as 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 has been focusing on the adjusted fiscal balance rather than consolidated fiscal balance when formulating fiscal policy.

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 birthrate 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. Fiscal balance to GDP ratio in Korea

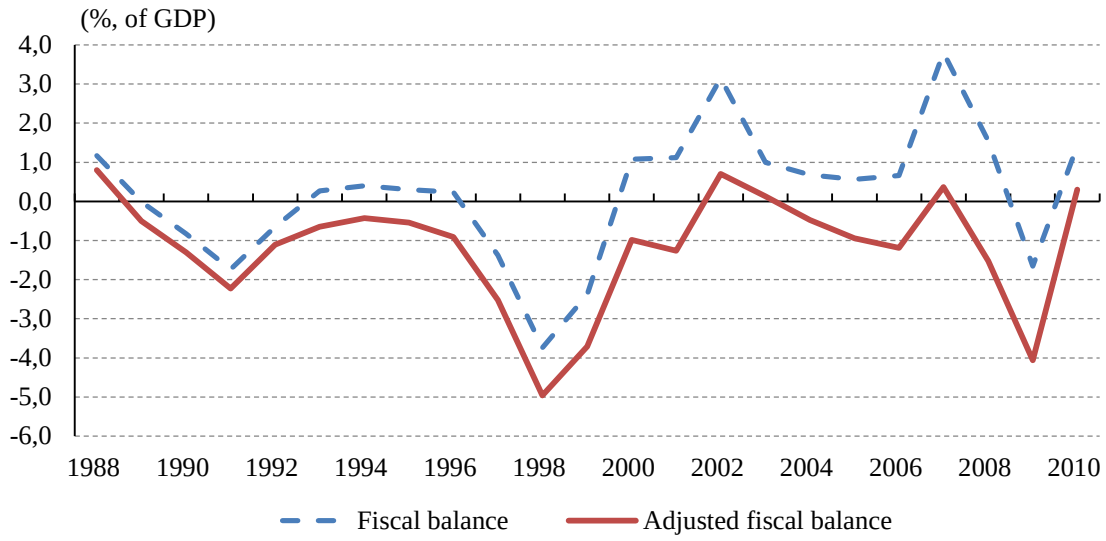
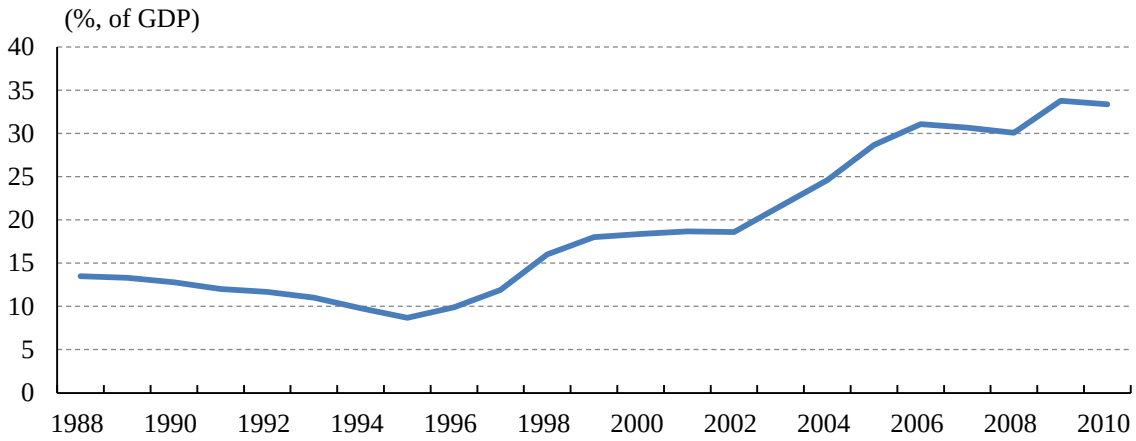


Figure 3. Government debt to GDP ratio in Korea



7 These are the Foreign Exchange Stabilization Bond, issued to raise funds for stabilization of 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.

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 paper focuses on the effects of government spending in Korea since the 1990s.

4. Empirical Framework and Data Adjustment

4.1 Constructing the exogenous fiscal series

(1) Identifying exogenous government spending shocks

In their empirical study of the effects of government spending utilizing the narrative approach, Ramey and Shapiro (1998) are the first to use military build-ups to identify exogenous shocks to government spending. 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 because of the following reasons. First, the demand on 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 health care. Fourth, as they are driven by geopolitical shocks, military build-ups are likely to be exogenous and unrelated to macroeconomic variables.

Ramey (2011) 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 military build-up series have important limitations for analyzing the effects of government spending in countries other than 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. Unlike military superpowers such as the U.S, 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. Therefore, this approach cannot be applied to most other countries. For example, Korean government spending in the defense sector has remained in the range of 2.1~6.0% of GDP since 1970 without any trend over time. 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. So, the effects on the economy may be very different from those of fiscal shocks in the non-defense sector. Barro and Redlick (2011) make this point and show that the defense spending multiplier is different from the non-defense spending multiplier.

Therefore, we create a new exogenous series which can be applied more generally: the economic damages caused by natural disasters and the corresponding Natural Disaster Relief Expenditure (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 similar to military build-ups. First, NDRE does not remove resources from the private sector or public sector because it is usually drawn from an emergency reserve fund.[10] Second, it comprises inevitable and urgent spending on 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 that of general government spending. Lastly, NDRE also is less likely to affect labor productivity[11] or private technology because it is basically used only for repairs and restoration to the original state.

To sum up, NDRE can be more useful than military build-ups to analyze the effects of exogenous government spending shocks, especially in countries other than the US. Furthermore, in addition to collecting data on NDRE response to natural disasters, we also collect information on estimated economic damages from natural disaster. This is similar to Ramey's (2011) approach: she collects quantitative information based on news reports on 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 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

8 Some natural disasters may to an extent be expected in that some areas are more prone to earthquakes 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 is exogenous and unexpected.

10 In Korea, up to 1% of the general account budget is allocated in advance to contingency funds. NDRE is used only for urgent repair and relief from the contingency fund. If necessary, additional expenditure for repairs and prevention of natural disaster is allocated into the public sector section of the general account in the following year's budget.

11 Labor and labor productivity can be affected by the damage and the casualties caused by the 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 US involvement in extraterritorial wars were considerable. Military build-ups, furthermore, affect the labor market by removing large numbers of able-bodied men and women from the labor force.

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/.

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 1 shows the Top 5 natural disasters in Korea for this period. The economic damages from the heaviest typhoon corresponded to just 2.85% 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.

Table 1. Top 5 Natural Disasters in Korea from 1994 to 2010 according to damages

Rank	Date	Disaster	Damage (nominal billion,₩)	Damage / quarterly GDP	No. killed	Area
1	30/08/2002	Typhoon	5,148	2.85%	246	Chungchong, Gyeongsang
2	12/09/2003	Typhoon, Heavy rain	4,223	2.20%	131	Gyeongsang, Gangwon
3	09/07/2006	Typhoon, Heavy rain	1,834	0.8%	62	Seoul, Incheon Kyunggido
4	31/07/1998	Heavy rain	1,248	1.01%	324	Chungchong, Gyeongsang
5	23/07/1999	Typhoon	1,049	0.75%	67	Nation-wide, except Daegu

* The National Emergency Management Agency of Korea

(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 approval by the Cabinet. We construct the exogenous series on NDRE response to natural disasters by reviewing the agendas on Cabinet meeting: these are available on the website of the National Archives of Korea for the period 1949 to 2001. Since 2004, the contents of each Cabinet meeting briefing have been also reported on the official website for government policy promotion. To fill the occasional gaps between the two sources, we rely on 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 needs for urgent and unexpected expenses, 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 stimulus, disaster relief and shortfall of government revenues. Therefore, it is necessary to classify the revised supplementary budgets according to their use.

Finally, we collect 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.

(3) Transforming the narrative information into quarterly data

The timing of NDRE is straightforward to identify because NDRE is as a strategy decided upon and executed rapidly as a response to natural disasters. Therefore, NDRE data should be less affected by decision lags 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 for the analysis. 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 (2011), 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 belonging to the next quarter.[15]

Table 2 and Figure 4 show the transformed economic damages and NDRE series. As NDRE responds to the damage caused by natural disasters, the size of NDRE generally increases in proportion to the damage. In particular, Figure 4 shows very clearly that NDRE closely mirrors the damages occurring in the same or preceding quarter. Table 3 presents the top 5 disasters and the NDRE corresponding to them, as well as the timing of both the disaster and the NDRE response. In each of these cases, revised supplementary budgets were organized in order to make up for the shortage of contingency funds. For example, in July 2002, typhoon ‘Ramasun’ struck the central Korea. To alleviate the damages, 770.4 billion won of emergency funds was spent. After that, typhoon ‘Rusa’ followed in September.

13 Ramey (2011) 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 6.3 days to allocate NDRE budget to executive agencies after a approval of Cabinet meeting in 2004~2005.

Because of the lack of the emergency funds, revised supplementary budgets of 3,534.9 billion won (10.1% of total government spending in the fourth quarter of 2002) was made in September and spent mainly in October.

Tables 4 and 5 show the explanatory power of the damages and the 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, in this analysis, seasonal adjustment is not made to all variables because the 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 variables would be underestimated.

Table 4 presents Granger-causality test results. Regardless of the lags, damages Granger-cause NDRE, government spending and especially government investment spending. Moreover, Table 5 shows the R-squared and F-statistic obtained when regressing the change of real per-capita government spending on current and lagged damages or NDRE. Both variables have strong explanatory power. 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. In summary, the damage from natural disaster and NDRE are relevant instruments for analyzing the effects of government spending.

Table 2. The Economic damages and NDRE

(Billion ₩)

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

* All variables are expressed in real terms using the GDP deflator (2005=100)

Figure 4. The comparison of economic damages and NDRE

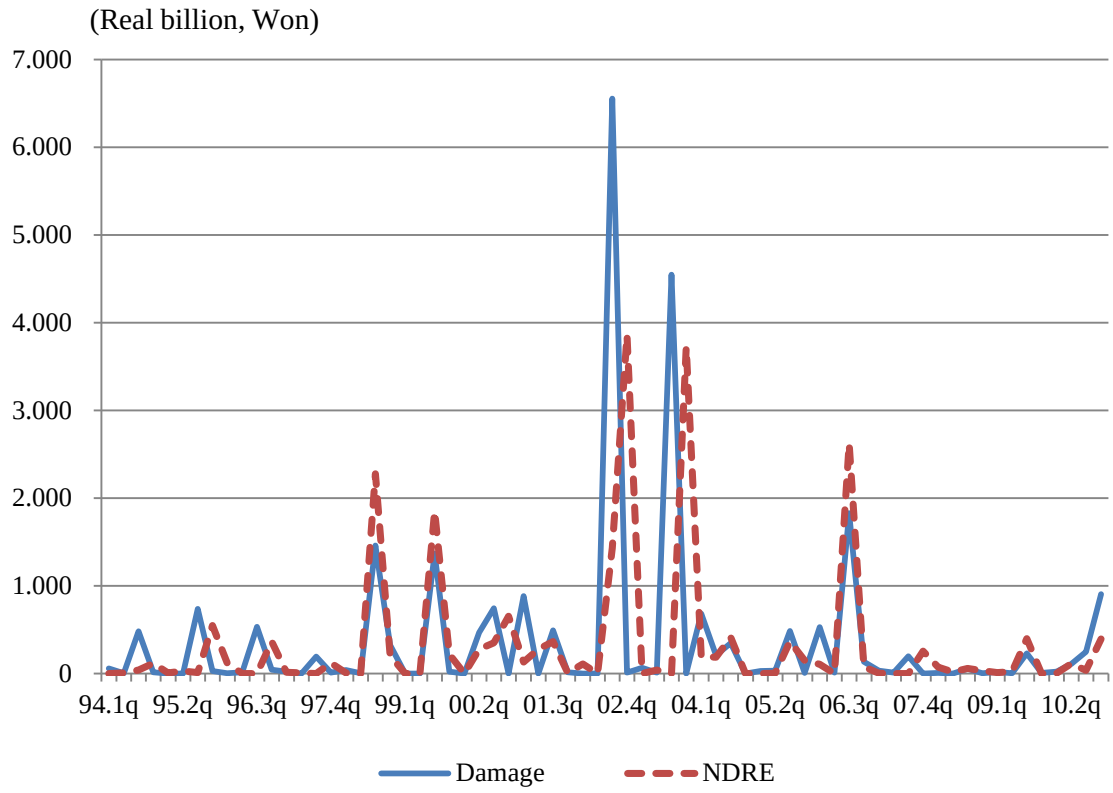


Table 3. Top 5 Natural Disasters and corresponding NDRE from 1994 to 2010

(Real billion(2005=100), Won)

Quater	Disaster	Damages	Quater	NDRE	Emergency Fund	Supplement Budget
98.2q	Heavy rain (23/6~29/6, 31/7~12/8)	1459.9	98.3q	2302.2	1,232.4 (20/8, 15/9)	1,069.8 (8/9)
99.3q	Typhoon 'Olga' (3/8), Heavy rain (23/7~4/8)	1369.3	99.3q	3040.6	1,337.4 (13/8, 7/9)	1,703.2 (24/8)
02.3q	Typhoon 'Rusa' (30/8)	6556.2	02.4q	3880.9	346.5 (24/9)	3,534.4 (17/9)
03.3q	Typhoon 'Maemi' (6/9)	4547.4	03.4q	3772.9	620.5 (16/9, 23/9)	3,102.4 (24/10)
06.3q	Typhoon 'Ewiniar' (10/7), Heavy rain (14/7~20/7)	1827.7	06.3q	2620.4	582.8 (21/7, 17/8)	2,037.6 (31/8)

Table 4. Granger Causality Test

(Lags: 1)

Null Hypothesis	F-Statistic	P-value
Damages does not Granger Cause NDRE	71.4685	5.1E-12
NDRE does not Granger Cause Damages	0.06226	0.80376
Damages does not Granger Cause Government spending	4.93599	0.02985
Government spending does not Granger Cause RDAM	0.03490	0.85240
Damages does not Granger Cause Government consumption spending	35.8492	1.1E-07
Government consumption spending does not Granger Cause RDAM	0.00147	0.96950
NDRE does not Granger Cause Government investment spending	7.84111	0.00674
Government investment spending does not Granger Cause NDRE	2.50873	0.11815

Table 5. Regressions of government spending on the shocks

Dependent Variable	R-squared	F-statistic	Prob (F-statistic)	Independent Variable
Government spending	0.13	4.57	0.01	Dam, Dam(-1)
Government investment spending	0.37	18.7	0.00	Dam, Dam(-1)
Government consumption spending	0.07	2.28	0.11	Dam, Dam(-1)
Government spending	0.03	1.15	0.32	NDRE, NDRE(-1)
Government investment spending	0.25	10.59	0.00	NDRE, NDRE(-1)
Government consumption spending	0.00	0.21	0.81	NDRE, NDRE(-1)
NDRE	0.61	50.33	0.00	Dam, Dam (-1)

* Government spending variables are linearly-detrended and real per capita and dependent variable is regressed on current and one lags of independent variable.

4.2 Macroeconomic Data and Adjustment.

To analyze the dynamic effects of exogenous government spending on economic activity, quarterly data for the following 8 macroeconomic variables are used in this paper: 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).

All variables are seasonally adjusted using the X-12 ARIMA method and are 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 Ministry of Finance. In Korea, quarterly data on government spending ($\boldsymbol{g_t}$) and revenues ($\boldsymbol{t_t}$) are available only from 1994 onwards. These data are on recorded on cash basis[16] and cover only the fiscal activity of central government. The data for the general government including local government have been made public only since 2005. Quarterly observations from 1994 to 2010 may constitute a shorter sample than is typical for VAR. However, before the Asian Crisis of 1997, Korea had not used fiscal policy actively as a countercyclical tool. Therefore, the effects of fiscal policy before the 1990's seem to be not critical. In line with the definition used by Blanchard and Perotti (2002), government spending ($\boldsymbol{g_t}$) is defined as total purchases of goods and services (i.e., government consumption + government investment). Revenues ($\boldsymbol{t_t}$) 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 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.[17] Private wage ($\boldsymbol{w_t}$) is the average wage of firms with 10 or more full-time employees, as reported by the Korean Statistical Information Service.

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

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 Monetary Policy Committee of Korea from 1999 to 2008. Real effective exchange rate ($\boldsymbol{e_t}$) 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:

16 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.

17 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.

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

Where X_t is a vector of endogenous variables, A is a constant term. B(L) is P-order lag polynomial and C(L) is (R+1)-order lag polynomial. D_t is narrative-based measure of fiscal shocks and ε_t is the vector of reduced-form innovations. 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 (2011) who includes them as an endogenous variable in the VAR.[18] To analyze the effects on a number of variables without losing degrees of freedom by including too many variables in the VAR, we follow Burnside et al (2004) in using a fixed set of variables in X_t and adding other variables to the list of X_t one at a time. The fixed set of variables in X_t consists of government spending (g_t), revenues (t_t), GDP (y_t), 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. Finally, the economic damages from natural disasters are included in D_t as the narrative fiscal shock variable in order to compare and analyze the effects of government spending.

5. Empirical Results[19]

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.[20] Therefore, "statistical significance" can be defined as this narrow error band not containing zero. To compare the results of the two approaches, we follow Ramey (2011) 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 5 depicts the effects of the macroeconomic variables to the natural disaster shocks related to the increase of government spending. First, when the shock occurs, government

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

19 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 (2011) using Stata.

20 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 (2011), Blanchard and Perotti (2002) , Francisco et al (2006), Caldra and Kamps (2008), Engemann et al (2008), while 95% is used in Burnside et al (2003), Perotti (2005, 2007), Ramey (2011). Additionally, our results with 95% error bands using the narrative approach are shown in Appendix B.

spending rises for 2 quarters, peaking in the first one. As explained in the previous section, it means that when a natural disaster occurs, it takes 1~2 quarters for government to execute the Natural Disaster Relief Expenditure (NDRE) using contingency funds or to draw up a revised supplementary budget. After the third quarter, the response of government spending returns to being insignificantly different from zero. This means that the shock is only temporary. GDP also rises after the natural disaster. Especially, it peaks in the third quarter, which is after the government spending begins to increase. This means that the shock to government spending causes the GDP to rise. Moreover, in the 1st quarter, the response of GDP is already positive, 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. When following the method of Ramey (2011), the elasticity of GDP to the government spending peak that we obtain is 0.18. This is similar to Ramey's finding (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 0.48 obtained by W. Kim (2006) for Korea, or 1.29 of Blanchard and Perotti (2002) and 1.1 of Ramey (2011) for the U.S.

The effect on revenues closely mirrors that of GDP and consumption with a lag of 2 quarters. This is not surprising, given that tax receipts reflect economic activity of the previous several periods. 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.[21] At the first quarter, revenues display large positive response to the increase of government spending. However, if revenues are replaced by tax revenues, although the response in the first quarter is negative, the impulse response subsequently turns upwards.[22] This implies that the increase in government spending is driven 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 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 are against the general inverse relation between interest rate and exchange rate according to the interest parity relation. Especially, the negative response of interest rate contradicts the theory or other literature. 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 effect 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. As was pointed out

21 Revenue is comprised of tax revenue, non-tax revenue and 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.

22 The results with tax revenue are in Appendix C.

in the previous literature, there is a difference between the responses of private consumption and real wage according to the two identification approaches. In most studies relying on the narrative approach as, for example, Ramey and Shapiro (1998), Ramey (2011) and Burnside et al (2004), private consumption and real wage fall, which is consistent with negative wealth effect. However, in our analysis, consumption increases, although the error band includes 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 positive and significant for five quarters. These results are consistent with the New Keynesian model. Nevertheless, these results 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 labor-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 largely get affected.

The previous literature finds different results for the response of investment regardless of the identification approach.[23] 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. This may reflect the fact that the relief effort in the wake of natural disasters usually involves large-scale private and public construction. 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 spending. Because the response of the investment includes public investment, the real effect on investment can be overestimated. We, therefore, analyze the response with private investment only, for which data are available since 2000. The response of investment is smaller than before but still positive.[24] The investment response, along with that of private consumption, is likely to contribute to the response of GDP, given that the pattern of their responses is very similar.[25]

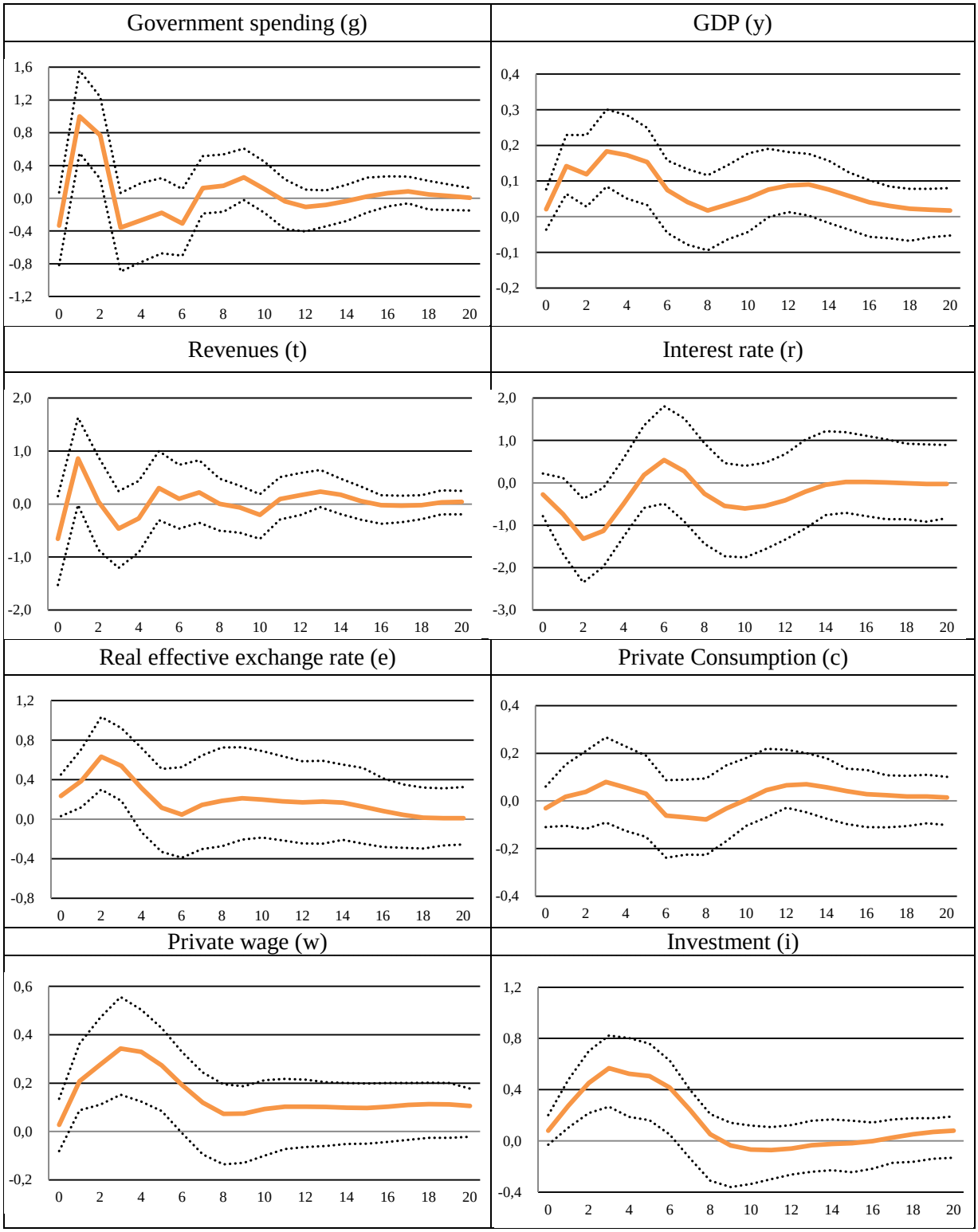
To sum up, the response of GDP to the government spending shock is positive, as expected. As for nominal interest rate and real effective exchange rate, they are included to control other factors such as monetary policy and foreign factors. As a result, their responses are less related to the government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

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

24 This result is shown in Appendix D.

25 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%.

Figure 5. The response of macroeconomic variables using the narrative approach[26]



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

5.2 The response of macroeconomic variables using the SVAR

Much of the literature on Korean fiscal policy uses the SVAR approach, following 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 paper, the SVAR specification follows Perotti (2005) because he uses five variables while Blanchard and Perotti (2002) include three variables (*g*, *t*, and *y*).

The reduced form p-order VAR is formulated as follows[27]:

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

where Y_t is n × 1 vector of economic variables, B(L) is a polynominal 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.[28]

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:

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

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

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.

27 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.

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

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[29] 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

$$u^y_{,t} = \alpha_{yg} u^g_{,t} + \alpha_{yt} u^t_t + e^y_{,t}$$

$$u^r_{,t} = \alpha_{rg} u^g_{,t} + \alpha_{ry} u^y_{,t} + \alpha_{rt} u^t_t + e^r_{,t}$$

$$u^e_{,t} = \alpha_{eg} u^g_{,t} + \alpha_{ey} u^y_{,t} + \alpha_{et} u^t_t + \alpha_{er} u^r_{,t} + e^e_{,t}$$

$$u^c_{,t} = \alpha_{cg} u^g_{,t} + \alpha_{cy} u^y_{,t} + \alpha_{ct} u^t_t + \alpha_{cr} u^r_{,t} + \alpha_{ce} u^e_{,t} + e^c_{,t}$$

The variance-covariance matrix of the reduced-form innovation has 21 elements while the above system of equations has 24 coefficients to be identified. Therefore, this system of equations is not 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.[30] This assumption presumes that all other variables have no contemporaneous impact on government spending, which means that $\alpha_{gy} = \alpha_{ge} = \alpha_{gc} = \beta_{gt} = 0$.[31] Lastly, the output elasticity of net revenues is estimated as $\alpha_{ty} = 1.116$; this figure being based on the national fiscal management plan (2009) of Korea.[32] 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:

29 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.

30 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.

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

32 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 de Cos, 2006).

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

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

Table 6 shows the estimated coefficients of the contemporaneous relations between the reduced-form innovations and the structural shocks.[33] 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 6. Estimated contemporaneous coefficients

	α_{yg}	α_{yt}	α_{te}	α_{tc}	α_{rg}	α_{ry}	α_{rt}	α_{eg}	α_{ey}
Coef.	1.146***	-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	

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

33 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^{g}_{t}, e^{t}_{t}) as a mean of instrumental variables as Perotti (2005).

Figure 6 shows the impulse response function with 68% error bands.[34] In order to compare the results of the two approaches, the first column presents the impulse response functions obtained with the SVAR approach while the second column shows the previous results of the narrative approach.

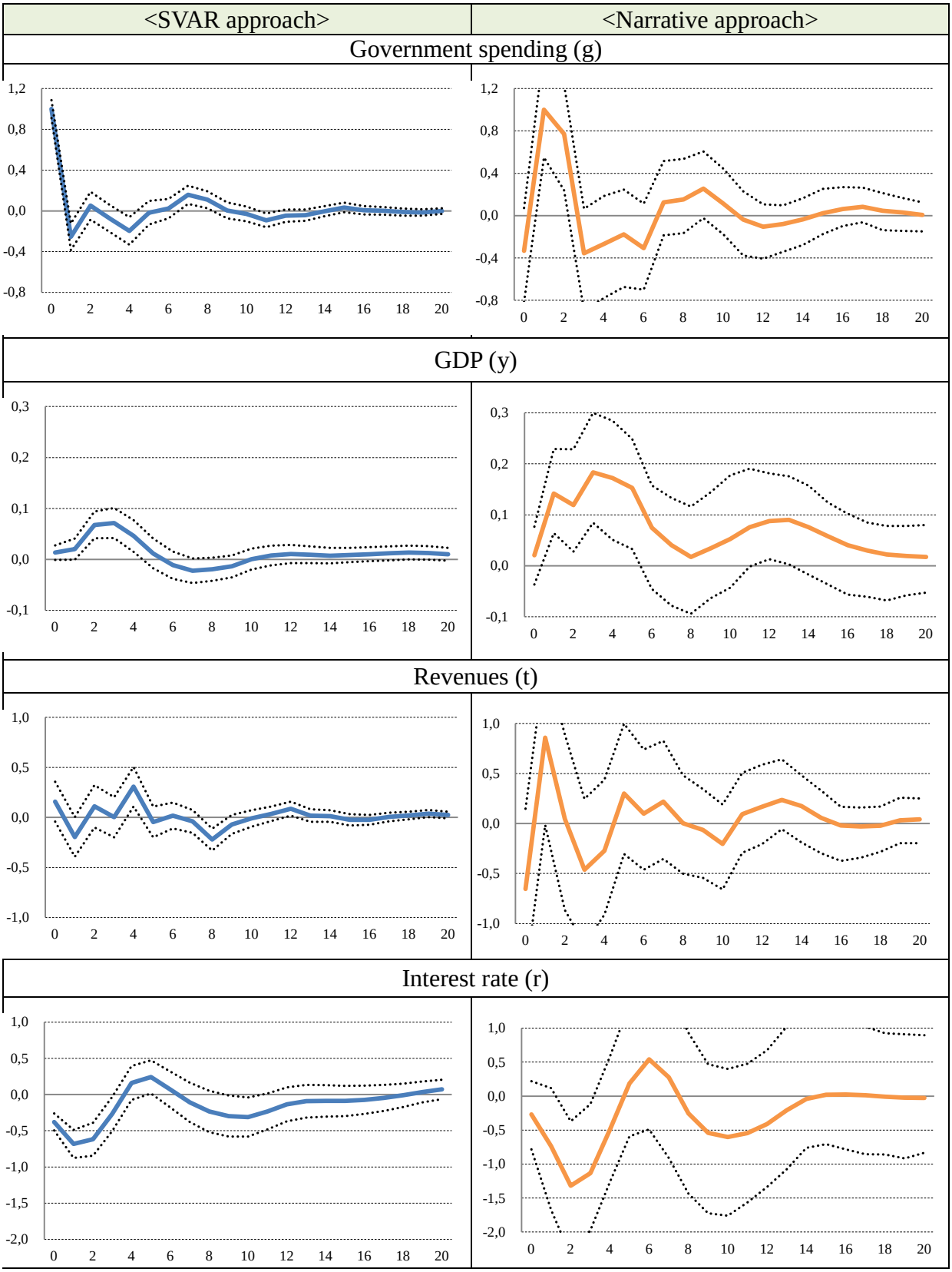
In the SVAR approach, the shock to government spending displays little persistence. This is similar to the finding of Hur (2007) with Korean data and Giordano et al (2006) with Italian data. However, in most other SVAR studies (Blanchard and Perotti, 2002; Perotti, 2005; De Castro and de Cos, 2006; Cadala 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 and Italian fiscal data are reported quarterly on a cash-basis.[35] 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 cash-basis or accrual-basis data are more appropriate when studying the impact of government operations on the economy. However, in this paper, 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.

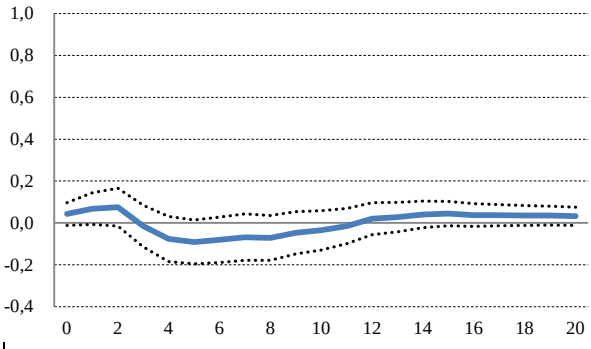
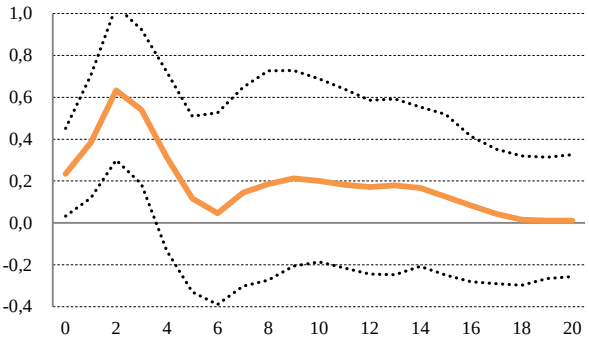
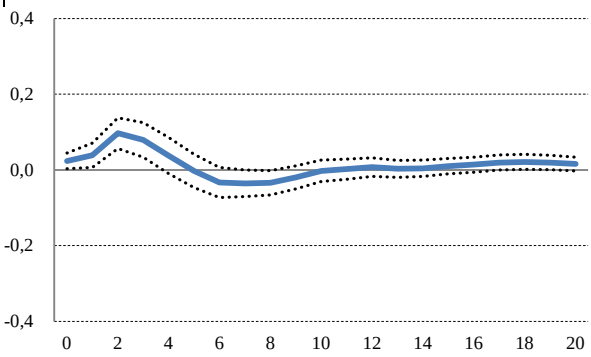
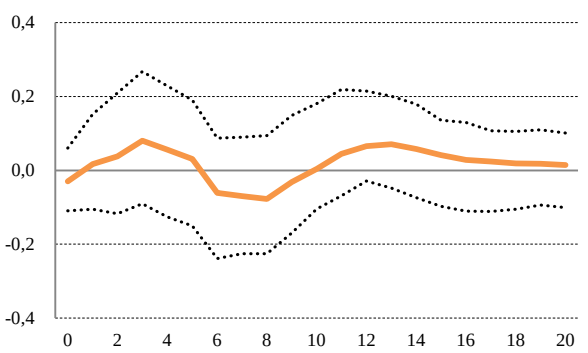
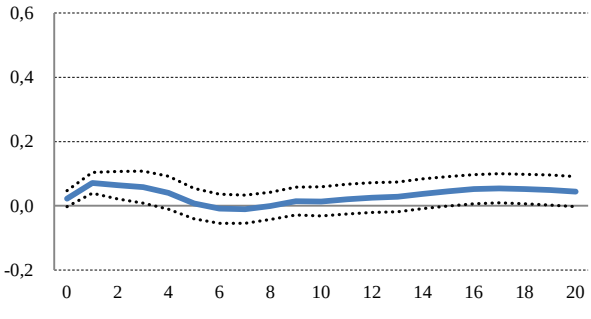
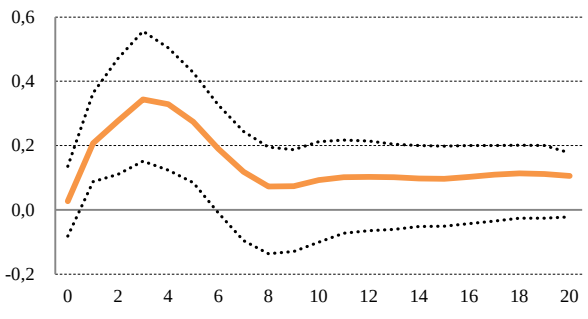
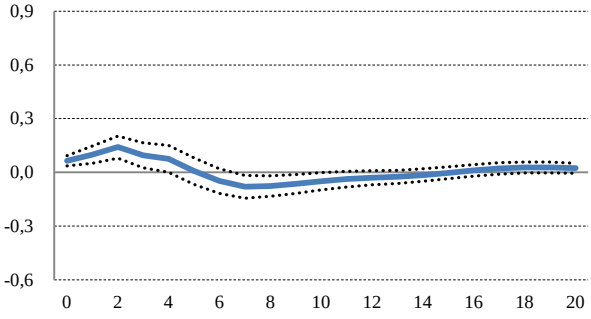
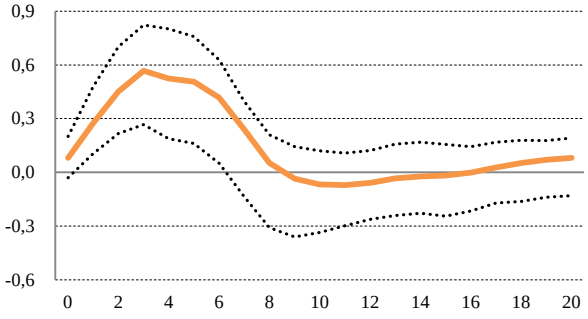
GDP increases for five quarters in response to a shock in government spending, returning to normal in a hump-shaped pattern as expected. The elasticity of GDP is 0.07 and the government spending multiplier is 0.56, given the average ratio (7.78) of nominal GDP to nominal government spending. This multiplier is very close to 0.48 of W. Kim (2006), who follows the methodology of Blanchard and Perotti (2002), even though the data and period are different. 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 the GDP with one quarter lag. The response of the interest rate is negative on impact for four quarters and afterwards remains near to zero. This negative response is contrary to the theory which predicts a positive response because of higher demand and inflationary pressure, but is likely due to being affected by monetary policy in the same way as in the narrative approach. The real effective exchange rate initially appreciates and then depreciates slightly. This variable is included to control for foreign effects. 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. Especially, 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.

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

35 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.

Figure 6. Results from the two identification approaches in Korea



<SVAR approach>	<Narrative approach>
Real effective exchange rate (e)	
	
Private Consumption (c)	
	
Private wage (w)	
	
Investment (i)	
	

5.3 Narrative and SVAR approaches compared

Comparing 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 (2011). 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, whose peaks are normalized at 1.00, 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. This means that after the natural disaster, it takes time for the government to start spending relief funds: there are lags for recognition, decision, and implementation. In order to accommodate these time lags, 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.[36] Real wage impulse response, finally, is lagged by two quarters due to its rigidity. This means that the private sector responds in advance of the increase of government spending. This could be an 'anticipation effect' which was highlighted in many other studies (Blanchard and Perotti; 2002, Perotti; 2005, Ramey; 2011a). We can guess that after natural disaster, people expect the subsidy from the government and go on to buy relief items even before receiving the subsidy. Therefore, repair construction is already in progress before government expenditure for relief is disbursed. As a result, it can affect the GDP in advance.

Figures 7 and 8 show the results with this modification. As explained before, the responses from the forward-shifted narrative approach are quite similar to those from the SVAR in the timing of fluctuations. Considering that the previous literature finds different effects on consumption and real wage depending on the identification method, this is very interesting. Government spending shocks raise the GDP, private consumption, investment, and 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.

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 (0.18) in the narrative approach is almost two and half times larger than that in the SVAR (0.07) .

36 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.

Figure 7. The comparison of the responses from two quarters forward-shifted in the Narrative Approach

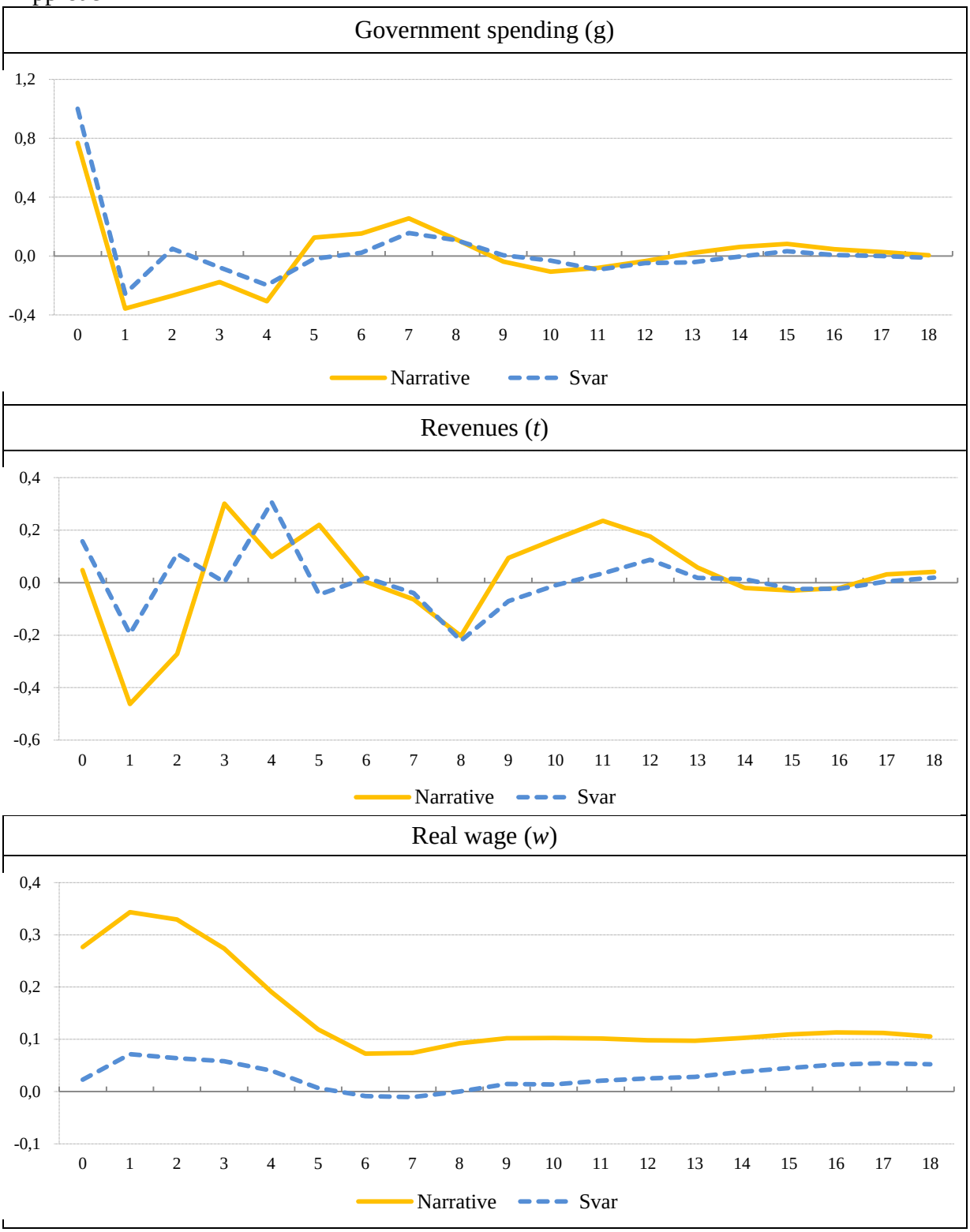
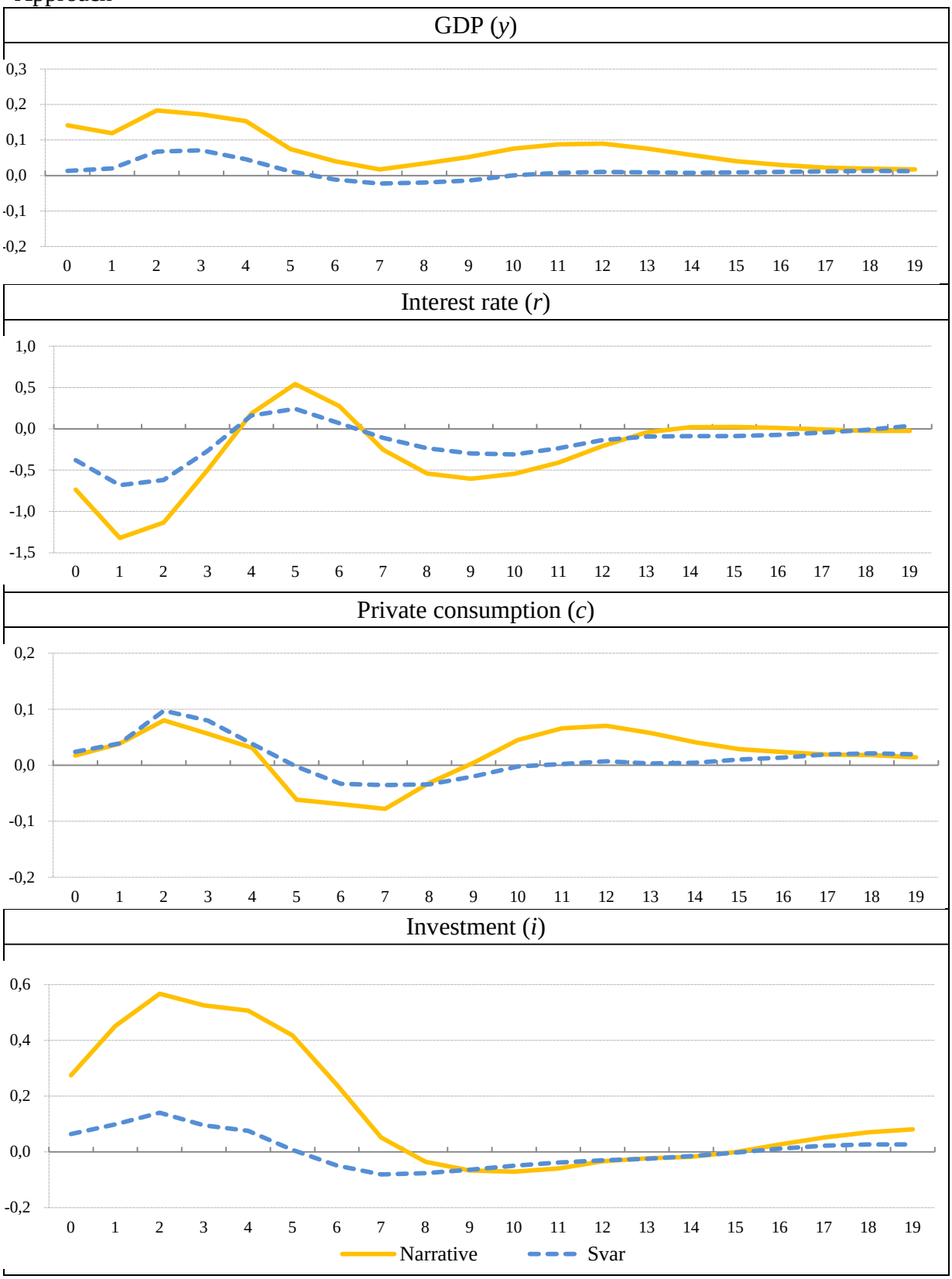


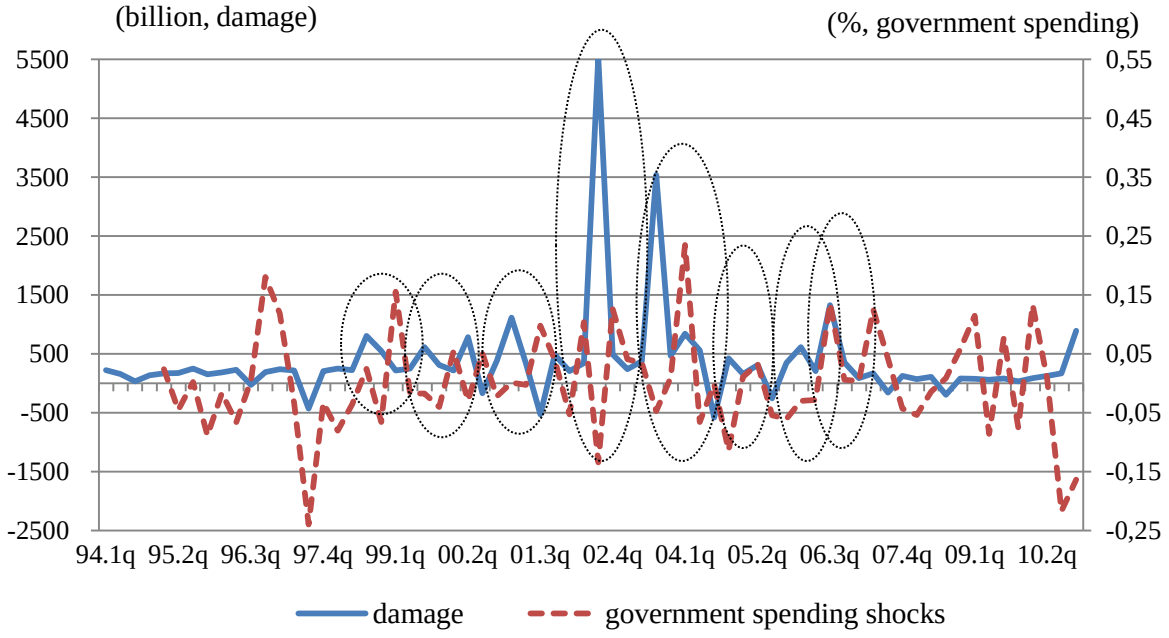
Figure 8. The comparison of the responses from one quarter forward-shifted in the Narrative Approach



Two possible explanations could be made for this observation. One is that this reflects the 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. Therefore, private agents anticipate fiscal policy to respond to the natural disaster. As a result, the response at the beginning of the natural disaster in the narrative approach is reinforced by this anticipation effects. 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) display 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 (2011) 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.

The other possible explanation for the difference in magnitude is the nature of the fiscal shocks. The SVAR approach identifies all kinds of shocks in government spending regardless of the size and cause, only if 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 military build-ups of Ramey (2011) or economic damages due to natural disasters in this paper. Therefore, the SVAR approach identifies a broader range of fiscal shocks, including but not limited to those identified by the narrative approach. Figure 9 shows that the shocks identified by natural disaster damages precede by 1~2 quarters most large government spending shocks identified by the SVAR. 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 response of other variables is also relatively large.

Figure 9. The comparison of the government spending shocks according to SVAR and the narrative approach



Moreover, as the defense news variable of Ramey (2011) is restricted mainly to the defense sector, the resulting multiplier can be different from that for nondefense purchases (Barro and Redlick, 2011). Likewise, in using this natural disaster damage, 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 Benetrix 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.

6. Robustness Checks

This section presents a variety of robustness checks in connection with the two approaches, and lists the results. First, we need to check whether and how far the natural disaster damages affect the supply side of the economy. Second, we use natural disaster relief expenditure (NDRE) 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 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 rates is opposite to the theoretical prediction, which we attribute to the fact that they respond to monetary rather than fiscal policy. We test whether this interpretation is justified.

6.1. Supply side effects of natural disasters

When natural disasters occur, they destroy property, including manufacturing facilities and infrastructure, and may also cause human casualties. This is likely to affect industrial production and labor supply, which would make government spending shocks endogenous with respect to macroeconomic variables.[37] However, as most natural disasters in Korea impact only relatively small regions, we believe this effect of natural disasters on the supply side to be relatively small or non-existent.

Nevertheless, to explore the potential supply-side effect of natural disasters, we test for the serial correlation between the natural disaster variable and a number of supply-side variables. Production variables such as agriculture-forestry-fishing sector of GDP (primary industries), industrial production index, manufacturing production capacity, and producer price index are chosen as representative of the supply side. The agriculture-forestry-fishing sector of GDP is

37 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, Raddaz (2007) argues that although natural disasters have negative effect on GDP in low income countries, the effect is very small.

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 labor market.

Table 7 shows whether the damage of natural disaster has any explanatory power with respect to the change in the supply side variable using Granger-Causality test with 2 quarters of lags, which is same as in the analysis of the relationship between natural disaster damage and government spending shocks. Clearly, natural disasters do not Granger-cause any supply side variables. When testing Granger-Causality again with 4 quarters of lags, it Granger-causes the agriculture-forestry-fishing sector. 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 can also 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 account for a very small portion (on average 3.3%) of Korea's GDP. Therefore, we can conclude that natural disaster damages have very weak or no impact on supply side variables and this variable is therefore exogenous.

Table 7. Granger Causality Test

(Lags : 2)

Null Hypothesis:	F-Statistic	Probability
DAMAGE[1] does not Granger Cause AGRICULTURE_FISHING[2]	2.04103	0.13867
AGRICULTURE_FISHING does not Granger Cause DAMAGE	5.93016	0.00443
DAMAGE does not Granger Cause MANU_OPERA_RATE[3]	0.32854	0.72124
MANU_OPERA_RATE does not Granger Cause DAMAGE	0.10708	0.89862
DAMAGE does not Granger Cause MANU_PRO_CAPACITY[4]	0.19388	0.82427
MANU_PRO_CAPACITY does not Granger Cause DAMAGE	0.81239	0.44854
DAMAGE does not Granger Cause INDUSTRIAL_PRODUCTION[5]	1.76001	0.18067
INDUSTRIAL_PRODUCTION does not Granger Cause DAMAGE	0.23975	0.78756
DAMAGE does not Granger Cause PRODUCER_PRICE[6]	0.15924	0.85315
PRODUCER_PRICE does not Granger Cause DAMAGE	0.13404	0.87481
DAMAGE does not Granger Cause EMPLOYMENT[7]	0.24514	0.78336
EMPLOYMENT does not Granger Cause DAMAGE	0.09482	0.90967
DAMAGE does not Granger Cause UNEMPLOYMENT[8]	0.11859	0.88837
UNEMPLOYMENT does not Granger Cause DAMAGE	0.15842	0.85384

1』 Estimated economic damages by natural disasters; 2』 Agriculture-Forest-Fishing sector of GDP; 3』 Manufacturing production capacity; 4』 Manufacturing operation ratio, 5』 Industrial production index; 6』 Producer price; 7』 Employment to population ratio; 8』 Unemployment rate

Notes: all variables except employment ratio and unemployment rate are log-transformed and linearly time-detrended. In order not to have unit roots, only manufacturing production capacity is expressed differentiated over preceding period. Also, all variables are seasonally- adjusted.

6.2 Effects of Natural Disaster Relief Expenditure (NDRE)

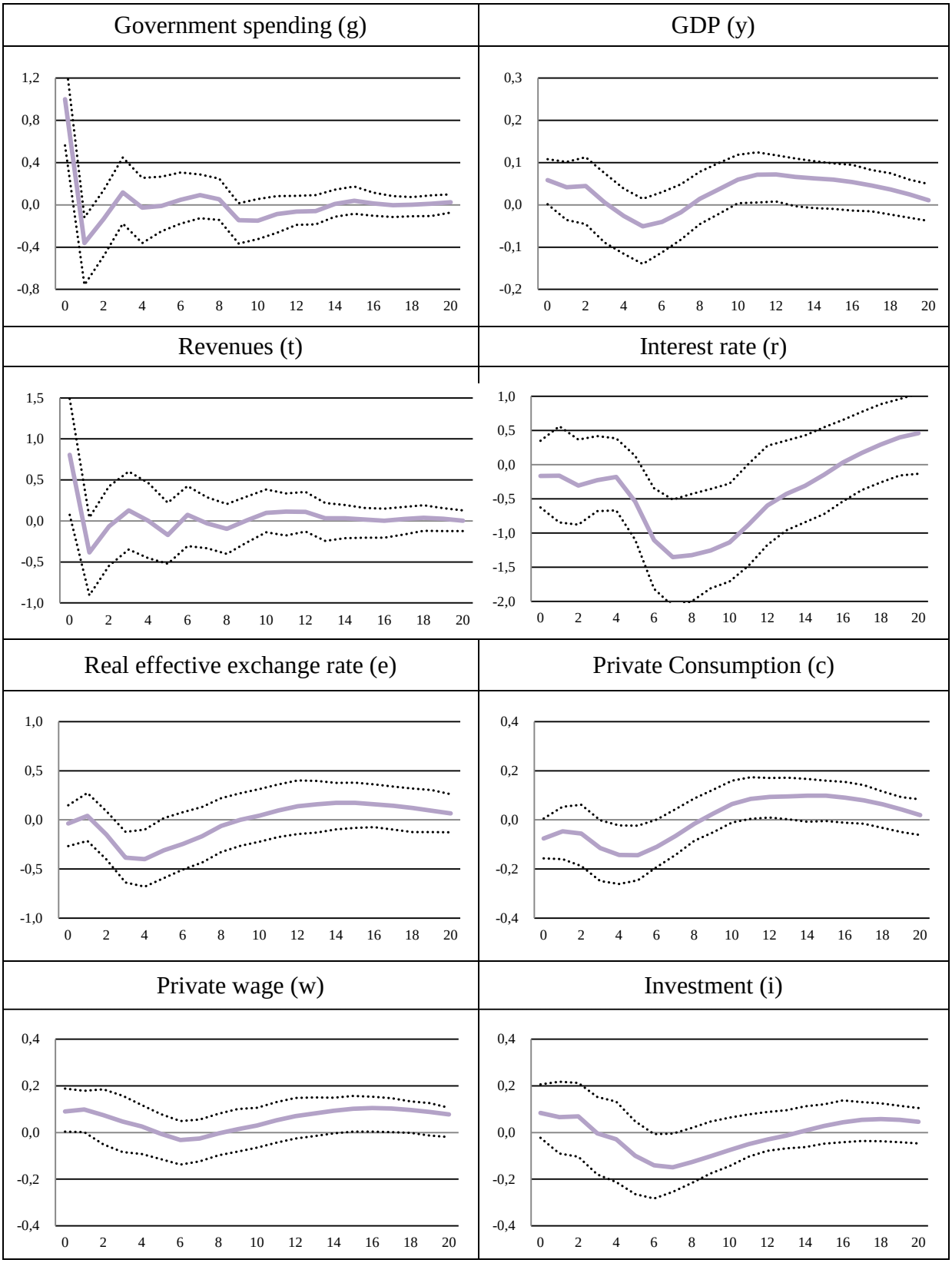
As pointed out before, the damages variable is not only a significant cause of the government spending shocks but also an important predictor of such shocks. When economic damages are used in the preceding section, the specification includes this exogenous variable with lags of 0 to 2 according to the 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 conditions for the analysis are the same as in the previous analysis using the narrative approach.

Figure 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 7 and 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 due to natural disasters are a subset of the fiscal shocks identified by the SVAR. Therefore, when comparing the results obtained with economic damages (Figure 5) and with NDRE (Figure 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 10) with the SVAR ones (Figure 6), the responses in Figure 10 follow the trends of SVAR in Figure 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.[38]

This analysis therefore confirms the existence of an anticipation effect of the private sector, which is hard to capture with the SVAR approach. As Ramey (2011) 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.

38 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.

Figure 10. The response of macroeconomic variables to the NDRE shocks

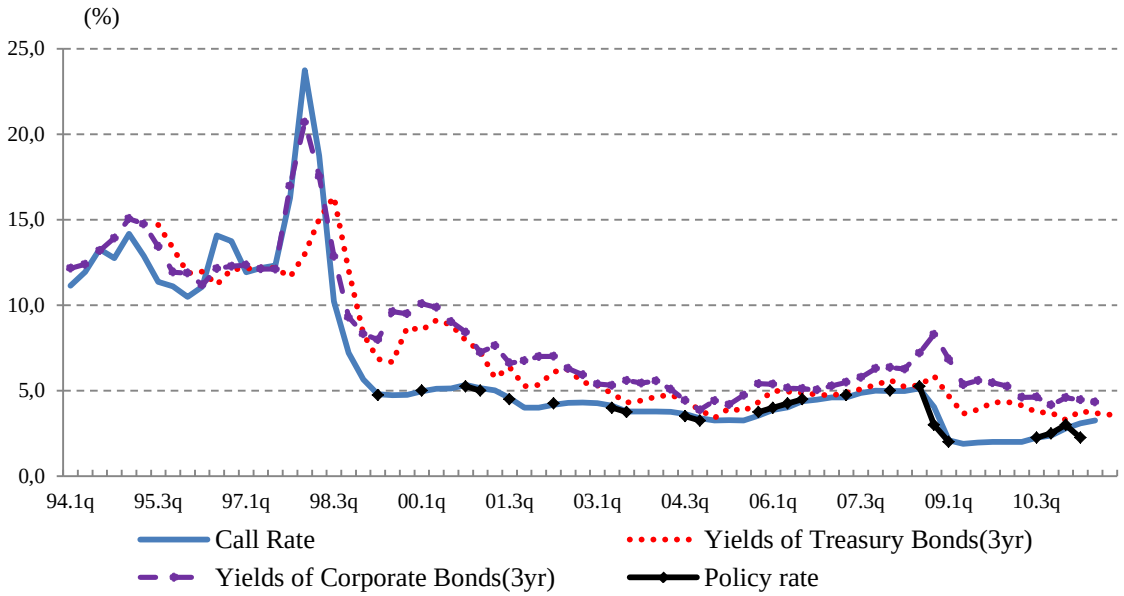


6.3 Response of interest rate without considering monetary policy

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.[39] 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.[40]

Korea has experienced two big economic crises: the Asian crisis of 1997 and the global financial crisis of 2008. Especially, 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 11 shows the trends of market rates and the policy rate.[41] 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 is may be too short a period for VAR analysis.

Figure 11. The trends in interest rates in Korea



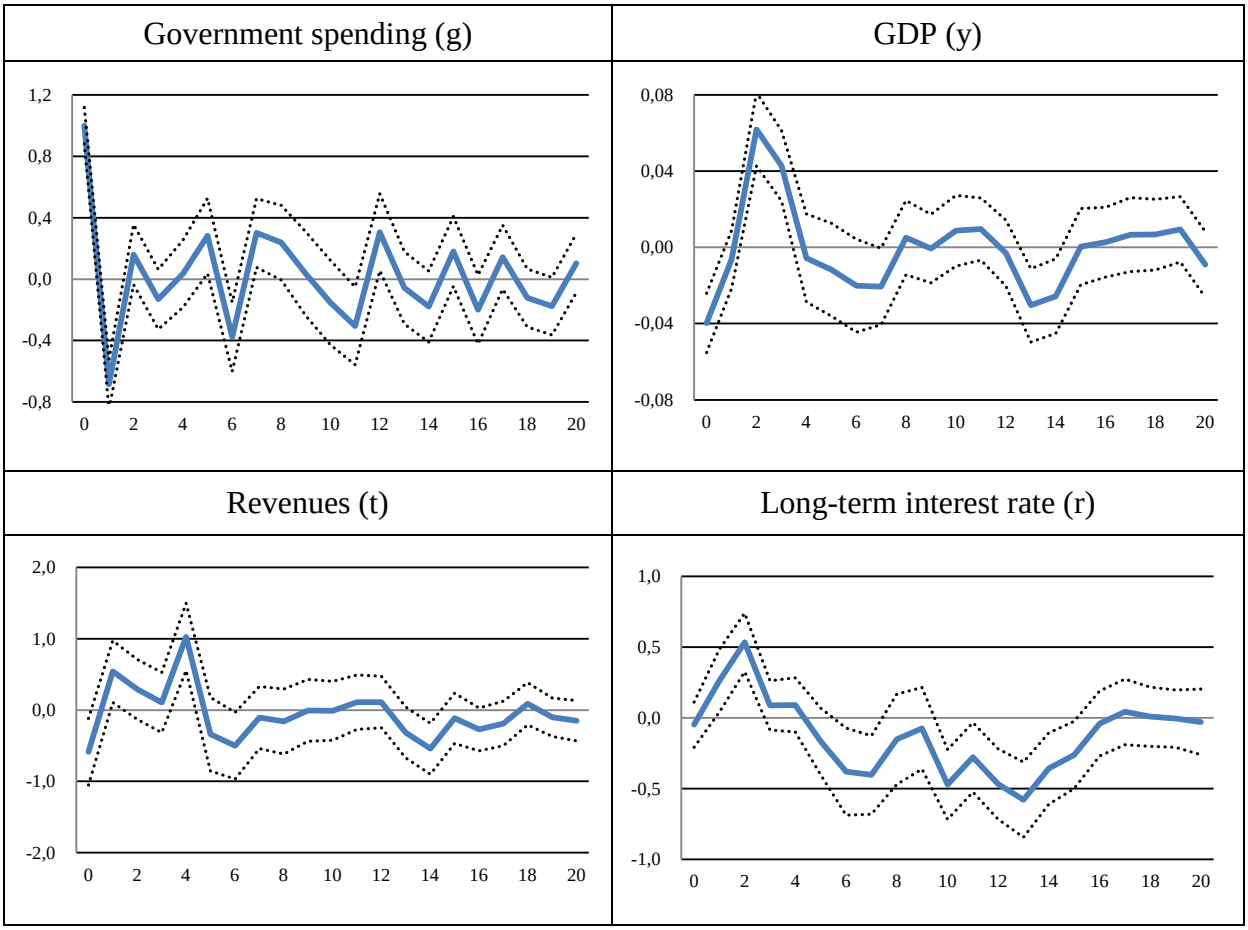
39 Perotti (2005), De Castro and de Cos (2006) and Giordano et al (2007) use the long-term interest rate. On the other hand, Ramey (2011) and Caldara and Kamps (2008) use the short-term interest rate.

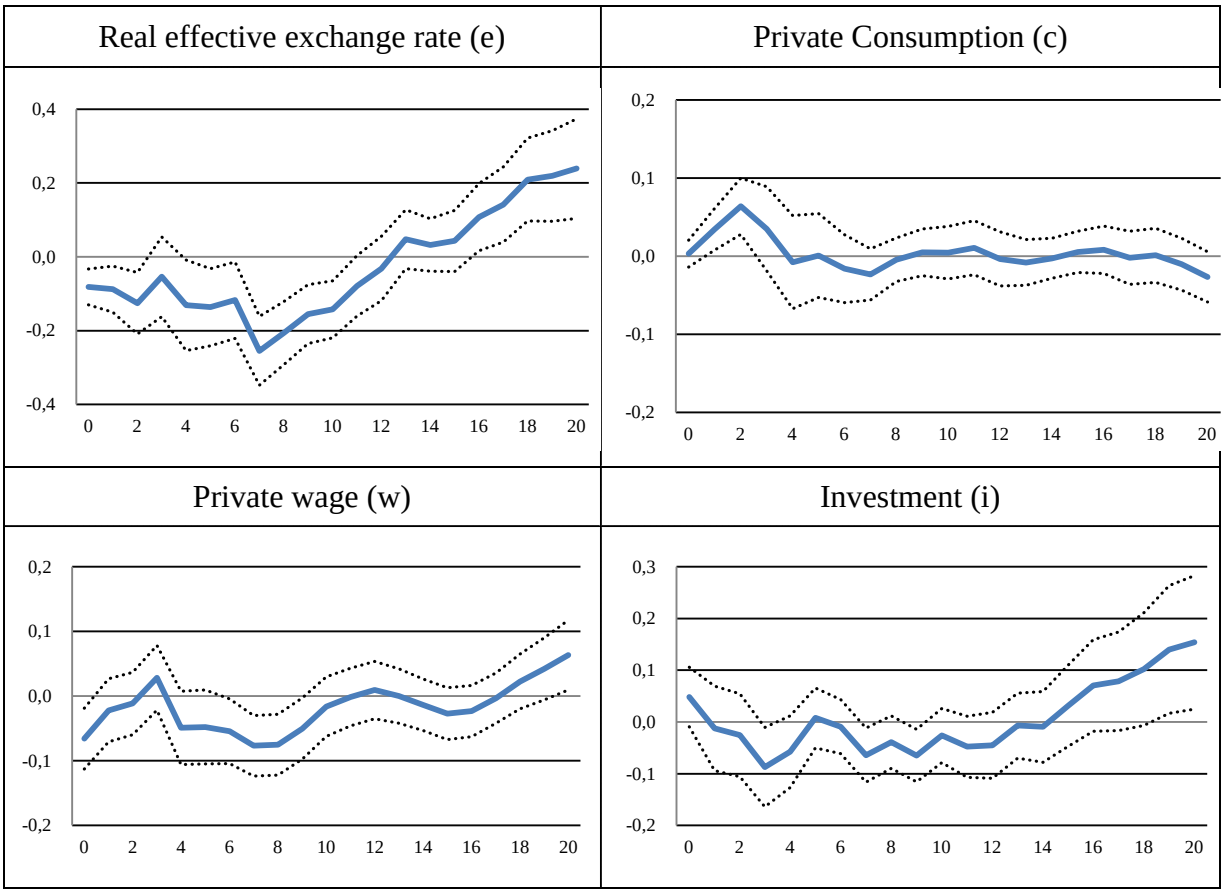
40 Giordano et al (2007) similarly analyze the response of short-term interest rates as robustness checks and find that there is no noticeable difference between the results with long-term and short-term interest rates.

41 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 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 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 (0.049) of its response is much smaller than the peak (0.071) in the previous analysis. 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 12. The response to government spending shocks for 1999.1q~2008.3q





7. Conclusions

This paper has analyzed 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. 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 US economy. We argue that military build-ups have limited application outside of the US context: few other countries have been involved in mainly extra-territorial conflicts associated with increases in government spending without a concurrent negative supply effect. Moreover, the relevance of studying military build-ups is also questionable inasmuch as we want to gauge the effects of government spending shocks: the nature of spending associated with such build-ups is dramatically different from 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 economic damages are useful in that they can capture the

different intensity of government spending shocks and in that the associated relief expenditure is similar to the general government activities. In addition, unlike military build-ups used in the literature on US fiscal shocks, our methodology can be easily extended to other countries.

Our main findings are as follows. First, when government spending increases temporally, the response of GDP remains consistently positive for a considerable time. The responses of private consumption and real wage are also positive according to both approaches. Similarly, investment increases in response to the increase of government spending. Therefore, our results are consistent with the New Keynesian model, regardless of the methods 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 (2011), 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.

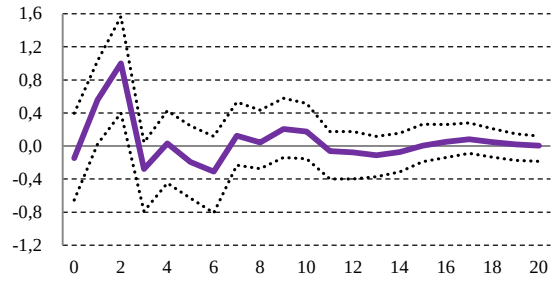
Further research could use natural disaster to identify fiscal shocks and their effects in other countries. This would help confirm the general applicability of this method and our findings. In contrast to using military build-ups, many countries are sufficiently exposed to natural disasters to make this method feasible outside of the US context. The data on such disasters and the associated damages is 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 our paper, most natural disasters befalling Korea are relatively small and localized and therefore are likely to have at the most modest supply side effects, which justifies our approach to studying the effects of fiscal policy shocks.

Appendix

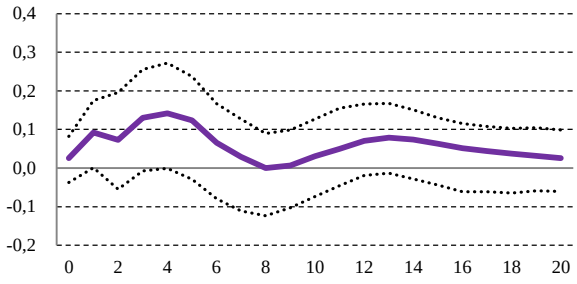
A. Results from the specification with a dummy variable of natural disasters

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%

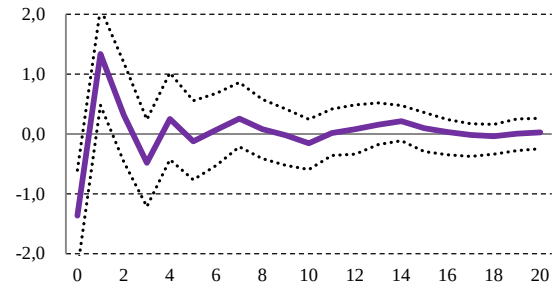
Government spending (g)



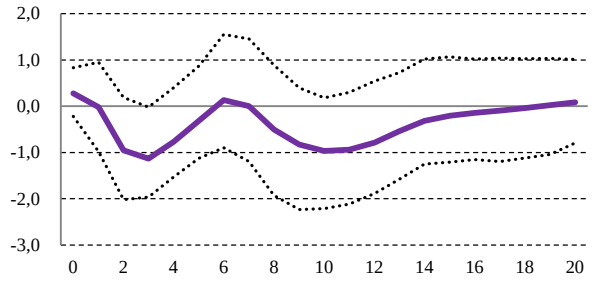
GDP (y)



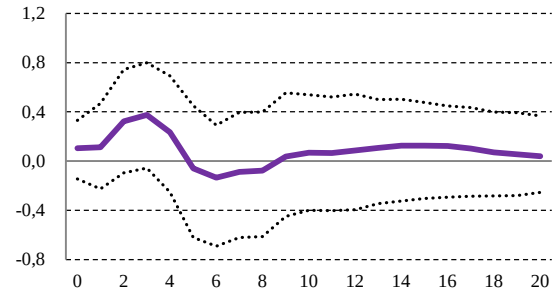
Revenues (t)



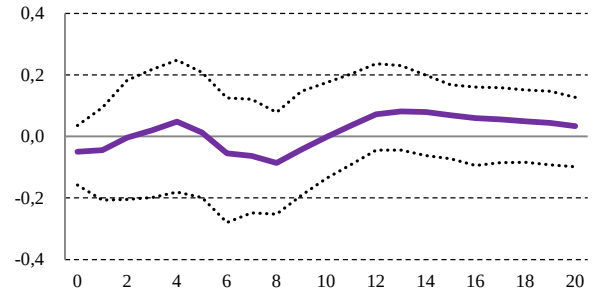
Interest rate (r)



Real effective exchange rate (e)

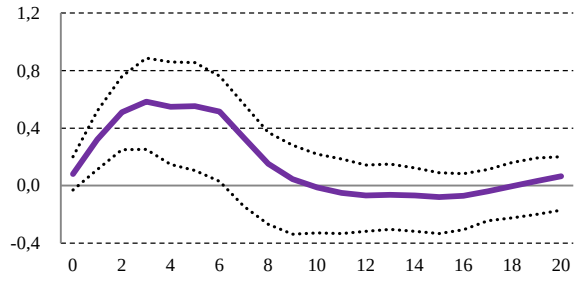


Private Consumption (c)

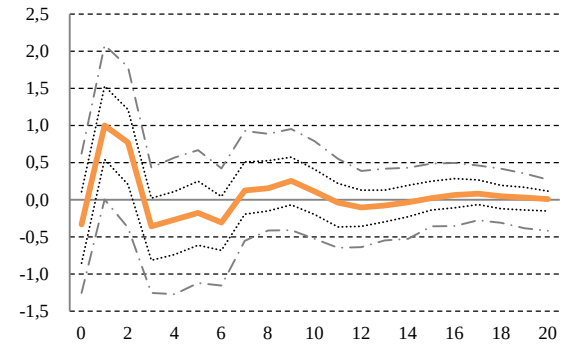
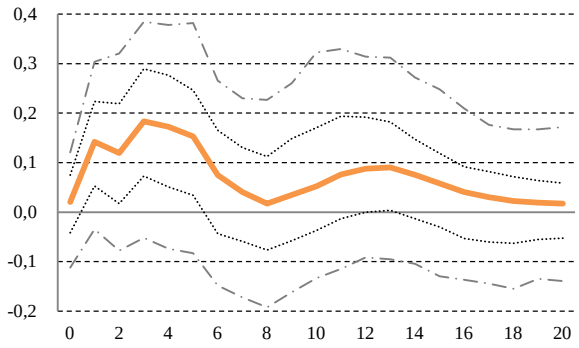
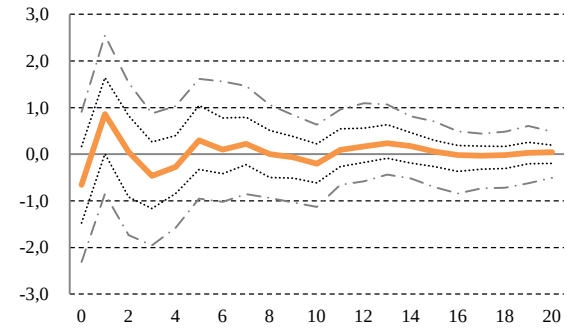
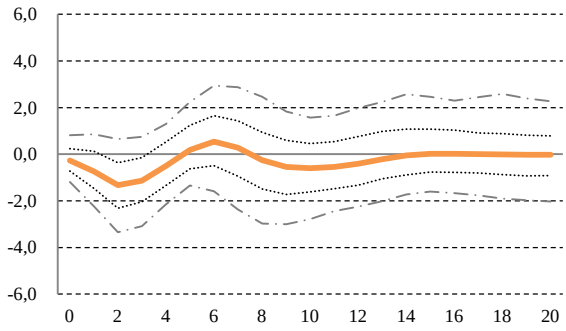
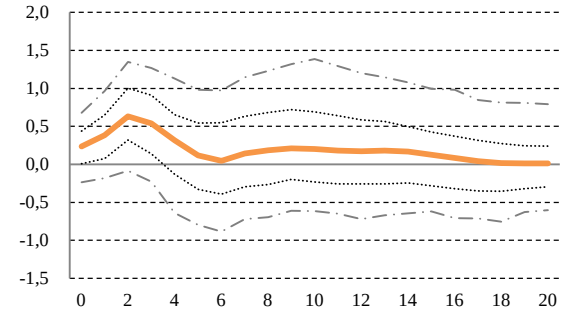
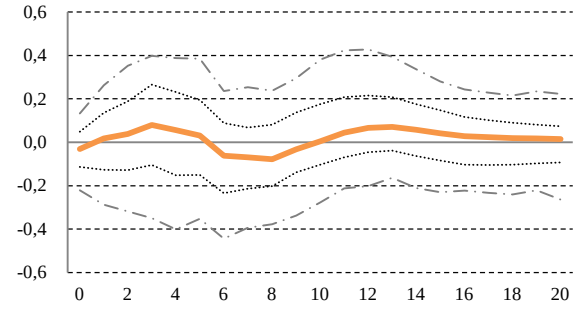
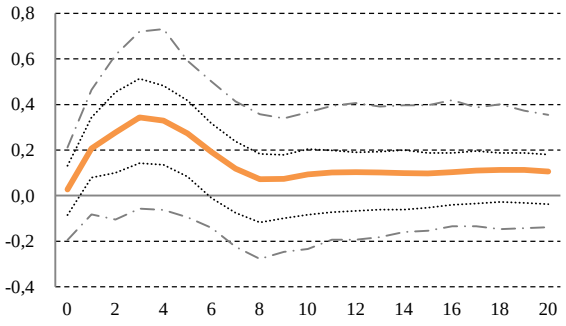
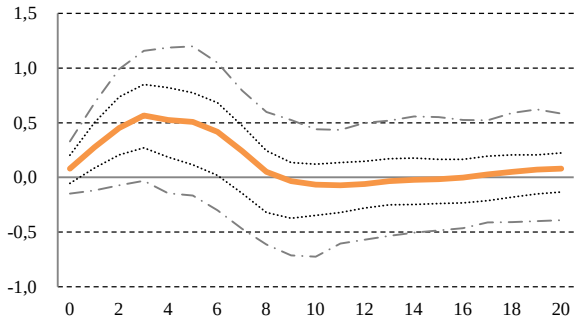


Private wage (w)

Investment (i)



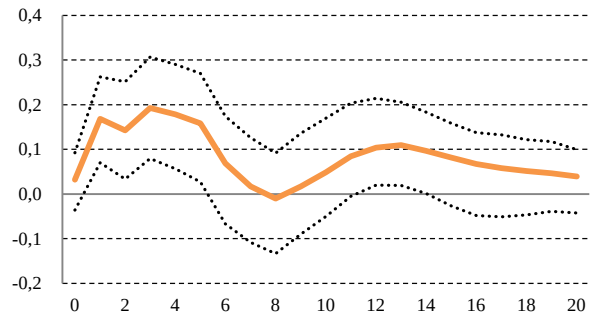
B. 68% and 95% confidence band using the narrative approach.

Government spending (g)	GDP (y)
	
Revenues (t)	**Interest rate (r)**
	
Real effective exchange rate (e)	**Private Consumption (c)**
	
Private wage (w)	**Investment (i)**
	

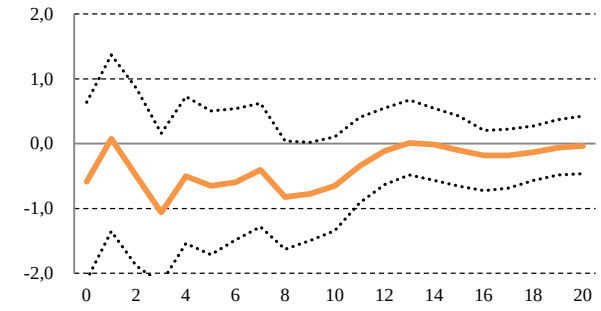
C. Analysis with tax revenues using the narrative approach

Government spending (g)

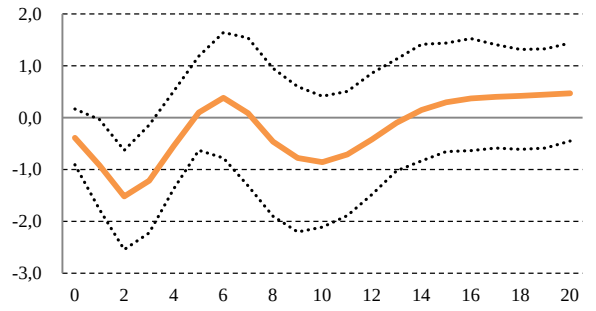
GDP (y)



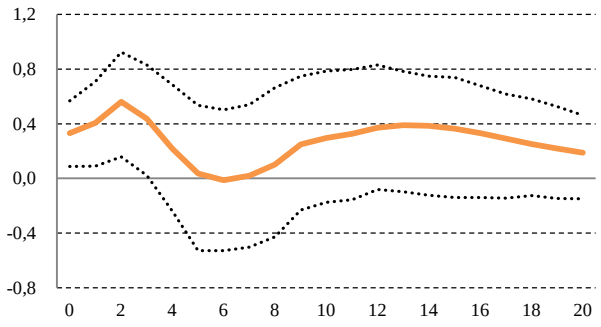
Tax revenues (t)



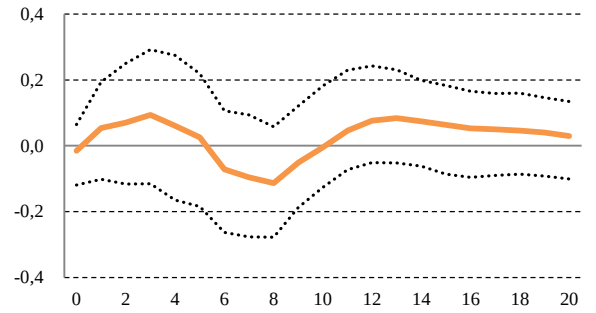
Interest rate (r)



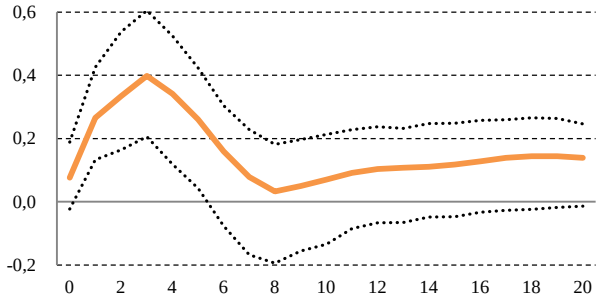
Real effective exchange rate (e)



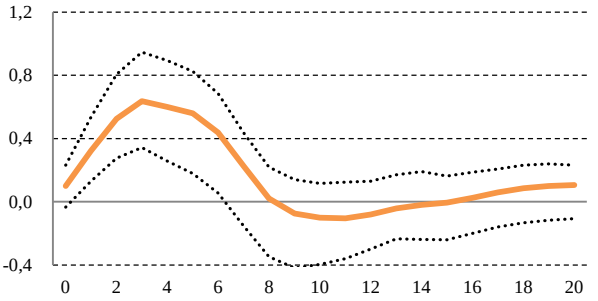
Private Consumption (c)



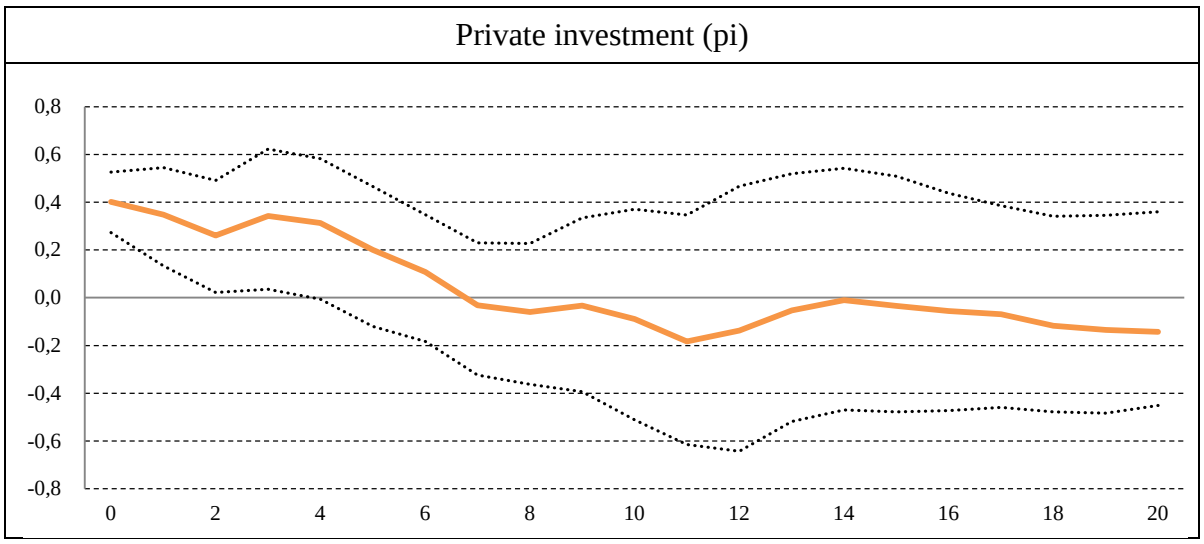
Private wage (w)



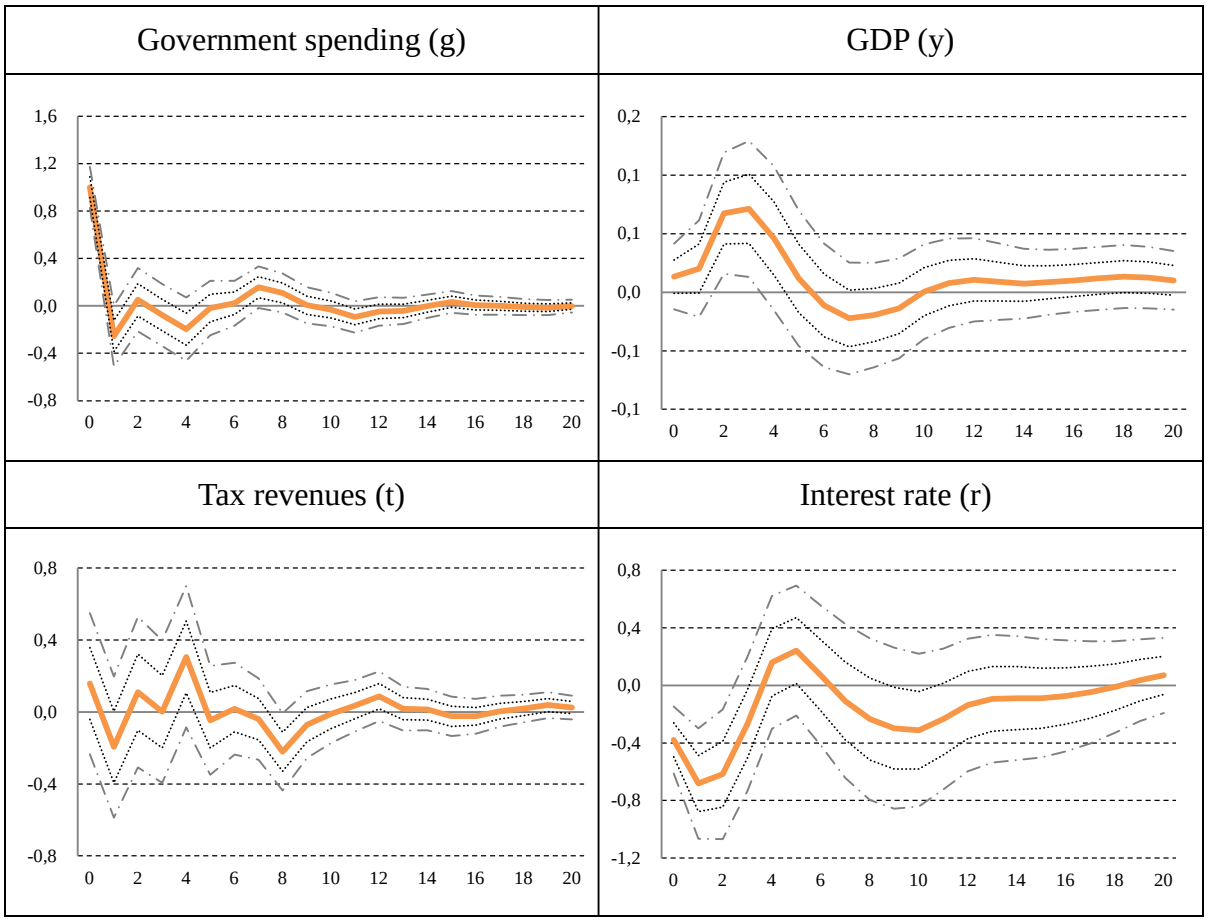
Investment (i)

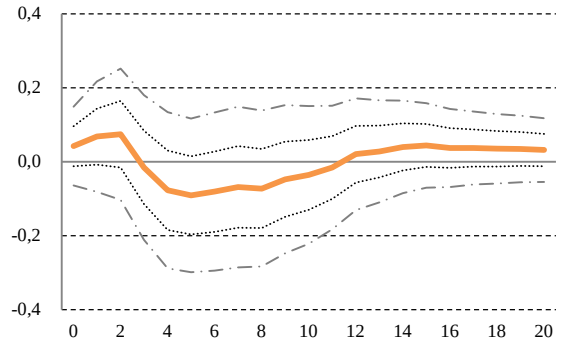
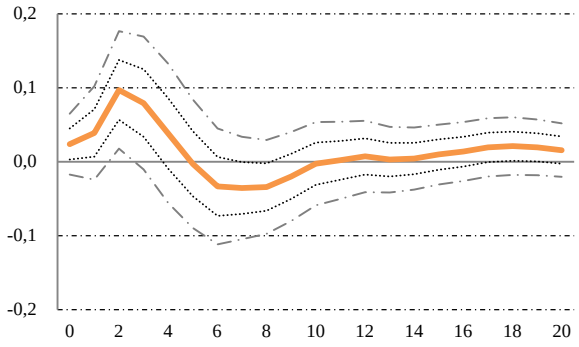
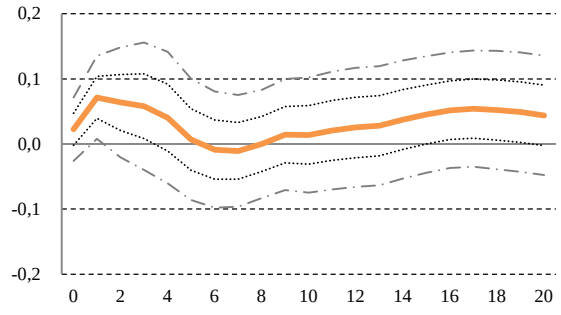
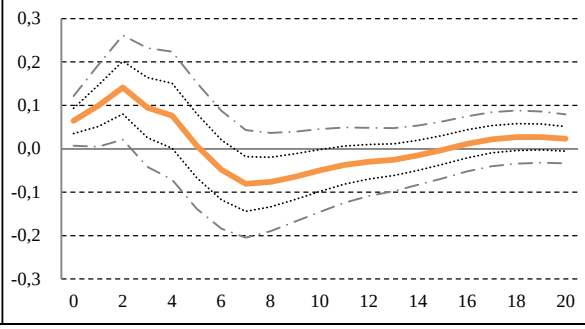


D. The response of private investment to government spending increase using the narrative approach for 2000~ 2010



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



Real effective exchange rate (e)	Private Consumption (c)
	
Private wage (w)	**Investment (i)**
	

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