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The Effects of Government Spending Shocks with Fiscal Foresight

재정예측을 고려한 정부지출충격의 효과 분석

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Abstract

The Effects of Government Spending Shocks with Fiscal Foresight

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This thesis investigates the effects of government spending with consideration of fiscal foresight. In chapter 2, we suggest that a part of the controversy in the literature may be explained by the difference in the nature of the shocks identified by Ramey (2011b). We show evidence of inconsistency in the results in Ramey (2011b); we also explain the mixed results in follow-ups in Ramey (2011b). Moreover, we study the effects of the news shock by constructing changes in the expected present value of changes in government spending based on the SPF data, as in the first method. With this modified method, we investigate the effects of anticipated government spending shocks and discuss whether the empirical results are consistent with the neoclassical view.

In chapter 3, we study the effects of unanticipated government spending shocks. Our focus is on verifying whether a specific VAR model has funda-

mental representation by a theoretical model and empirical test. First, we discuss three widely used specifications of VAR models—conventional structural VAR (SVAR), expectation-augmented VAR with forecast error (EVAR FE), and expectation-augmented VAR with future news (EVAR FN)—with theoretical examples.

We conduct the formal presentation of fundamentalness based on two types of news processes: observable news process and noisy news process. We find that i) assuming that agents can observe the news clearly, SVAR may not be fundamental. Also, EVAR FE may still be non-fundamental, but EVAR FN be fundamental. ii) With noisy news assumption, a simple remedy of adding relative information may not be working in terms of theoretical models. EVAR FN become also nonfundamental where the news is noisy.

In the second part of chapter 3, we empirically examine the fundamentalness of three VAR specifications. We conduct the orthogonality test of Forni and Gambetti (2014c) to check whether the shocks from each VAR are fundamental. We find that unanticipated government spending shocks estimated from SVAR and EVAR FE are likely to be non-fundamental, but EVAR FN is not.

Keywords: Structural VAR, fiscal policy, government spending, fiscal foresight,non-fundamental representation, News,Survey of Professional Forecasters

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Chapter 1

Introduction

Unprecedented financial crises have brought many world-wide economic changes. One of the biggest changes has been on the policy of easing business cycle fluctuations. Beyond its historical scope, monetary and fiscal policies have been used to reboot the economy by stimulating activities of the agents. However, traditional excises of policy do not appear to work as effectively as in the past, and this pushes the scope of the policy beyond its conceptual boundary, for example, the zero lower bound in monetary policy. With the increasing severity of the crisis, decreases in the effectiveness of traditional policy have been perceived, and the importance of stimulating the confidence or expectation held by private agents has been the focus of policy makers, economists, and the media to enhance the effects of policy on the economy.

Expectation—which can also be considered confidence or foresight—can

play a significant role in the economy. In the business cycle literature, change in expectation is discussed as an important driver of business cycle fluctuations. A sharp, exogenous change in expectation followed by sudden shifts in demand may explain the boom–bust phenomenon.[1] In addition to expectation's role as a driver of business cycle fluctuations, how the agents build their expectation may affect the transmission and consequences of policy. SchmittGrohé and Uribe (2012) investigated the effects of seven types of different structural shocks, which disentangled as unanticipated and anticipated according to the foresight, on the economy. Barsky and Sims (2012) examined the nature of consumer confidence from the views in the literature: animal spirits, news, and noise. In conjunction with a New Keynesian model, they studied the impulse response of confidence and concluded that confidence innovations can be characterized as a noisy measure of changes in expected productivity growth over a long period.

With respect to foresight, fiscal policy is one topic that is actively investigated, and fiscal policy is a clear example of where the foresight issue has its gravity. The policy variables, taxes, or government spending are relatively easy for the agents to observe compared to other structural shocks, like productivity. The information flow of fiscal policy can be conceptually well organized according to its legislative process.[2]Before enactment of a newly proposed pol-

[1]See Beaudry and Portier (2014), which is a thorough survey paper about the news-driven business cycle literature.

[2]With considering of the importance in legislation in the information process, Leeper et al. (2013) reorganized labels of period in the process of policy implementation, like recognition and decision lags from Friedman (1948) as inside and outside lags. See Leeper et al. (2013) for the details.

icy, a discussion about the policy is needed, and in the process of discussion, private agents can access the news about future policy, which enables agents to adjust their behavior before policy implementation. In sum, the expected fiscal policy change can be well adapted in the behavior of private agents before its materialization.

Clearness of foresight structure stimulated research about fiscal foresight. Building explicit models with foresight structure has been investigated for several key features of foresight, including foresight period and accuracy or intensity of foresight. [3] Based on the assumption about foresight structure, studies have examined the effects of fiscal foresight on equilibrium dynamics. When news arrives, the accuracy of the news and how the agents respond to the news are assumed. To identify the effects of foresight on equilibrium dynamics, disentangling structural shocks, including unanticipated and anticipated, and examining the relative importance of the shocks on the business cycle have been studied.[4].

In the empirical literature, fiscal foresight is both important and problematic. A news shock literature shed some light on the different nature of the shocks with respect to foresight. However, foresight has been considered as culprit of bias in VAR estimation. It generates a "nonfundamentalness" problem to the VAR literature. Since foresight cannot be incorporated in current and past observables, an estimation with a time series without information about the future state of the economy or fundamentals may be biased. In other words,

[3] See Leeper et al. (2012, 2013) for theoretical and empirical estimation of fiscal foresight.
[4] See SchmittGrohé and Uribe (2012); Mertens and Ravn (2010)

if foresight is not considered, the timing of the shock perceived by agents may be different from that of an econometrician. Agents can adjust their behavior when the news arrives, but an econometrician estimates the timing of the shock when the policy variable is changed. As a results, the responses estimated by the econometrician may not be the "response" to a specific policy shock.

Although the gravity of foresight in the transmission of fiscal policy is well perceived, it is still unclear how agents build their expectation about a certain policy and how agents respond to a positive change of tax or government spending. For government spending, the reaction can be captured by the GDP components, like consumption and real wage, and these are key channel variables in empirical research. If the agents respond to increases in government spending according to the negative wealth effects view, they will reduce their consumption and raise labor supply so that aggregate consumption and real wages will decrease. Other theory models indicate increasing consumption and real wages after a positive shock of government spending with additional features. However, estimated changes in consumption and real wages could come from other sources, such as the state of the economy, highlighting why the identification of exogenous shock or change in government spending is important in the empirical literature.

The foresight structure of fiscal policy, fiscal foresight, is being actively discussed as a way to achieve the exogeneity of fiscal shocks. However, due to difficulties in measuring foresight, empirical studies have incorporated various measures of expectation, which are not consistent each other. The conclusions

on the key variables, GDP, consumption, and real wage are also diverse. In theoretical research, foresight structure of specific episodes may be widely diverse from each other, and investigation of general form of foresight on the economy has been conducted.

Despite the fact that interactions between theoretical and empirical research on fiscal foresight are ongoing, more interaction is needed to gain consensus about key questions: how the GDP and its components will respond to a positive change of government spending and what the effects of unanticipated and anticipated government spending shocks are. By comparing the measures in literature and examining foresight structure with respect to identification of shocks with foresight, this thesis sheds some light on an appropriate empirical methodology to address the research question with respect to assuming a certain information structure. Although identifying the information structure that best fits the data is beyond the scope of this thesis, identifying which method is better on a specific assumption is possible. Moreover, although the information included in the model has its value, the way of incorporating information may hinder resolving the problem generated by fiscal foresight. Specifically, if one wants to identify the effects of foresight about future government spending, the measure included in the empirical model should capture future information rather than excluding past foreseen part. If one wants to investigate the response of the economy to unanticipated government spending shocks, excluding past expectations may not sufficiently address fiscal foresight issues. In Chapters 2 and 3, these issues are addressed in more detail.

Chapter 2

Government Spending News Shocks

2.1 Introduction

The seminal paper of Ramey (2011b) asserted that government spending shocks identified by the popular VAR framework, such as that of Blanchard and Perotti (2002), can be anticipated and that this can lead to a spurious result on the effects of fiscal policy. To address this issue, Ramey (2011b) constructed government spending news variables and introduced them into the standard VAR model. Ramey (2011b) found that the effects of government spending news shocks are substantially different from those of government spending shocks in the standard VAR model without a news variable (for example, Blanchard and

Perotti (2002); Galí et al. (2007)). In particular, consumption and real wage fall and the government spending multiplier is low, contrary to the results in the standard VAR model. Ramey (2011b) suggested that such results support the neoclassical view and that the timing issue is important in explaining why a narrative approach, such as that of Ramey and Shapiro (1998), often found negative effects on consumption and real wage.

Following Ramey and Shapiro (1998) and Ramey (2011b), subsequent studies on the effects of fiscal policy introduced news variables in the standard model, for example, Edelberg et al. (1999); Burnside et al. (2004); Caldara and Kamps (2008); Monacelli et al. (2010); Tenhofen and Wolff (2010); Barro and Redlick (2011); Perotti (2011); Rossi and Zubairy (2011); Auerbach and Gorodnichenko (2012, 2013); Bachmann and Sims (2012); Born et al. (2013); Ben Zeev and Pappa (2014); Forni and Gambetti (2014a) and Caggiano et al. (2015) among many others. However, even these subsequent studies found controversial results on the effects of government spending shocks. For example, using Ramey and Shapiro (1998) war date dummy, found consumption falls in response to government spending shocks, while Caldara and Kamps (2008) and Monacelli et al. (2010) showed a positive response of consumption and real wage. Employing measures in Ramey (2011b), decreases in consumption and real wage were reported by Corsetti et al. (2012) and Tenhofen and Wolff (2010), while Ben Zeev and Pappa (2014) showed increases in consumption and real wage.

With close examination of Ramey (2011b)'s results, we find that the results

are somewhat different under the two methods used by Ramey (2011b). Ramey (2011b) constructed news variables in two ways. First, for the period including WW II and the Korean War, an estimate of changes in the expected present value of government spending was constructed based on Business Week and other newspaper sources. Second, for the post-Korean War period, forecast errors of changes in government spending were constructed based on the Survey of Professional Forecasters(SPF). We find that there are differences in the response to government spending and in the key variables, such as GDP, hours, consumption, and real wage, in the VAR with the two measures in Ramey (2011b).

We suggest that the empirical results are inconsistent because the government spending shocks identified under the two methods are different in nature. Only the first method makes sense because it takes account of anticipated future changes in government spending. Shocks to forecast errors of changes in government spending are not likely to capture expected future changes in government spending, which is important in evaluating theory. Our results are in line with those of Perotti (2011); Forni and Gambetti (2014a); Caggiano et al. (2015). Perotti (2011) points out that factors, such as the sample period including 2008, the composition, and the explanation power of forecast error, may be problematic. Forni and Gambetti (2014a) and Caggiano et al. (2015) claim that Ramey (2011b)'s SPF forecast error shocks may not be appropriate to estimate the news shock of government spending based on the amount of information; this is supported by the test results that their news measures can expect a

forecast error in Ramey (2011b).[1]

As a contribution to the existing literature, we suggest that a part of the controversy in the literature may be explained by the difference in the nature of the shocks identified by Ramey (2011b). We show evidence of inconsistency in the results in Ramey (2011b); we also explain the mixed results in follow-ups in Ramey (2011b). Moreover, we study the effects of the news shock by constructing changes in the expected present value of changes in government spending based on the SPF data, as in the first method. With this modified method, we investigate the effects of anticipated government spending shocks and discuss whether the empirical results are consistent with the neoclassical view.

The rest of the paper is organized as follows. Section 2.2 explains two methodologies of Ramey (2011b) and discusses the nature of shocks identified in each method. Section 2.3 suggests a modified methodology and shows the empirical results based on these modifications. Section 2.4 shows the robustness of the empirical results, and Section 2.5 concludes with a summary of the findings.

[1] Also, Caggiano et al. (2015) and Forni and Gambetti (2014a) focused on the estimation of news shock by employing their own measures in different set ups, rather matching their results with the first measures of Ramey (2011b).

2.2 Ramey (2011b)'s Models with Government Spending News Variables

2.2.1 Two Empirical Models in Ramey (2011b)

Ramey (2011b) suggested that conventional VAR models with government spending fail to identify government spending shocks properly, because changes in government spending are often anticipated before actual changes are implemented. Therefore, Ramey (2011b) constructed expectation measures incorporating news about future changes in government spending. Ramey (2011b) used two different ways.

First, an estimate of changes in the expected present value of government (defense) spending is constructed by using Business Week and other newspaper sources. Based on these sources, Ramey (2011b) built the narrative data of changes in public expectations, and then constructed the measure of the changes in expected discounted value of government spending from 1939:1 to 2008:4. The changes in present discount value is employed to test the predictions of wealth effect from the neoclassical models. After the news about increases in government spending arrives, agents can have revision about future level of government spending and adjust their behavior accordingly.

$$f_t^{news} = \sum_{j=1}^{\infty} \frac{1}{r_{t+j}} (f^e_{t+j|t} - f^e_{t+j|t-1}) \tag{2.1}$$

This measure (or the "defense news" variable) was added to the conventional VAR model that includes the log of real per capita government spending, the

log of real per capita GDP, the three-month T-bill rate, the Barro-Redlick average marginal income tax rate, and an additional variable of interests such as total hours, the manufacturing product wage, the real BAA bond rate, the three components of consumer expenditures, nonresidential investment and residential investment. In the model, the news variable is assumed to be contemporaneously exogenous to all other variables in the model. Then, the effects of shocks to the news variable are examined.

However, as discussed in Ramey (2011b), the first news series has its most of the explanatory power for the period of WW II and the Korean war, so the results may become different for the periods after wartime. Hence, Ramey (2011b) built an alternative measure for the recent period by using SPF data. To construct news series covering the period after the Korean war, she constructed the second news variable as a consecutive series of forecast errors of defense and federal spending. Specifically, since SPF forecasts for real federal government spending are available only from 1981:3, she extended the sample span by using forecasts of nominal defense spending from 1968:4 to 1981:2.[2] The measure is calculated as the growth rate of forecast errors of real defense and federal spending by the difference between actual government growth rate and forecast growth rate. By combining two forecast error series, the second news variable covers from 1968:4 to 2008:4.

$$f_t^{FE} = \triangle f_t - \triangle f_{t|t-1}^e \tag{2.2}$$

[2]This series is converted into real value by using GDP deflator

Then, this new variable was again added to the conventional VAR model. As before, this news variable is assumed to be contemporaneously exogenous to all other variables and the effects of the shocks to the series are investigated. Although it is unclear from the discussion in Ramey (2011b) as Ramey (2011b) called both variables "news" variables, the nature of shocks identified in two models are clearly different, besides the differences in data sources. In the first model, shocks to news or expectation on future changes in government spending are identified by using changes in the expected present value of government (defense) spending. However, shocks to unexpected changes in government spending are identified in the second model, by using forecast errors of government spending.

Ramey (2011b) emphasized that a proper measure should incorporate news about future changes in government spending since changes in government spending are often anticipated before actual changes are implemented. In the first model, the identified shocks include news about future government spending changes. However, in the second model, a different nature of shock is identified since unexpected shocks to government spending are identified by using forecast errors. It is not clear whether unexpected shocks to government spending can include news about future government spending changes. From now on, we indicate the first model as the model with defense news and the second model as the model with SPF FE (forecast error).

2.2.2 Empirical Results from Two Models

We reproduce the results from the two models of Ramey (2011b). Following Ramey (2011b), we estimate six-variate VAR; $x_t = [News_t, g_t, y_t, r_t, \tau_t, h_t]$ where $News_t, g_t, y_t, r_t, \tau_t$ and h_t are the news variable, log of real per capita government spending, the log of real per capita GDP, the three-month T-bill rate, the Barro-Redlick average marginal income tax rate and a variable of interests. To avoid including too many variables in the model, Ramey (2011b) used the first five variables as a fixed set and rotated the sixth variable as the series of variables of interest, such as hours, real wage and consumption and investment components. We follow this specification. A quadratic time trend and four lags are included in the model.

Figure 2.1 and 2.2 report the results of the first model (or the model with defense news) and the second model (or the model with SPF FE), respectively. Because the identified shocks in two models are different in their natures, it is not surprising that the effects of two shocks are different in some cases. The government spending responses are quite different, which confirms the idea that the nature of two shocks are different. In the first model, government spending starts to increase only from the third quarter after the shock. Then, from the third quarter, government spending increases gradually over time, reaches to the peak in about two years, and then decreases back to the initial level in about four years. This is a likely response to shocks to news on future persistent increase in government spending. Since government spending is anticipated before actual changes, government spending increases only from the third quarter after the

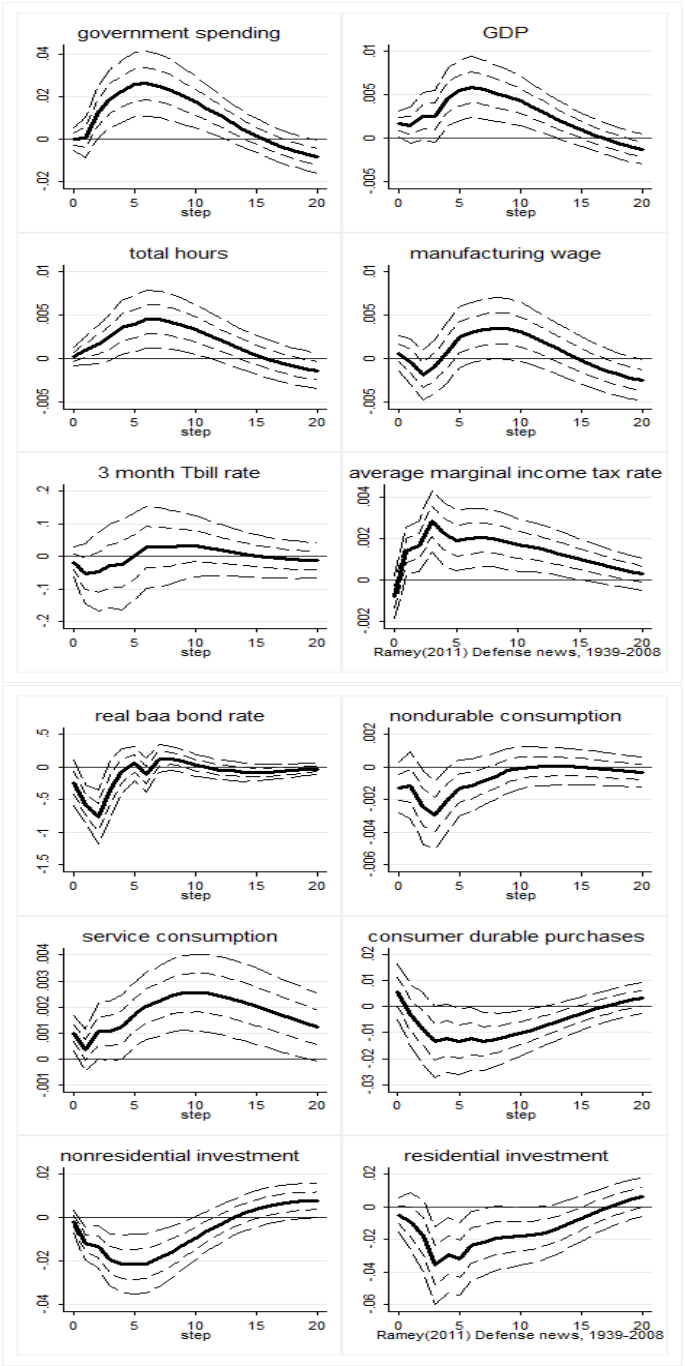

Figure 2.1 Ramey (2011b): Defense news from 1939:1-2008:4

The standard error bands for 68 % and 95 % are displayed.

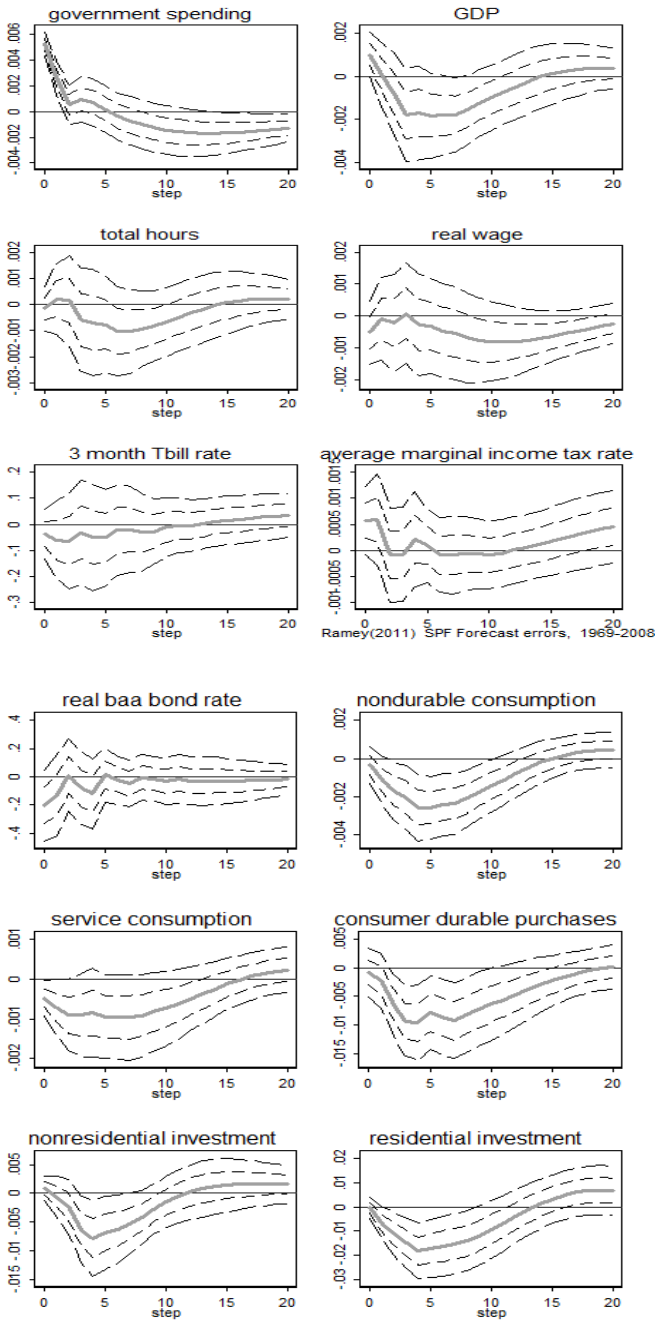

Figure 2.2 Ramey (2011b): SPF forecast error from 1969:1-2008:4

The standard error bands for 68 % and 95 % are displayed.

shock.

However, in the second model, government spending immediately increases and then decreases back to the initial level in the third quarter after the shock. Such responses are likely to be observed when there is a surprise shock of temporary changes in government spending. In particular, such a shock does not seem to capture news about future changes in government spending.

The inference on the effects of government spending shocks is also quite different in two models. First of all, the size of government spending multiplier is different. In the first model, the government spending multiplier tends to be positive, but it is often negative in the second model. Table 2.2 displays the government spending multipliers estimated in two VAR models. In the VAR with defense news, the cumulative multipliers rigidly exceed 1 during 5 years. The multiplier of max to max also exceeds 1. In the second VAR with the SPF FE, The multiplier of peak responses are close to 1.[3] However, because GDP become negative after 2 quarters, the sign of multiplier is not meaningful and the gap between lower and upper bound of the multiplier are much bigger than that of the defense news.

The responses of working hours, real wage, and service consumption are also quite different. In the first model, working hours increase significantly over time and then decreases back to the initial level in about four years, like the responses of real GDP. However, in the second model, hours rather decreases

[3]Our replication on multipliers are consistent with Ramey (2011b)'s multipliers of the peaks. Ramey (2011b) reports only the multipliers of peaks and under integral without lower and upper bounds; the defense news multipliers are 1.1(peak) and 1.2(integral), the SPF FE multipliers are around 0.8(peak) and negative under integral.

	Identification	output multiplier	Consumption	Real wage
Ramey and Shapiro (1998) war dates				
Burnside et al. (2004)	Narrative 1947:1 - 1995:4	+	=	-
Caldara and Kamps (2008)	Narrative 1955:1 - 2006:4	NA	+	=
Edelberg et al. (1999)	Narrative 1948:1 - 1996:1	+	-	-
Monacelli et al. (2010)	Narrative 1954:1 - 2006:4	1.6	+	+
Ramey (2011b) Defense news				
Auerbach and Gorodninchenko (2012)	Smooth transition VAR 1966:1-2009:4	Expansion (-0.49) Recession (3.76)	NA	NA
Caldara and Kamps (2008)	Narrative 1955:1 - 2006:4	NA	+	=
Edelberg et al. (1999)	Narrative 1948:1 - 1996:1	+	-	-
Monacelli et al. (2010)	Narrative 1954:1 - 2006:4	1.6	+	+
Ramey (2011b) SPF Forecast error				
Auerbach and Gorodninchenko (2012)	Smooth transition VAR 1966:1-2009:4	Expansion (-1.23 0.4) Recession (2.09 2.99)	NA	NA
Corsetti et al. (2012)	Narrative 1983:1-2007:4	-	-	NA

Table 2.1 Literatures based on Ramey and Shapiro (1998) and Ramey (2011b)

Notes. The sign +, = , - denotes positive, insignificant, negative. NA means no results about the variable in the corresponding study.

	Defense news	SPF Forecast error	Rebased SPF PV
1 year	1.17 (-4.3, 1.15)	-1.65 (-22.3, 1.59)	-54.2 (1.69, 9.68)
2 year	1.12 (1.11, 1.12)	-6.35 (20.26, 1.24)	54.25 (0.79, 9.14)
3 year	1.14 (1.19, 1.14)	-30.83 (9.04, 1.7)	12.92 (0.59, 6.57)
4 year	1.19 (1.46, 1.17)	15.7 (6.05, 2.79)*	6.85 (1.24, 4.97)
Max to Max	1.11 (1.09, 1.12)	0.97 (-0.01, 1.67)	4.64 (9.42, 4.87)
Integral	1.26 (-0.29, 1.2)	6.19 (5.11, 4.19)*	4.59 (2.45, 4.08)

Table 2.2 Cumulative GDP Multipliers

Notes. Values in parenthesis are 95 % percentiles estimated using 1,000 bootstrap replications. The sign * denotes that the cumulative response of government spending and GDP are both negative.

over time and then increases back to the initial level. Real wage tends to increase in about 1-2 years in the first model, but real wage tends to decrease in the second model. Service consumption increases strongly in the first model, but it tends to decrease in the second model.

In fact, these variables are key variables when we evaluate the theory based on the empirical results. Two contrasting views on the effects of government spending shocks have the opposite predictions on these variables. The neoclassical approach (e.g., Aiyagari et al. (1992), and Baxter and King (1993)) emphasizes a negative wealth effect, and predicts that consumption decreases, labor increases, real wage decreases, and output rises. In contrast, the new Keynesian approach (e.g., Rotemberg and Woodford (1992); Devereux et al. (1996); Galí et al. (2007)) tries to explain a rise in consumption and real wage found in some empirical studies. Among the empirical studies which examine responses of consumption and real wage, SVAR-based studies (e.g., Blanchard and Perotti

(2002); Fatás et al. (2001), sign restriction approach (e.g., Mountford and Uhlig (2009); Pappa (2009)) generally show positive responses of consumption and real wage. On the other hand, narrative approaches like Ramey and Shapiro (1998), and Ramey (2011b) found falls on consumption and real wage.

However, with taking a closer look at the narrative approach literature, the effects of positive government spending shock still have no clear consensus. Table 1 shows the inconsistencies in the narrative approach literature. Using Ramey and Shapiro (1998) war date dummy, Edelberg et al. (1999); Burnside et al. (2004) found consumption falls to the government spending shocks, while Caldara and Kamps (2008) and Monacelli et al. (2010) displayed positive response of consumption and real wage. With defense news in Ramey (2011b), Ramey (2011b) found decreases in consumption and real wage, but Ben Zeev and Pappa (2014) showed increases in consumption and real wage. Cimadomo et al. (2011) showed that the positivity of response in consumption may depend on the future expected reversality of spending. Employing forecast errors, Corsetti et al. (2012) and Tenhofen and Wolff (2010) had negativity in the responses of consumption and real wage. As explained, the first model seems to be the one that Ramey (2011b) intended to build. Throughout the paper, Ramey (2011b) emphasized that conventional VAR models do not properly capture the timing of changes in government spending and that measuring news about future government spending changes is important. The first model properly captures a news shock on future government spending changes. However, the second model does not seem to capture such a news shock.

When testing the Neoclassical approach, it is worthwhile to identify news shocks to future government spending changes. In the Neoclassical approach, persistent government spending shocks have a negative wealth effect for the representative household. Consumption decreases and labor supply increases when the representative household recognize the persistent changes in government spending. In other words, such effects will be captured strongly if theory is correct, when persistent government spending changes are anticipated. When government spending changes unexpectedly and temporarily, such a channel is not likely to work.

Moreover, for the defense news, there are some debates about the sample period issue and the literature based on the defense news is not consistent. First, because the defense news covers the period with WW II and Korean war, there is a concern that the results may be affected by the war time where it has most of its explanatory power of government spending. Perotti (2011) claims that rationing should be considered to analyze response of consumption component in the sample periods with war time, and he finds that durable consumption rises to defense news if one dummies out 1941:4 and 1942:1. Ramey (2011a) contradicts Perotti (2011)'s view and if one wants to deal with the rationing issue, one should dummy out 1942:1 and 1942:2, rather than 1941:4 and 1942:1. In figure 2.3 and 2.4, which are our replication with dummy following Perotti (2011) and Ramey (2011a), although the signs of the responses are kept, the significance are shown to be affected by the choice of the dummy. We also test the extended defense news series of Ramey (2011b) for the 1955:1-2013:4(not

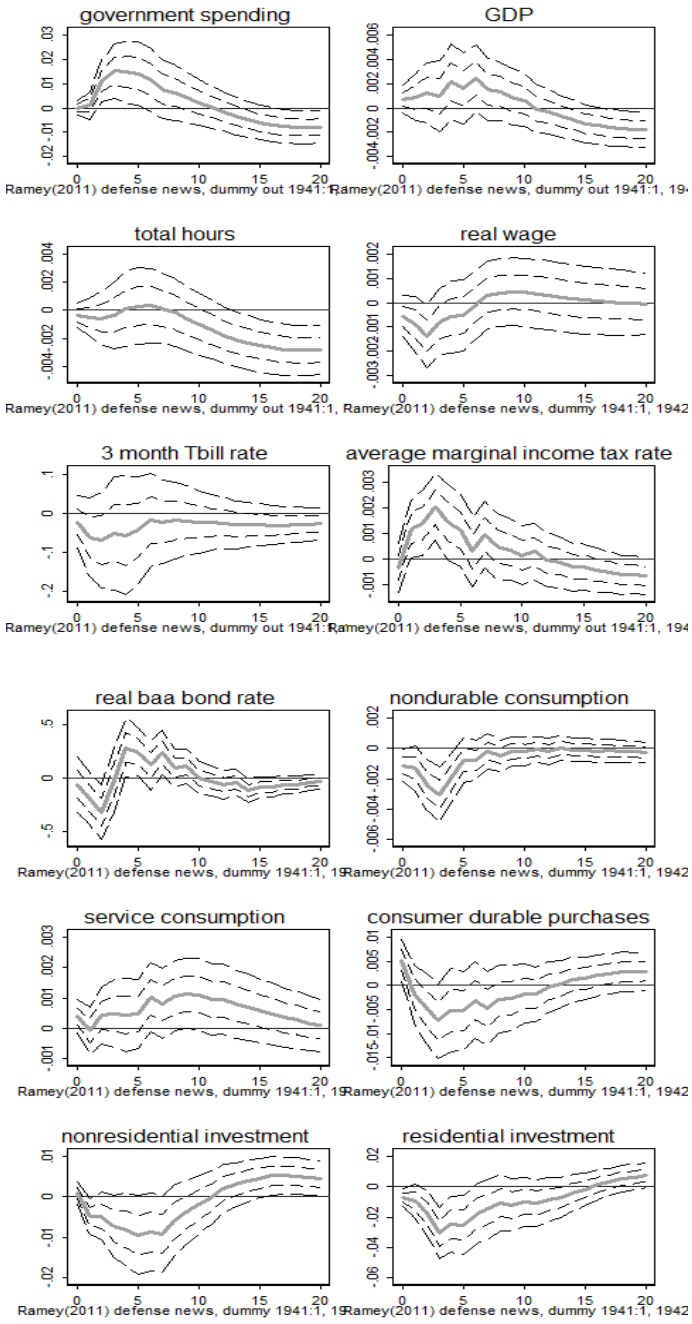

Figure 2.3 Ramey (2011b): Defense news from 1939:1-2008:4, dummy out 1941:1 and 1942:1

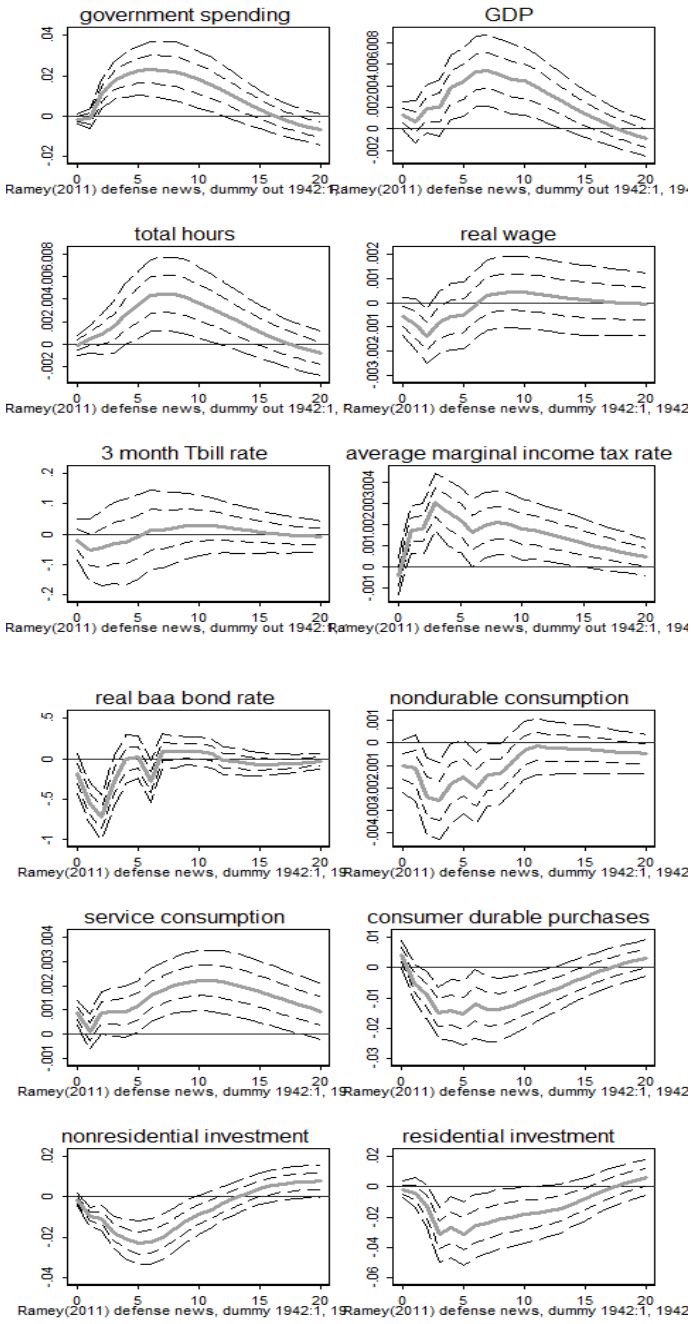

Figure 2.4 Ramey (2011b): Defense news from 1939:1-2008:4, dummy out 1942:1 and 1942:2

shown), however, due to its weak explanatory power after Korean war, the results are insignificant and shows very wide error bands.

Based on these findings, another evidences seem to be needed to support the negative effects of government spending with fiscal foresight on consumption and real wage, at least for the post-Korean war period.

2.3 Modified Model with Government Spending News Variable

2.3.1 Modified Model based on SPF Data

In the previous section, we suggest that the second model does not properly capture news shocks on future government spending changes, which is important when the effects of government spending shocks are examined. In this section, we modify the second model to properly capture the news shocks on future changes in government spending for the post-Korean war period. In particular, we construct an estimate of changes in the expected present value of government spending by using the forecast data from the SPF. The following is the details on how we construct the estimate. The Federal Reserve Bank of Philadelphia provides forecasts for real federal government spending from 1981Q3, and from zero to four-quarter ahead forecasts. Also, the base year of the original SPF forecast data changes over time, past studies including Ramey (2011b) often used the growth rate of the SPF forecast data.

In contrast, Leeper et al. (2012) construct the SPF forecast level data by

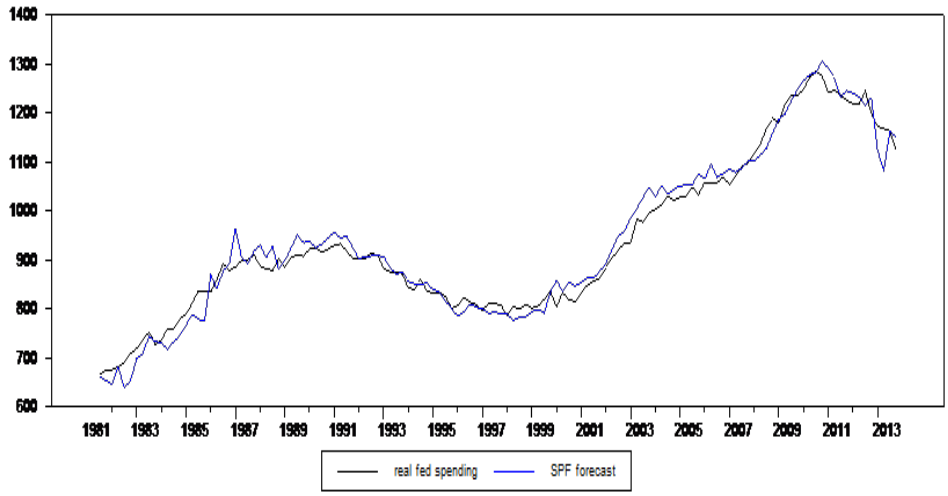

Figure 2.5 Real federal government spending and SPF forecast for federal government spending(in Billions of chained 2009 dollars).

Source: Real federal government spending is obtained from real-time data for macroeconomist given by Fed of Phliladelphia.

rebasing the series.[4] Figure 2.5 plots the rebased SPF forecast data for time t made at t in level and actual federal government spending. The base year change of SPF is not shown the rebased SPF data, and it accompanies the trend of actual government spending, showing some fluctuations around the actual data.

Also, table 2.3 reports the explanatory power of rebased SPF level data, following the test conducted in Ramey (2011b). Without actual spending component in the measure, rebased SPF data has F-statistics exceeding 10 for the

[4]See appendix A in Leeper et al. (2012) for the details on the rebase procedure of SPF data. For the sample until 2008, we use the exact rebased SPF forecast in Leeper et al. (2012), which are in 2005 constant dollar. However, after 2013:2, the base year of NIPA series is changed by year 2009. Thus, for the post-2008 period, we replace the implicit price deflator by 2009 constant dollars, so that the rebased forecast series are in 2009 constant dollar.

Model	(1) R^2	(2) Marginal F-statistics	(3) Coeff. of lag 0	(4) t-statistics
1981:3 - 2008:4				
Ramey (2011b)	0.349824	8.69939	0.97265	2.39281
Perotti (2011)	0.35003	7.40077	0.997882	2.41736
1981:3 - 2013:4				
Ramey (2011b)	0.477363	10.48249	0.916819	2.41181
Perotti (2011)	0.378904	11.17037	0.972532	2.49197

Table 2.3 The explanatory power of rebased SPF

Notes. Columns (1), (3), and (4) are statistics obtained from a regression of the growth of real per capita federal spending on current and 1 to 4 lags of the growth of rebased SPF, lags 1 to 4 of the log of real per capita of government spending, which is total spending for Ramey (2011b) and federal and state and local spending for Perotti (2011), the log of real GDP, the 3-month T-bill rate, and the Barro-Redlick average marginal tax rate. Column (2) are from a regression which is same with previous one except excluding the growth of SPF.

longest sample period, and around 7 or 8 for 1981:3-2008:4. F-statistics below 10 may the evidence of weak-instrument problem, however, as Ramey (2011b) mentioned, macro shocks in the literature usually have F-statistics which is lower than 10, and the defense news in Ramey (2011b) for post-Korean war has F-statistics below 5.[5]

We use the rebased SPF forecast level data to construct the expected present value of SPF forecast data.

$$f_t^{PV} = \sum_{j=1}^{4} \frac{1}{r_{t+j}} (f_{t+j|t}^e - f_{t+j|t-1}^e) \tag{2.3}$$

Since SPF forecast data provides one- to four-quarter ahead forecasts, we calculate the expected present value of government spending of each quarter by

[5] As specification of Perotti (2011) of testing explanatory power is slightly different from Ramey (2011b)'s, so we conduct both specifications of test.

summing up the discounted value of one- to four-quarter ahead forecasts. Following Ramey (2011b), we use the 3-year treasury bond rate as the discount rate.[6] We take log-difference, which may capture percentage changes in the present value from the last period.

Then, we estimate the VAR model that replaces the forecast error measure with the newly constructed measure of expected present value of government spending.

2.3.2 Comparison with other measures: Forni and Gambetti (2014a) and Caggiano et al. (2015)

Our method to identify future news shock in government spending is in line with the methodology used in Born et al. (2013); Forni and Gambetti (2014a); Caggiano et al. (2015), which are all constructed as growth rate or changes in growth rate due the base year change.[7] That means the measures capture basically the difference in the growth rate which may lose some information about the level of data, rather than in the level of government spending.

$$\begin{aligned} n^g_{13} &= \sum_{j=1}^{3} \triangle f^e_{t+j|t} - \triangle f^e_{t+j|t-1} \\ &= \sum_{j=1}^{3} (f^e_{t+j|t} - f^e_{t+j-1|t}) - (f^e_{t+j|t-1} - f^e_{t+j-1|t-1}) \end{aligned} \tag{2.4}$$

[6] Similar results were also obtained when we use 3-month T-bill rate and 1-year treasury bond rate.

[7] Born et al. (2013) uses one-quarter ahead forecasts for time t+1 made time t to deal with fiscal foresight. Perotti (2011) also construct the approximation of the present value based on forecast revisions which is not shown in the paper. However, without rebase of the years, the PV measure in Perotti (2011) has outliers due to the base year changes and that may affects the estimation to be biased. In the follow-ups of the literature, as mentioned above, many studies dealt with the base year issue by taking growth rate.

2.3.3 Empirical Results

Figure 2.6 reports the impulse responses to shocks to the newly constructed news variable based on SPF data. Now government spending initially does not change, as in the first model of Ramey (2011b), and it starts to increase in about six quarters. The increase in government spending is persistent. This response may be regarded as those to news shocks on expected changes in future government spending. Output response is more persistent as in the first model of Ramey (2011b). Due to weakly negative initial response of government spending, government spending multipliers at 1 and 2 year swings from negative -50 to positive 50. Because the response of government spending peaks around 17 quarters, cumulative multiplier steadily decreases after 3 years.

The multipliers calculated by peak responses is 4.6, and under integral is almost identical to the peak multiplier.[8] For the estimated shock of government spending is so persistent, we also test the VAR with SPF PV for longer period: 80 quarters. Figure 2.7 shows the responses of government spending and GDP for 80 quarters. As predicted by news hypothesis, GDP rises before government spending goes up. GDP peaks at around 10 quarters and after that steadily decreases, while government spending rises after like 4 quarters, peaks at around 20 quarters, and after that gradually go down to the normal level. The cumulative multiplier(not shown) rapidly declines after 4 quarters and stays around 2 after 10 years. Hours and real wage also increase as in the first model of Ramey

[8]Our multipliers are in line with Auerbach and Gorodnichenko (2012), which estimates government spending multipliers controlling measures in Ramey (2011b) in recession and expansion. They also have big multipliers, like 4.88, for the defense news of Ramey (2011b) in recession.

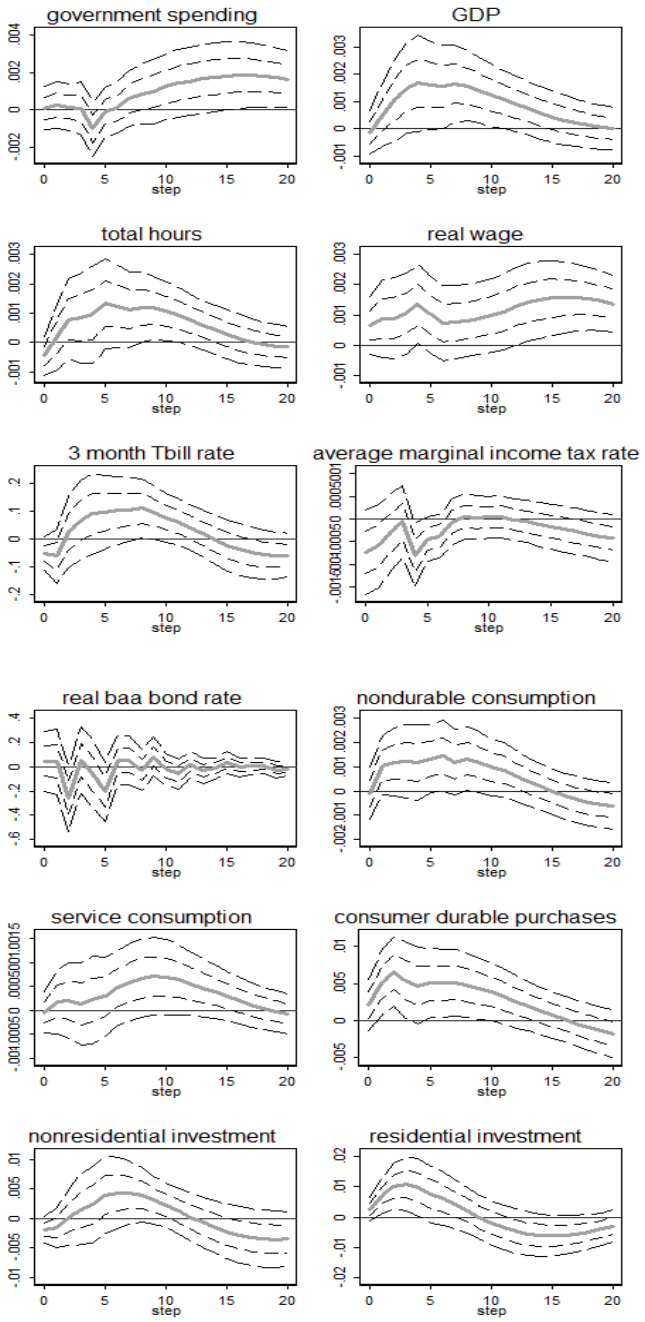

Figure 2.6 The effects of SPF PV shocks : SPF PV shock from 1981:4 to 2008:4

The standard error bands for 68 % and 95 % are displayed.

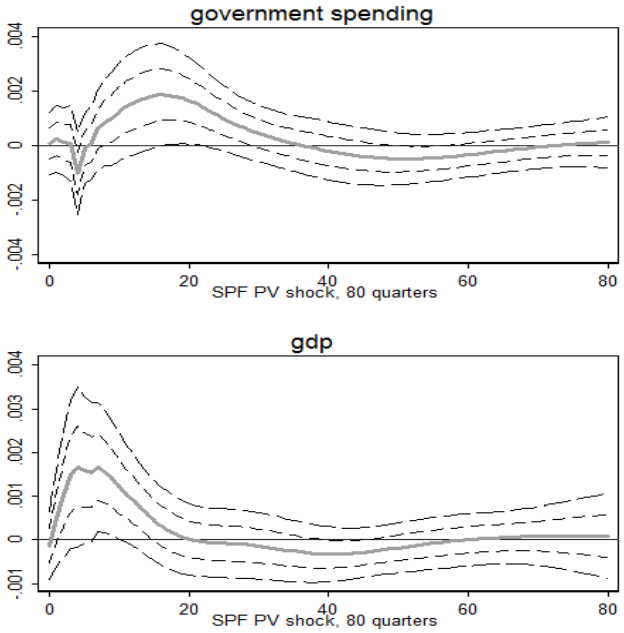

Figure 2.7 Long IRFs: The effects of SPF PV shocks for 1981q3-2008q4

The standard error bands for 68 % and 95 % are displayed.

(2011b). It is also notable that consumption and investment tend to increase.

Overall, government spending shocks have more expansionary effects on the economy by properly constructing news shocks. Government spending multiplier is larger. Although government spending multiplier is found to be negative in the second model of Ramey (2011b), government spending multiplier is at least larger than zero by properly constructing news shocks, as in the first model of Ramey (2011b). In addition, working hours and consumption also increases, as in the first model of Ramey (2011b) but differently from the second model of Ramey (2011b). Therefore, by using a similar method to properly construct news shocks, the results are similar to the first model of Ramey (2011b). Our results are in line with Ben Zeev and Pappa (2014), which investigated the effects of anticipated defense spending shocks identified using the maximum forecast error variance methodology. They concluded that fiscal news shock raises not only GDP, but also consumption and investment.

However, the result of this modified model shows even more expansionary effects than the first model of Ramey (2011b). Our multiplier is much bigger than that of Ramey (2011b). The positive responses of consumption and investment are more significant. Real wage increases are also significant. These responses are not really consistent with the Neoclassical view, contrary to what Ramey (2011b) argued. In particular, consumption and real wage increases, contrary to the prediction of the Neoclassical models.

2.4 Robustness

2.4.1 Alternative Sample Periods

Some alternative sample periods are considered. First, we estimate the SPF PV shocks with several subsample periods; first, based on Perotti (2011), we estimate the VAR without severe recession periods(1981-1982 and 2008) from 1983:1 to 2007:4(in figure 2.8), and with the longest avilable sample period, from 1981:3-2013:4(in figure 2.9). The results are almost identical, while in the former, response of government spending become less significant than the original model. Exploiting the sample period fully, we also find that the results are similar, whereas government spending and components consumption and investment rise more significantly and hours become less significant.

2.4.2 Component issue: Federal spending and Private GDP

The issue of components in government spending and GDP may affect to our result. First, federal spending may have different effect with the total spending.[9] In figure 2.10, we estimate the SPF PV VAR with rotating total government spending by federal government spending, and we find that the results are almost identical.

Second, Ramey (2012) examined whether the increases in government spending stimulates the private sector or not, to see the effects of government

[9]See for the issues on government spending components, e.g., Ben Zeev and Pappa (2014) for the defense spending, Perotti (2014) for the comparing defense spending and civilian spending.

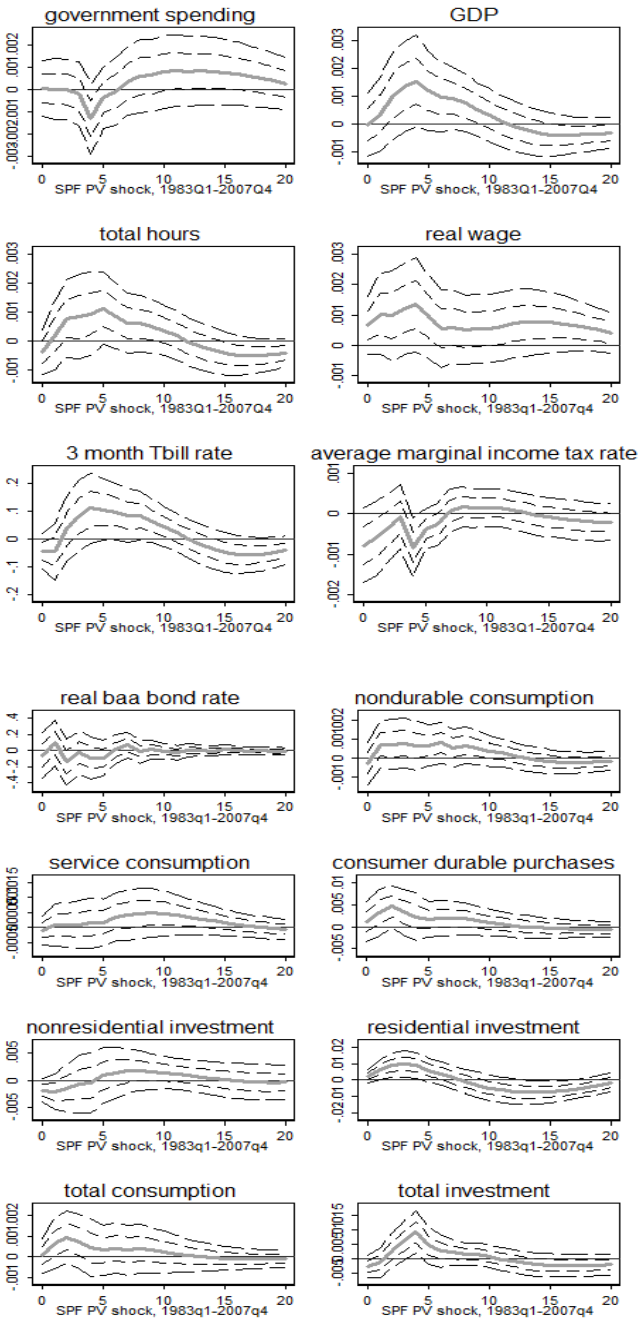

Figure 2.8 Subsample period: the effects of SPF PV shocks for 1983q1-2007q4

The standard error bands for 68 % and 95 % are displayed.

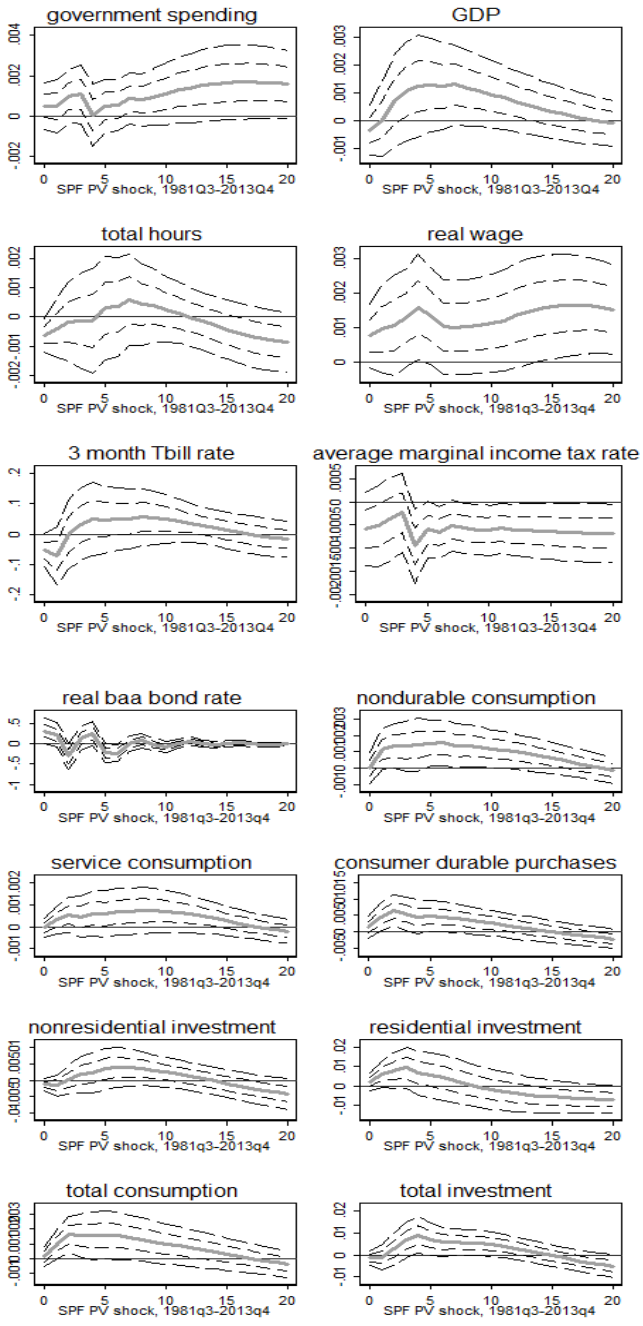

Figure 2.9 Subsample period: the effects of SPF PV shocks for 1983q1-2007q4

The standard error bands for 68 % and 95 % are displayed.

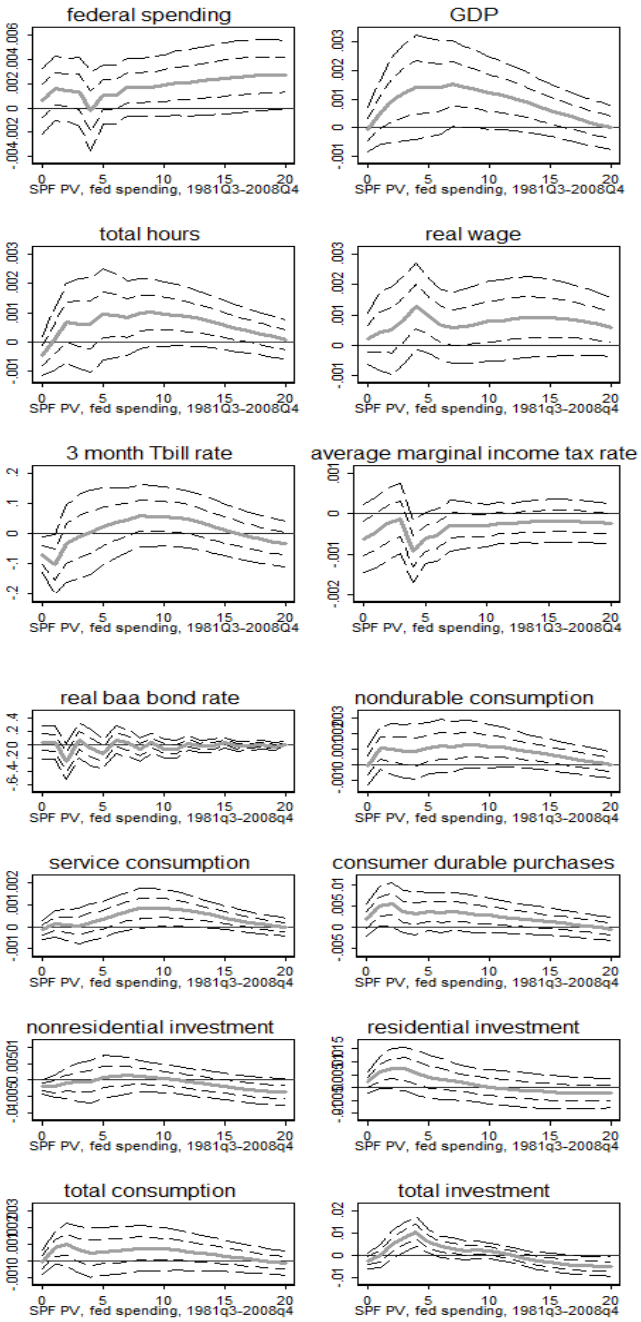

Figure 2.10 Government spending Components: federal spending, 1981q3-2008q4

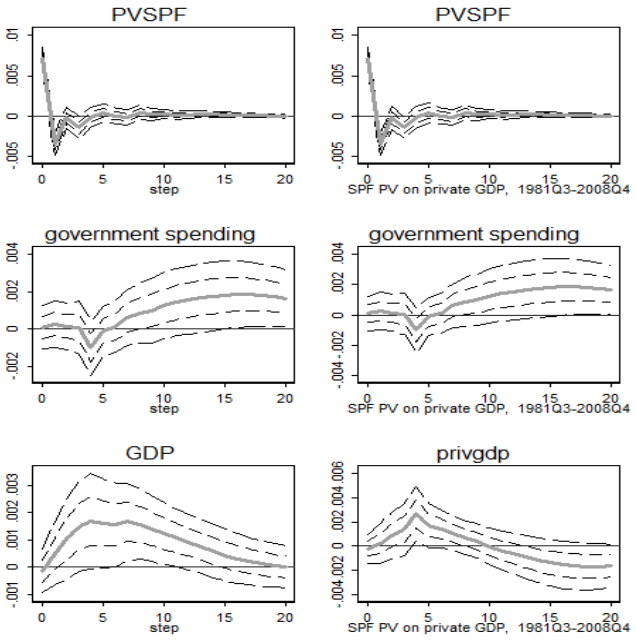

Figure 2.11 GDP components: the effects of SPF PV shocks with private GDP, 1981q3-2008q4

The standard error bands for 68 % and 95 % are displayed.

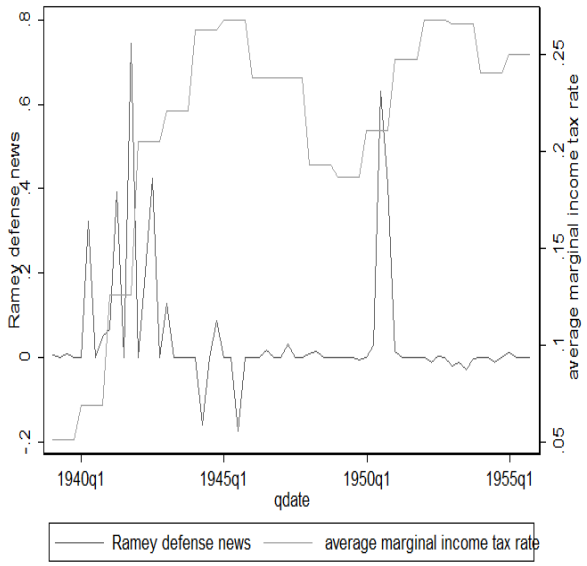

Figure 2.12 Tax rate: Defense news measure in Ramey (2011b) and Barro-Redlick tax rate

spending on the private welfare. She analysed response of private GDP to government spending shocks, rather than that of total GDP. In figure 2.11, we check the response of private GDP to the SPF PV shock. As total GDP reacts, private GDP rises significantly before the government spending increases, and turns to the normal level.

2.4.3 Tax Policy

In our results, Barro-Redlick tax rate falls to every specifications, while it rises to the defense news of Ramey (2011b). We do robustness checks that the different response of tax rates may come from the sample period. In figure 2.12 and 2.13, we find that the tax rate and components of government spending

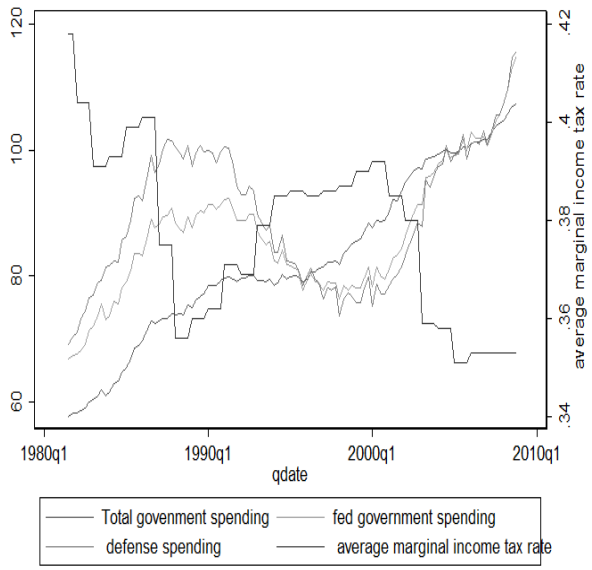

Figure 2.13 Tax rate: government spending components and Barro-Redlick tax rate

significantly correlated negatively after 1980 period. In contrast, looking the graph of tax rate and the defense news of Ramey (2011b), we find that the peaks of defense news are followed by rises in tax rates. However, in the figure XI in Ramey (2011b), average tax rate rises to three different samples, which for with and without WW II and Korean war.

To control the effects of tax rate on our results, we do the counterfactual analysis holding tax rate constant to the government spending shock, which is similar to the methodology in Bachmann and Sims (2012). Figure 2.14 displays the impulse response estimated from counterfactual analysis. With holding tax rate, we still find the consumption components and real wage rises significantly while GDP and hours slightly become insignificant.

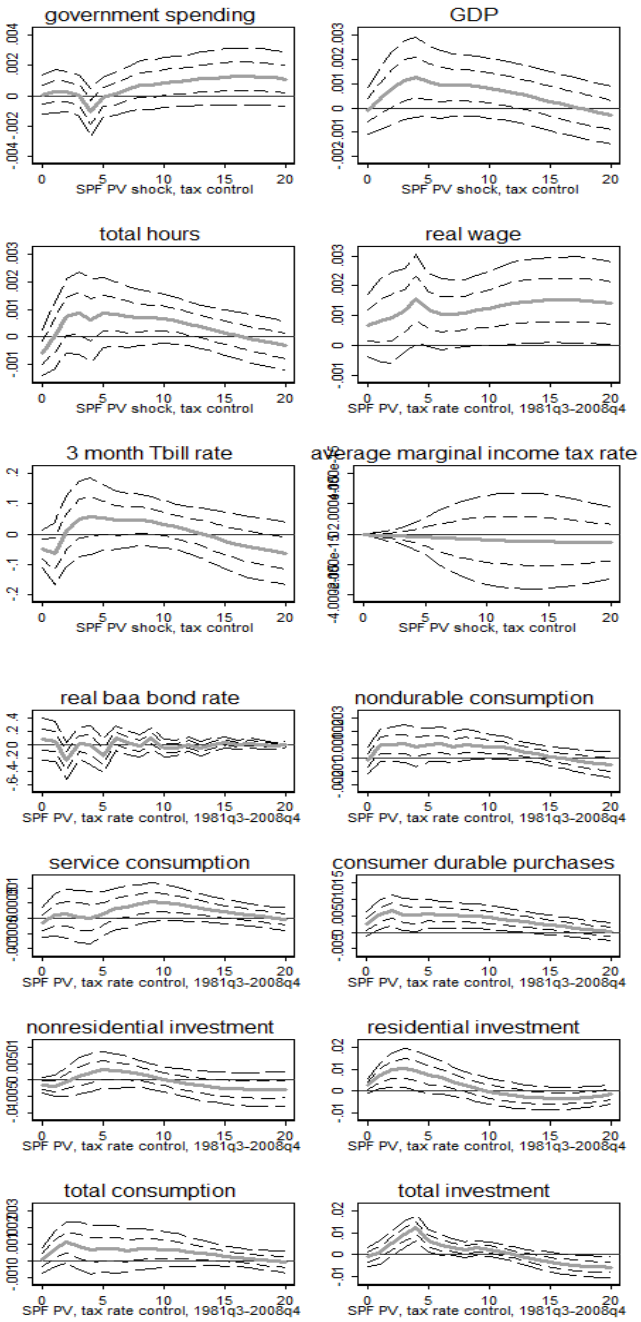

Figure 2.14 Counterfactual analysis: tax rate control for 1981q3-2008q4

The standard error bands for 68 % and 95 % are displayed.

2.5 Conclusion

Ramey (2011b) suggested that anticipated future government spending changes should be fully taken into account in order to properly measure the effects of government spending shocks. Ramey (2011b) further constructed two types of news variables to address these issues: changes in expected future present discount value of defense spending (based on the Business Week and other newspaper sources) and forecast errors of changes in government spending (based on SPF data).

This paper argues that the second measure cannot properly capture anticipated future government spending changes, contrary to Ramey (2011b)'s original assertion. Forecast errors of government spending are unanticipated parts of government spending by construction and are not likely to include anticipated future government spending changes. In fact, the empirical effects of the forecast error shocks do not resemble the ones that comprise anticipated future government spending changes.

This paper further suggests the construction of changes in the expected future present discount value of changes in government spending based on SPF data. Impulse responses to shocks to such variables tend to capture anticipated government spending changes. The empirical results further show that the government spending multiplier is clearly positive and that consumption, investment, and real wages increase. These results are not consistent with the neoclassical view.

Chapter 3

Future News, Forecast Errors and Nonfundamentalness of VAR Analysis for Fiscal Policy

3.1 Introduction

The effects of government spending shocks have been intensively researched, however, little consensus has been reached. How the aggregate GDP and its components, especially private consumption and real wage, respond to the change of government spending is at the center of empirical research, which shown an opposite direction of responses from that of the economy. The range of the GDP multiplier is still actively debated, and responses of consumption and real wage are diverse. The main factor driving this disagreement is related

to how government spending "shock" is identified. Endogeneity of fiscal policy demands estimation of policy by shocks, which is the change in government spending orthogonal to the current "state" of the economy.

One of the recent debates on the identification method is related to the "fiscal foresight" phenomenon. Because of the usual long implementation lags of fiscal policy, fiscal policy actions are likely to be anticipated. After Ramey (2011b) argued that government spending shocks identified by the popular VAR framework, such as that of Blanchard and Perotti (2002), can be anticipated, this anticipation, or fiscal foresight, has been discussed as a source of disagreement.

Fiscal foresight is important in the fiscal policy literature for at least two reasons. First, the nature of government spending shocks can affect the economy differently with respect to foresight. The anticipated and unanticipated change of government spending can be distinguished in their effects on the economy. Hence, the nature of government spending shocks identified in the popular VAR model can be different from what we would like to investigate, if the expectation is not considered in the model. Second, the underlying structural MA representation of the conventional VAR model without foresight structure can be non-fundamental. [1] In these cases, the estimated impulse responses can

[1]Nonfundamentalness of VARs are can be thought as a problem of possibility of recovering structural shocks from past observations. Non-fundamentalness problem has been recognized in the VAR literature long ago. Hansen and Sargent (1980) addressed the non-fundamentalness in VAR models first, and [Hansen and Sargent,1991], Lippi and Reichlin (1993, 1994), emphasize the importance of the issue. The debates actively rise on the consistency or inconsistency of general VAR models, which are followed by empirical implications with consideration of fundamentalness in specific structural shocks. For example, there are literatures on the structure of the non-fundamentalness and the amount of bias in the estimation of general VARs(e.g.,

be different from the true ones.

Due to fiscal foresight, a burgeoning topic on fiscal policy has been researched about the identification of government spending shocks that are orthogonal to the current "information set" of the agents. For example, Ramey and Shapiro (1998) suggested introducing a narrative about defense spending and forecast data in the VAR model to isolate any foreseen part. Fisher and Peters (2010) added relevant stock price data to the standard fiscal VAR to capture future news of government spending, and Ramey (2011b) added future news on defense spending to the standard VAR model. Forni and Gambetti (2014b) and Caggiano et al. (2015) employed forecast data about government spending from the Survey of Professional Forecasters. As their empirical applications, Leeper et al. (2013) introduced an implicit tax rate, calculated from the difference in municipal and treasury bonds, as a measure for future news of a tax rate.

This paper studies the effects of unanticipated government spending shocks with respect to fiscal foresight. Our focus is on verifying whether a specific VAR model has fundamental representation, by using both of theoretical model and empirical test. First, we discuss three widely used specifications of VAR models—conventional structural VAR (SVAR), expectation-augmented VAR with forecast error (EVAR FE), and expectation-augmented VAR with future

Chari et al. (2008); Fernández-Villaverde et al. (2007)), structure of non-fundamentalness and strategies to overcome the problem on specific VARs, (e.g., Yang (2005); Beaudry and Portier (2006); Mertens and Ravn (2010); Romer and Romer (2010); Fisher and Peters (2010); Ramey (2011b); Leeper et al. (2013)).

news (EVAR FN)—with theoretical examples.[2] [3] To estimate unanticipated change of government spending, some studies excluded the "foreseen" part from the shock. In the VAR model with forecast errors, Ramey (2011b) estimated unanticipated changes of government spending as the shock on the forecast error. Such a model has been frequently used in past studies, for example, Corsetti et al. (2012); Auerbach and Gorodnichenko (2012, 2013); Belinga and Ngouana (2015), and can be called EVAR FE. Other studies isolate the foreseen part of the estimate by including additional information about future news. These types of models are EVAR FN.

We conducted the formal presentation of fundamentalness based on two types of news processes: observable news and noisy news. According to the news process, the theoretical fundamentalness can be changed. We find that i) assuming that agents can observe the news clearly, SVAR may not be fundamental. Also, among the EVARs, EVAR FE may still be non-fundamental, but EVAR FN may be fundamental. ii) With a noisy news assumption, a simple remedy of adding relative information may not work in theoretical models. EVAR FN also become non-fundamental when the news is noisy.

Theoretical results on the fundamentalness depend on the information struc-

[2]Interestingly, Kirchner (2010) suggested that strategy of enlarging the information set to mitigate non-fundamentalness should be employing future expectations, not the forecast error by investigating a simple theoretical model with fully observable news process. This paper discusses the issue in a more general environment and shows that theoretical results can be different in a more general environment. In addition, we perform the empirical test to discuss the issue in practice, and compares the empirical results from different VAR models to draw implications on how it matters in practice.

[3]VAR with expectation measures are called as EVAR. The term "Expectation-augmented" VAR, EVAR, was coined first in Perotti (2011).

tures. Moreover, some past studies suggested that the SVARs may perform well even with non-fundamenal representations. In the second part of this paper, we empirically examine the fundamentalness of three VAR specifications. We conduct the orthogonality test of Forni and Gambetti (2014c) to check whether the shocks from each VAR are fundamental. We find that unanticipated government spending shocks estimated from SVAR and EVAR FE are likely to be non-fundamental, but EVAR FN is not.

Both analyses suggest that the typical VAR model with government spending is likely to be non-fundamental even after introducing forecast errors of government spending. This paper shows that EVAR FN can be more reliable for recovering unanticipated changes in government spending. We also show in our empirical implications how the impulse responses to government spending shocks are different in these VAR models. We find that impulse responses from EVAR FN differ from those of EVAR FE and conventional VAR. In particular, the former shows more positive effects, albeit insignificant in some cases, on output and its components compared to the latter. Therefore, we conclude that with fiscal foresight consideration, unanticipated changes in government spending affect non-negative effects on the economy.

Section 3.2 analyzes theoretical models. Section 3.3 performs the empirical test. Section 3.4 concludes with summary of findings.

3.2 Theoretical example

3.2.1 A simple model

We examine three VAR specifications with regard to resolving the nonfundamentalness problem by using a simple model. Consider a standard RBC model with representative agent that maximizes expected discounted utility

$$max\ E_0\left[\sum_{t=0}^{\infty}\beta^t\ log\left(C_t\right)\right],\ 0<\beta<1 \tag{3.1}$$

subject to

$$C_t+K_t+T_t\ =\ Y_t\ =\ A_tK_{t-1}^{\alpha}\ ,\ 0<\alpha<1 \tag{3.2}$$

where C_t, K_t, T_t, Y_t, A_t denote consumption, capital, lump-sum taxes, output and technology shock, respectively. For simplicity, we assume full capital depreciation and inelastic labor supply. Technology A_t is assumed to be independent and identically distributed. Government spending G_t is financed by lump-sum taxes, $G_t\ =\ T_t$. The equilibruim conditions are

$$\frac{1}{C_t}\ =\ \alpha\beta E_t\left[\frac{1}{C_{t+1}}\frac{Y_{t+1}}{K_t}\right] \tag{3.3}$$

$$C_t+K_t+G_t\ =\ Y_t=\ A_tK_{t-1}^{\alpha} \tag{3.4}$$

$\bar{C}$ is the ratio of steady state value of consumption over output, $\bar{C}\ =\ (1-\alpha\beta-\bar{G})$, where $\bar{G}$ is that of government spending. Log-linearization of

Euler equation and resource constraint gives

$$c_t = E_t c_{t+1} - E_t a_{t+1} - (\alpha - 1)k_t \tag{3.5}$$

$$c_t = \frac{1}{\bar{C}}\left[-\theta k_t - \bar{G} g_t + a_t + \alpha k_{t-1}\right] \tag{3.6}$$

where $\theta = \alpha\beta$, and lower case letters denote percentage deviations from steady state.

Combining (3.5) and (3.6) provides log-linearlized equilibrium condition for capital,

$$\begin{aligned} E_t k_{t+1} - \frac{1}{\theta}\left(\theta + \alpha + \bar{C}(1-\alpha)\right) k_t + \beta^{-1} k_{t-1} \\ = \frac{1}{\theta}\left[(1-\bar{C}) E_t a_{t+1} - a_t + \bar{G} g_t - \bar{G} E_t g_{t+1}\right] \end{aligned} \tag{3.7}$$

To solve the equation, consider the characteristic equation. Let $\xi = \frac{1}{\theta}\left(\theta + \alpha + \bar{C}(1-\alpha)\right)$. The characteristic equation for (3.7) is

$$\lambda^2 - \xi\lambda + \beta^{-1} = 0 \tag{3.8}$$

Let λ_1 and λ_2 are roots of saddle path solutions for (3.8), where $\lambda_1 < 1$ and $\phi = \frac{1}{\lambda_2} < 1$. The solution for capital is

$$k_t = \lambda_1 k_{t-1} + \eta_1 a_t + \eta_2 g_t + \eta_3 \sum_{i=0}^{\infty} \phi^i E_t g_{t+i+1} \tag{3.9}$$

where

$$\begin{aligned} \eta_1 &= \frac{\phi}{\theta(1-\phi)} \\ \eta_2 &= -\frac{\bar{G}\phi}{\theta} < 1 \\ \eta_3 &= -\eta_2(1-\phi) \end{aligned}$$

To obtain the equilibrium dynamics of capital, we assume a simple form of information flows on government spending. [4]

$$g_t = \varepsilon_{t-q} + e_t \tag{3.10}$$

ε_{t-q} denotes the anticipated change of government spending at time t which is expected at t-q period. According to this form of information, private agent have q-period ahead forecast of government spending, which will be fully implemented as expected, and adjust their behavior q-period before the realization. e_t denotes the unexpected government spending shock. Therefore, once there is news about future level of government spending, agents correctly know about and adjust according to it.

$$E_t g_{t+h} = \varepsilon_{t-q+h},\ h \leq q \tag{3.11}$$

Based on the information flow as , the equilibrium dynamics of capital is following:

$$\begin{aligned} k_t &= \lambda_1 k_{t-1} + \eta_1 a_t + \eta_2(\varepsilon_{t-q} + e_t) + \eta_3 \Theta(L)\varepsilon_t \\ &= \lambda_1 k_{t-1} + \eta_1 a_t + (\eta_2 L^q + \eta_3 \Theta(L))\varepsilon_t + \eta_2 e_t \end{aligned}$$

where $\Theta(L) = L^{q-1} + \phi L^{q-2} + \phi^2 L^{q-3} + \cdots + \phi^{q-2} L + \phi^{q-1}$.

[4] Many studies use the information flows without discussion, because the effects of information flows are not the focus of the paper. According to Walker and Leeper (2011), this news process can be considered as a simple form of "correlated news" because it does not distinguish the distribution of innovation for each foresight period q. The other news process, which is also frequently used, is "i.i.d news". It assumes that each shock $\varepsilon_{q,t-q}$ is orthogonal to $\varepsilon_{h,t-h}$ for $h \neq q$. This feature demands us additional assumption about explicit expression of expectations on future government spending and signal. Hence, we set our benchmark model on the correlated news process.

3.2.2 Fundamentalness of VAR models

The MA representations in the solution captures behavior adjustment by agents made before time t based on the forecast. Fiscal foresight, is actively discussed as a concrete example of foresight, because conducting fiscal policy demands time to be implemented. During the implentation lag, news about newly enforced fiscal policy arrives to private agents so that they can react to the news.

Recent empirical and theoretical studies address the fiscal foresight issue as a serious challenge to VAR model with fiscal policy. Ramey (2011b) asserted that conventional VAR model on government spending is biased due to ignoring fiscal foresight. She compared the results of conventional VAR and VAR with forecast error and concluded the differences on the results come from the different timing of the identified shocks. Leeper et al. (2013) rigorously demonstrated that fisal foresight generates nonfundamental MA representations using analytical models with general assumptions on the form of information flows. They mentioned that the key factor behind the nonfundamentalness problem from fiscal fosight is the information gap between agents and econometricians. Also, they discussed strategies in the literature coping with fiscal foresight with respect to enlarging information set.

A burgeoning empirical literature suggests several strategies to overcome nonfundamentalness issue by including information in the VAR model, which is the so-called "Expectation-augmented VAR(EVAR)". With respect to the timing of the information, EVAR models can fall into two categories; First one

is the EVAR model which is explicitely isolating anticipated portion of the changes by identifying government spending shock as a shock of forecast error or a shock controlled by past forecast. We refer it to "EVAR FE". Second one is the VAR with future news, which includes future forecast of government spending for separating expectations from its change. We refer it to "EVAR FN".

In this section we show that EVAR FE still cannot resolve the nonfundamentalness problem by using the simple model. Note that the results are limited by the form of the information flows used in the model. We examine another information flows in the section 3.2.3 to address that fundamentalness presented by analytic model depends on the assumption of information flows.

We briefly explain the definition of fundamentalness in VAR. Following Rozanov (1967), Alessi et al. (2008) and Lütkepohl (2012) addressed formal presentation of Fundamentalness. The condition applies for the case that there are equal number of shocks and variables in the VAR.

Definition Consider a covariance stationary process X_t. The representation $X_t = H(L)e_t$, where $H(L)$ is square matrix, is fundamental if i) e_t is a white noise vector; ii) $H(L)$ has no poles of modulus less or equal than unity. iii) The determinant of $H(z)$ has no roots of modulus less than unity, i.e., all its roots are outside the unit disc,

$$detH(z) \neq 0 \quad \forall z \in C \quad s.t. \ |z| < 1$$

We calculate the fundamentalness of VAR models based on the simple model

we built in former section. For the EVARs, we employ a perfect signal, s_t, which is fully realized after q-period, therefore, $s_t = \varepsilon_t$.

SVAR We first show the case of standard VAR model.

$$\begin{bmatrix} g_t \\ a_t \\ k_t \end{bmatrix} = \begin{bmatrix} 1 & L^q & 0 \\ 0 & 0 & 1 \\ \frac{\eta_2}{1-\lambda_1 L} & \frac{\eta_2 L^q + \eta_3 \Theta(L)}{1-\lambda_1 L} & \frac{\eta_1}{1-\lambda_1 L} \end{bmatrix} \begin{bmatrix} e_t \\ \varepsilon_t \\ a_t \end{bmatrix}$$

For q=1, the determinant of $h(z)$ is $\frac{-\eta_3}{1-\lambda_1 z}$, so that the MA represenation is fundamental where $|\lambda_1|, |\phi| < 1$. When $q \geq 2$, the determinant is calculated as a function of cyclotomic polynomial $\Theta(L), -\frac{\eta_3 \Theta(L)}{1-\lambda_1 z}$, where the roots are inside the circle with radius $|\phi|$. Given $|\phi| < 1$, the MA representation is non-fundamental for $q > 1$.

EVAR FE In the research using EVAR FE, government spending shock is recovered as innovation on the difference between actual government spending and its corresponding forecast. With quarterly data, forecast error can be treated as the most exogenous variable in the VAR, so that the forecast error is ordered first.

$$\begin{bmatrix} g_t - s_{t-q} \\ g_t \\ k_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 1 & L^q & 0 \\ \frac{\eta_2}{1-\lambda_1 L} & \frac{\eta_2 L^q + \eta_3 \Theta(L)}{1-\lambda_1 L} & \frac{\eta_1}{1-\lambda_1 L} \end{bmatrix} \begin{bmatrix} e_t \\ \varepsilon_t \\ a_t \end{bmatrix}$$

The determinant of the matrix from EVAR FE vanishes in zero for $q \geq 1$, therefore the MA representation is non-fundamental.

EVAR FN In the EVAR FN, government spending shock is identified as a controlled change by the future forecasts.

$$\begin{bmatrix} g_t \\ s_t \\ k_t \end{bmatrix} = \begin{bmatrix} 1 & L^q & 0 \\ 0 & 1 & 0 \\ \frac{\eta_2}{1-\lambda_1 L} & \frac{\eta_2 L^q + \eta_3 \Theta(L)}{1-\lambda_1 L} & \frac{\eta_1}{1-\lambda_1 L} \end{bmatrix} \begin{bmatrix} e_t \\ \varepsilon_t \\ a_t \end{bmatrix}$$

Different from the above results, EVAR with future news has the determinant that is given $\frac{\eta_1}{1-\lambda_1 z}$, implying that the MA representation is fundamental for $\forall\ q$. Note that EVAR FN demands the exact q-period ahead forecast to have fundamental MA representation. [5] With generalized information flows, EVAR FN may be nonfundamental according to the match between timing of forecast and the private agents' information.

3.2.3 Noisy news process and fundamentalness

The solutions driven from the model can be affected by the assumptions of the model, especially that of information flows. Walker and Leeper (2011) demonstrated that the dynamics of equilibruim depends on the news process by comparing two kinds of information flows with respect to the correlation among the innovations. They emphasized that the news process in literature are chosen quite arbitrary, therefore the equilibrium based on the certain process should be tested by other assumptions of information.

With this considerations, several papers assess the effects of different in-

[5] Demanding exact timing of the foresight period is discussed as the limitation of including narratives. See Leeper et al. (2013) about difficulty of matching exact timing of foresight and advantage of employing price variables with respect to the timing match.

formation flows on their results. Hur et al. (2013) analyzed the importance of information structure on the DSGE models by comparing equilibruims of four kinds of information structure. In the robustness checks in Leeper et al. (2013), they consider general form of information flows with respect to correlation among innovations and foresight periods.

We discuss the fundamentalness of VAR models with respect to an alternative information flows, a noisy news process. In the former section, we employ a news process based on perfect information, an observable news process. This news process, a simple generalization of AR(1) process, includes additional term of news arrived before time t to innovation. A noisy news process can describe the economy with information frictions. When news is noisy, agents can have a signal which has imperfect information about future fundamentals, rather than a fully accurate news. That affects to the expectation so that the equilibrium based on this news process is likely to be different from that of observable news process.

We choose the noisy news process as an alternative one for two reasons. First, observable and noisy news process can describe two types of problem that agents face in the flow of fiscal policy. Leeper et al. (2013) modeled the information flows of tax policy and categorized the process as two; first is the period between proposal or discussion and legislation, a "inside lag". Second is the period between enactment and implementation, a "outside lag". They emphasized that these two lags are different with regard to the certainty of the news. That is, in the inside lag, agents face signal-extraction problem due to

imperfect information. In the outside lag, agents can have perfect foresight. The noisy news process can be a simple example of the expectation building process of inside lag. That is, News become accurate after legislation and different level of accuracy affects expectation.

Second, there are debates on the reliability of VAR where the news process is noisy. Blanchard et al. (2013) showed that noisy news process hinder VAR model to recover news and noisy shocks, because the structural shocks are nonfundamental to agent's information set. Under imperfect information assumption, not only econometrician but also agents do not have sufficient information to recover structural shocks. In this case, enlarging information set does not work to resolve nonfundamentalness problem. In contrast, Forni et al. (2014b) demonstrated that VAR method still can work well with assumption of "learning" after the shock is implemented. If agents can learn whether the signal was noise or the true shock, VAR model can recover the structural shocks by combination of past and future innovations. Thus, we examine the fundamentalness of expectation-augmented VAR models about two types of news process.

We assume the noisy news process as following; the process of government spending is identical with observable case, $g_t = \varepsilon_{t-q} + e_t$. Under imperfect information, a signal s_t can be modeled as sum of the news term ε_t and the

noise term ν_t.[6]

$$g_t = \varepsilon_{t-q} + e_t \tag{3.12}$$

$$s_t = \varepsilon_t + \nu_t \tag{3.13}$$

where ν_t is a Gaussian white noise and is uncorrelated with ε_t. The variance of s_t is the sum of variance of the news and the noise, $\sigma_s^2 = \sigma_\varepsilon^2 + \sigma_\nu^2$, where σ_ε^2 is the variance of ε_t and σ_ν^2 is the variance of ν_t. The conditional expectation of g_{t+q} is

$$E_t g_{t+q} = E_t \left[\varepsilon_t | s_t\right] = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\nu^2} s_t \tag{3.14}$$

Therefore the solution for capital (9) on noisy news is

$$\begin{aligned} k_t &= \lambda_1 k_{t-1} + \eta_1 a_t + \eta_2(\varepsilon_{t-q} + e_t) + \eta_3 \Theta(L)(\varepsilon_t + \nu_t) \\ &= \lambda_1 k_{t-1} + \eta_1 a_t + (\eta_2 L^q + \eta_3 \gamma \Theta(L))(\varepsilon_t + \nu_t) + \eta_2 e_t \end{aligned} \tag{3.15}$$

where $\gamma = \frac{\sigma_\varepsilon^2}{\sigma_\nu^2}$.

Now we examine the fundamentalness of the VAR according to the solution (3.15). Since noisy news process separate signal into news and noise, the number of shock to estimate increases by one. If the number of variable is less than the number of the shock, theoretical fundamentalness cannot be satisfied because it demands the full column rank condition.[7] To match the number of variables and shocks, we include both forecast error and future news in the VAR.

[6] The noisy news process and conditional expectations calculated based on it are used in Beaudry and Portier (2004, 2014); Forni et al. (2014b), etc.

[7] Forni et al. (2014b) pointed that VAR cannot recover the structural shocks in Blanchard et al. (2013); Barsky and Sims (2011), because in their system more number of shocks exist than that of variables.

EVAR FEFN VAR with forecast error and future news narrative(EVAR FEFN)

$$\begin{bmatrix} g_t - s_{t-q} \\ g_t \\ s_t \\ k_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & -L^q & 0 \\ 1 & L^q & 0 & 0 \\ 0 & 1 & 1 & 0 \\ \frac{\eta_2}{1-\lambda_1 L} & \frac{\eta_2 L^q + \eta_3 \gamma \Theta(L)}{1-\lambda_1 L} & \frac{\eta_3 \gamma \Theta(L)}{1-\lambda_1 L} & \frac{\eta_1}{1-\lambda_1 L} \end{bmatrix} \begin{bmatrix} e_t \\ \varepsilon_t \\ \nu_t \\ a_t \end{bmatrix}$$

The determinant of EVAR FEFN vanishes zero for all z values; that is, this VAR specification is nonfundamental. That means, EVAR models may not work well if the news process of government spending is noisy.

In conclusion, we demonstrate that whether theoretical fundamentalness of certain VAR specification can be achieved or not relys on the features of model, especially about the information flows.[8] We show that not only SVAR, but also EVAR FE have nonfundamental representation on both observable and noisy news process. A VAR model with future news can work well where the news is accurate, while it cannot where the news is noisy. We find that simple form of enlarging information set by adding information, forecast error or future news, or both of them simultaneously, may not be able to recover the structural shocks.[9]

[8] Which news process can be more suitable to the data is beyond our scope. See Hur et al. (2013).

[9] This result is consistent with the conclusion of Blanchard et al. (2013); Barsky and Sims (2011) with a VAR featuring TFP, and understanding about them in Forni et al. (2014b). Forni et al. (2014b) suggested a remedy for recovering news and noisy shocks by dynamic identification which requires further information such as ratio of shocks' variances.

3.3 Empirical Test

In the former section, we demonstrate the influence of assumption about information flows in terms of checking theoretical fundamentalness. That is, the fundamentalness presented by a certain model can be swifted as nonfundamental in another model, and vise versa. Moreover, with consideration of uncertainty and diversity on the news processes on the policy implementation, what empirical analysis can be the best candidate for ameliorating the nonfundamentalness problem on the effects of government spending?

There are some studies about reliability of SVAR where its nonfundamentalness is formally presented. Sims (2012) examined the gap between estimation of DSGE models and VARs with featuring news shock. Based on the simulation evidences from medium-scale DSGE model about future productivity, this paper found that the SVARs can work well even though it has nonfundamental representations theoretically. Féve and Jidoud (2012) analyzed the conditions for reliability of SVARs; they showed that the bias of SVARs can be smaller where the news shocks play significant role in the economics and the tendency of forward-looking behavior of the economy is pronounced. Beaudry and Portier (2014) discussed thoroghly about the literature on the news and business cycles, and showed that a nonfundamental system can be close to its fundamental representation.

Fundamentalness of VAR can be also quantitatively tested. It can be thought as a problem of relative size of information set. That is, environment with fore-

sight or news shock implies richer information set of agents than that of econometrician, which hinders econometrician to recover structural shocks from past value of observations. Based on this notion, Forni and Gambetti (2014c) suggests a testing procedure to verify whether a specific VAR model is informationally sufficient for recovering structural shocks. If one can tangibly capture the information set of the economy that agents are likely to have subset of it, one can test the fundamentalness as information sufficiency by testing orthogonality of a certain shocks.[10] Assuming sufficient large dataset to have relevant information in the economy, they extract principal components from 107 quarterly macroeconomic series for US. By performing Granger causality test on shocks estimated from VAR and principal components, they propose testing procedure to figure out whether information of VARs are sufficient. Also, as mentioned in Forni et al. (2014b), if noisy news is revealed after time t, the shocks estimated by using future information should be orthogonal to the current information. Therefore, the testing procedure can be adopted in the noisy news process structure, but as a necessary condition. With this consideration, we test the orthogonality of a single estimated shock, rather the information sufficiency in the VAR as a whole.

In the next section, we perform the test of Forni and Gambetti (2014c) to figure out whether the three specifications of VARs are quantitatively fundamental or not.

[10]Before Forni and Gambetti (2014c), to show the informational superior to other models, past studies employ Granger causality test between their model and others. However, the test result can tell only about informational superior between the models, not between the information sets from the model and that of economy.

3.3.1 Fundamentalness test

We perform testing procedure proposed in Forni and Gambetti (2014c) to see whether the nonfundamentalness problem is quantitatively important in the three VARs. Forni and Gambetti (2014c) suggested that if VAR specification have sufficient information, it will not be Granger caused by principal components estimated from large marcoeconomic data set. Even if the whole set of variables are informationally deficient, a single shock can be sufficient. As we shown the theoretical possibility of nonfundamentalness of three specific VARs with regard to a whole set, we perform a orthogonality test for the shock identified as "unanticipated" change of government spending.

Also, to be clear for the effects of including anticipation, we perform the test for small-scale VARs first. The information set of VAR may be affected by the size of model.[11] If the size of VAR is relatively small, it is more likely to be informationally deficient to recover the structural shocks, then the specific VAR is likely to be nonfundamental. With this consideration, we perform the test on small-scale VAR, three or four-variate VAR. For robustness, we also perform the test for medium-scale VAR, five or six-variate VAR. We follow the specification of Blanchard and Perotti (2002) for small-scale VAR, and Ramey (2011b) for medium-scale VAR. Implication is that the fundamentalness of unanticipated government spending shock are rejected for small-scale SVAR and EVAR FE, while is not for small-scale EVAR FN.

[11] Lütkepohl (2012) mentions that the nonfundamentalness can arise due to omitted variables.

We set small-scale VAR; $x_t = [g_t, y_t, t_t]$ where g_t, y_t, t_t are the log of real per capita government spending, the log of real per capita GDP, and the log of real per capita taxes. For EVAR FE, we add growth rate of one-period ahead forecast error constructed by difference between governmnet spending and the Survey of Professional Forecasters(SPF), as $\triangle g_t - s_{t|t-1}$, which is ordered first. For EVAR FN, we use growth rate of the SPF for time t+1 made time t. $\triangle s_{t+1|t}$ as news variable ordered second. A quadratic time trend and four lags are included respectively.[12]

For building comparable information set of economy, we employ the principal components estimated from the dataset of Forni and Gambetti (2014c), consist of 107 quarterly US macroeconomic variables for 1960:1-2010:4. The principal components can be treated as proxy of unobservable states.

Because the availability of SPF series, we perform the test for several subsample periods. For SVAR, we perform the test for three different subsamples: 1960:1-2010:4(the longest sample), 1969:1-2010:4(sample period that the growth rate of SPF series are avilable), and 1982:1-2010:4(sample period that the level of SPF sereis are avilable). For Expectation-augmented VARs, we do the test for the last two subsample periods.

Table 3.1 reports the fundamentalness test results of small-scale VARs. Column i in table 1 present the p-values of F-test which regresses the shocks estimated from VARs on the lags of the first i principal components. We find some

[12]We use the growth rate of SPF for comparing impulse responses with other studies, for example Ramey (2011b), and its availability for longer sample period. We also perform the test with s_t as level, but the qualitative results of the test(not shown) are similar.

interesting results from the table. First, with respect to the specifications, we find that shocks from SVAR and EVAR FE cannot pass the test at 5 % level for every subsample period, while from EVAR FN passes the test for all the subsample periods. Especially, from comparing EVAR FE and EVAR FN, we can find that excluding foreseen part from the whole change of government spending may not effective to mitigate the nonfundamentalness problem. From this results, we suggest the EVAR FN as a best candidate as a VAR specification for recovering unanticipated government spending shock.

If one adds additional information to SVAR, can the shock estimated from SVAR have fundamental representation? That is, can it be similar that results of SVAR with more information to the results of EVAR FN? Following this idea of FAVAR and research in Forni et al. (2014a), we also conduct the test of fundamentalness on the SVAR with adding series of principal components. Table 3.2 reports that specification of SVAR can pass the test with more than three principal components at 5 % level. Therefore, we conclude that EVAR FN and SVAR with three principal components("SVAR PC") can perform well in terms of recovering unanticipated shocks.

3.3.2 Robustness check

Components of government spending: federal spending

There are some studies about different effects of change in government spending by the component. For example, Perotti (2014) analysed differences between the effects of defense government spending and civilian spending on

the economy. To see the effects of government spending components, we test the orthogonal test for the VARs with replacing total spending by federal spending. Table 3.3 shows test results for federal spending, which are qualitatively identical; the test results also indicate that shocks from SVAR and EVAR with forecast error in small-scale may still be nonfundamental.

Six-variate VAR

We also perform the orthogonality test on medium-size VARs; we set three VARs on the VAR specifications following Ramey (2011b). Specifically, we set VARs; $x_t = [g_t, y_t, i_t, \tau_t, h_t]$ where g_t, y_t, i_t, τ_t and h_t the log of real per capita government spending, the log of real per capita GDP, the three-month T-bill rate, the Barro-Redlick average marginal income tax rate, and an additional variable of interests such as total hours, the manufacturing product wage, the real BAA bond rate, the three components of consumer expenditures, nonresidential investment and residential investment with rotation in the position of h_t. Analogous to small-scale VARs, we include one-period ahead forecast error constructed by difference between governmnet spending and the Survey of Professional Forecasters(SPF), as $\triangle g_t - s_{t|t-1}$, which is ordered first. For EVAR FN, we use growth rate of the SPF for time t+1 made time t. $\triangle s_{t+1|t}$ as news variable ordered second. A quadratic time trend and four lags are included.

Table 3.4 shows test results for six-variate VAR. In contrast with the small-scale VAR, SVAR and EVAR FE passes the test with the sample period from 1982 to 2010, while they are rejected marginally for the longer samples. That means may the news process of government spending be time-varying(see

Leeper et al. (2012)). Also, government spending shock from SVAR may be quantitatively fundamental with sufficient size, even without explicitly forward-looking variables or expectation measures. Consistent with the former section, EVAR FE show marginal p-values for 1969:1-2010:4 period and pass the test for 1982:1-2010:4. For the EVAR FN, the shock from the VAR passes the test for both of sample periods.

3.3.3 Impulse Responses

In this section we study impulse responses of three VARs. Figure 3.1 displays impulse responses estimated from SVAR.[13] The data period is 1969:1-2010:4. The change of government spending is estimated from cholesky decomposition with ordering government spending first. A quadratic time trend and four lags are included in the model.

In accordance with Blanchard and Perotti (2002), GDP and taxes show insignificant responses, which are followed by insignificant responses of almost all the variables of interest. Government spending also has relatively wide error bands than results of typical fiscal VARs. Figure 3.2 displays results from EVAR FE; the responses of variables become significant and it shows clear negative effects on the economy. GDP, taxes, total consumption, total investment and components of consumption and investments decrease significantly. Although the government spending shocks from SVAR and EVAR FE are both non-

[13]To avoid including too many variables in the model, we set the first three variables as a fixed set and rotates the 4th variable as the series of variables of interest, such as hours, real wage and consumption and investment components.

fundamental, but the impulse responses are quite different; the results from EVAR FE show contractionary effects.

Figure 3.3 demonstrates impulse responses of EVAR FN. First, in general, the responses of EVAR FN become relatively more significant than that of SVAR; the response of government spending becomes persistent and significant. Impact responses of GDP, hours, business wage and total and nonresidential investment are relatively more significant than that of SVARs. Second, comparing with EVAR FE, the negative responses of economy is vanished in the impulse responses of EVAR FN.

In figure 3.4, we show the impulse response of SVAR with 3 principal components. As we predict before, the impulse responses of SVAR with more information is quite similar with EVAR FN; first, the response of government spending become significant and persistent, as in the EVAR FN. Second, the responses of GDP, hours, taxes, total and nonresidential investment gain significance so that they are alike the corresponding results of EVAR FN.

We estimate impulse response of EVAR with future news in 6-variate VAR for 1969-2010(figure 3.5). Notes that in the six-variate VAR, unanticipated government spending shock may have non-negative effects on the economy, or rather be expansionary.

3.4 Conclusion

We analyzed the fundamentalness of commonly used VAR models for fiscal policy, namely conventional VAR, EVAR FE, and EVAR FN, both theoretically and empirically. Through theoretical examination, we showed that fundamental representation exists in the EVAR FN but not in the SVAR and EVAR FE. However, the fundamentalness relies on the information flow of government spending. We show that where the news is noisy, all three specifications are theoretically non-fundamental.

To identify the seriousness of the non-fundamentalness problem in quantitative analysis, we also conducted an empirical test on the fundamentalness of Forni and Gambetti (2014c), which captures fundamentalness by information sufficiency. The empirical test results demonstrated that EVAR FN is informationally sufficient, and therefore it may have fundamental representation. The SVAR and EVAR FE show informational deficiency in some cases. In addition, the impulse responses from three VAR specifications differed. Therefore, in applied research, the informationally sufficient and deficient VAR models on government spending generate different results. Based on the results of the theoretical and empirical analyses, the shock identified from EVAR FN is likely to be free of the non-fundamentalness issue. We also found that the unanticipated shock of government spending tends to have non-negative effects on the economy.

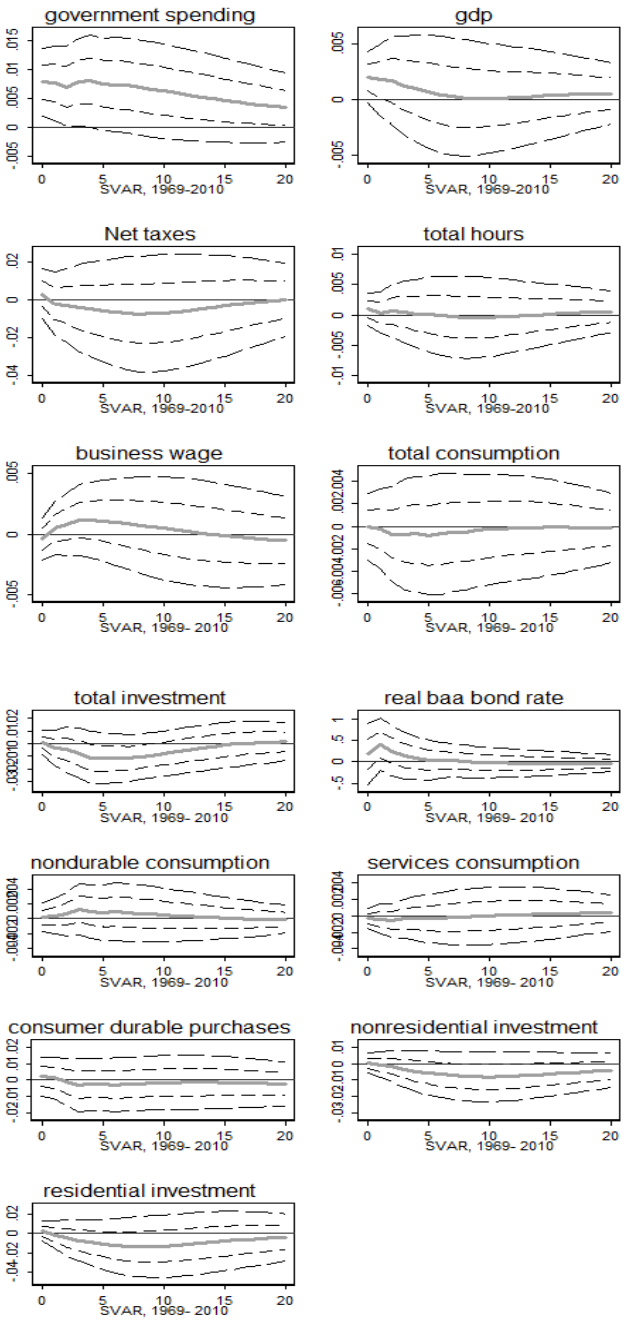

Figure 3.1 SVAR: 1969-2010

The standard error bands for 68 % and 95 % are displayed.

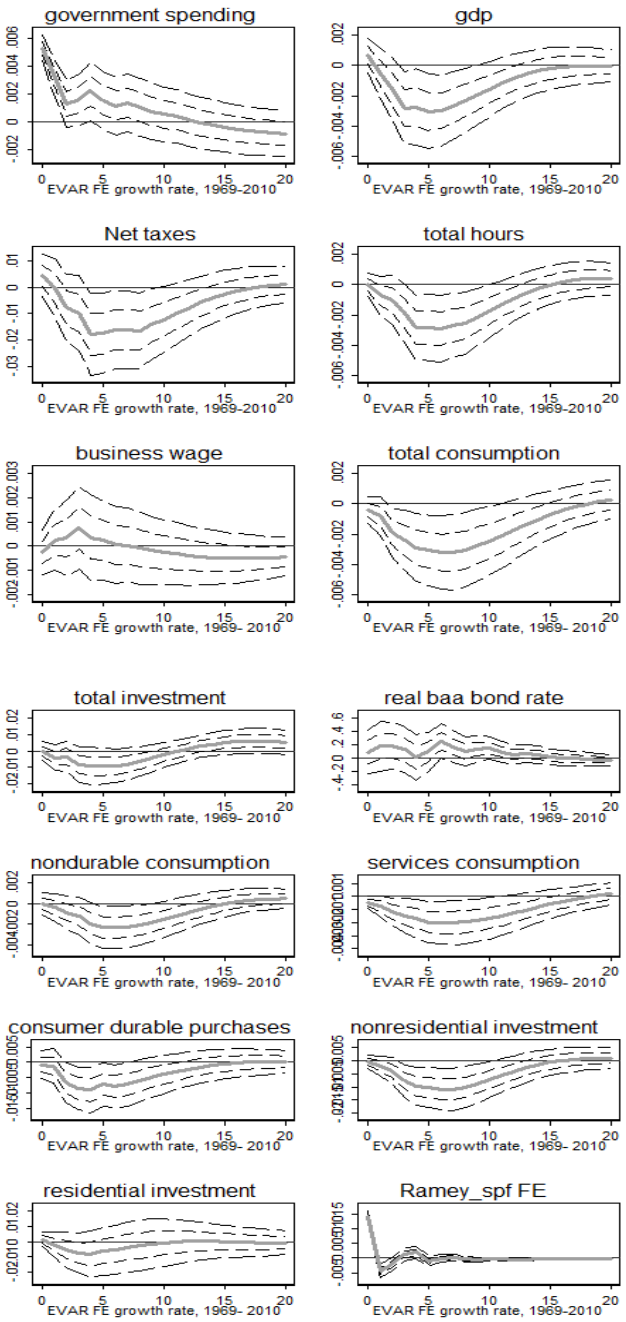

Figure 3.2 EVAR FE: 1969-2010

The standard error bands for 68 % and 95 % are displayed.

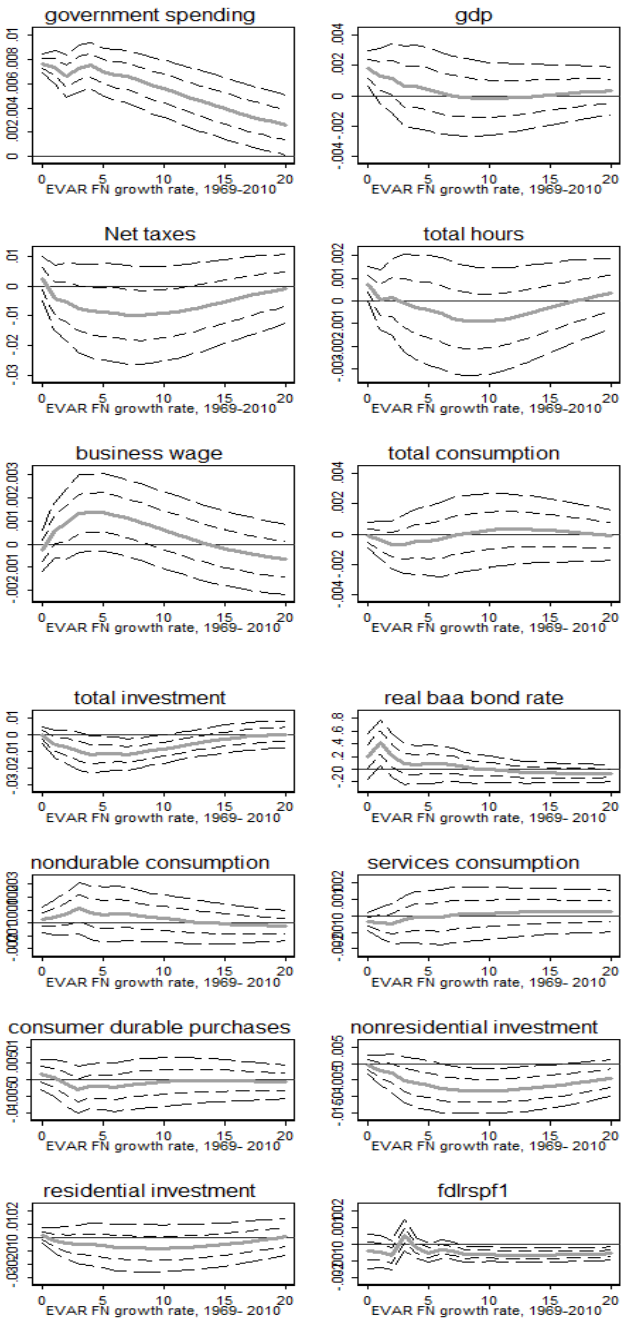

Figure 3.3 EVAR FN: 1969-2010

The standard error bands for 68 % and 95 % are displayed.

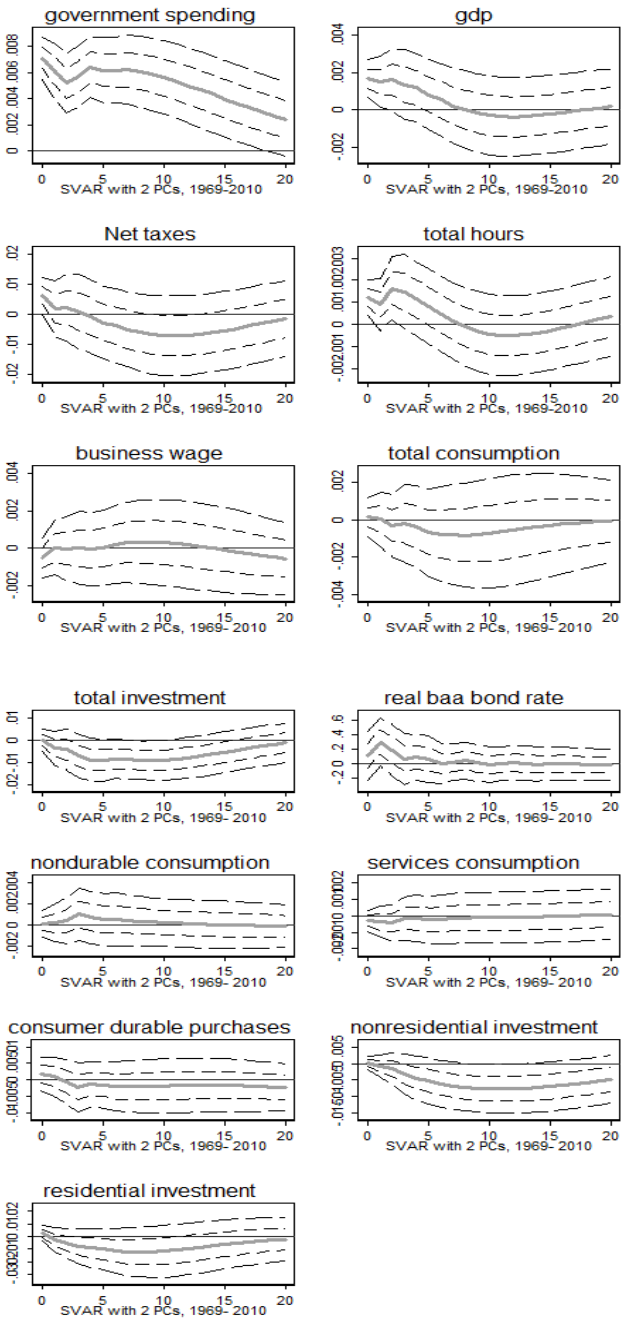

Figure 3.4 SVAR with 3 PCs: 1969-2010

The standard error bands for 68 % and 95 % are displayed.

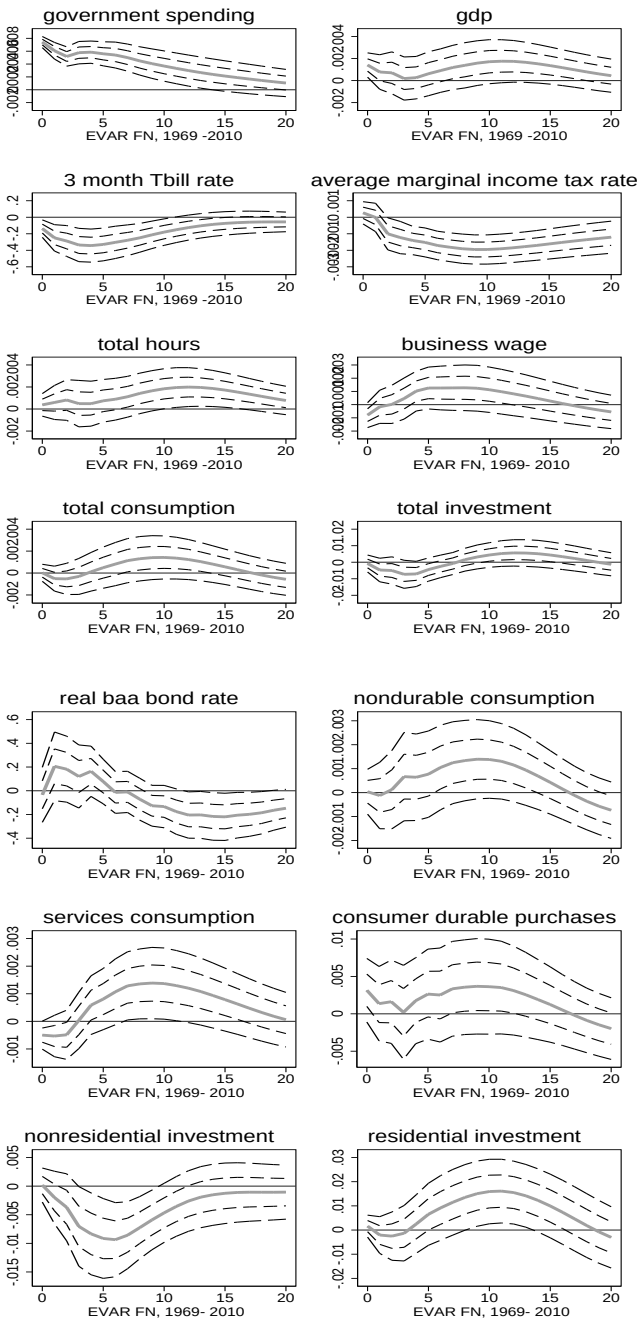

Figure 3.5 EVAR FN, 6-variate VAR: 1969-2010

The standard error bands for 68 % and 95 % are displayed.

		Principal Components														
	lag	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SVAR																
1960-2010	1	0.88	0.35	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.74	0.29	0.31	0.02	0.01	0.02	0.03	0.05	0.06	0.01	0.02	0.02	0.04	0.04	0.07
1969-2010	1	0.98	0.16	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	4	0.85	0.28	0.39	0.04	0.04	0.06	0.12	0.08	0.10	0.03	0.05	0.05	0.09	0.11	0.18
1982-2010	1	0.85	0.11	0.08	0.02	0.04	0.07	0.11	0.17	0.17	0.23	0.30	0.38	0.10	0.14	0.14
	4	0.94	0.08	0.07	0.11	0.13	0.17	0.22	0.10	0.07	0.02	0.04	0.06	0.08	0.08	0.08
EVAR FE																
1969-2010	1	0.92	0.57	0.48	0.14	0.19	0.04	0.07	0.09	0.10	0.15	0.09	0.05	0.06	0.03	0.05
	4	0.48	0.49	0.51	0.04	0.10	0.02	0.03	0.06	0.08	0.09	0.10	0.07	0.09	0.17	0.24
1982-2010	1	0.84	0.33	0.29	0.03	0.02	0.04	0.02	0.04	0.06	0.10	0.14	0.15	0.16	0.11	0.09
	4	0.49	0.05	0.04	0.01	0.01	0.01	0.04	0.07	0.06	0.07	0.10	0.16	0.22	0.30	0.08
EVAR FN																
1969-2010	1	0.79	0.95	0.94	0.98	0.54	0.57	0.29	0.35	0.40	0.49	0.38	0.45	0.33	0.18	0.24
	4	0.87	0.95	1.00	1.00	1.00	1.00	0.97	0.88	0.83	0.89	0.94	0.96	0.94	0.94	0.96
1982-2010	1	0.58	0.85	0.74	0.85	0.79	0.84	0.80	0.78	0.85	0.89	0.41	0.45	0.53	0.51	0.52
	4	0.78	0.88	0.92	0.88	0.79	0.39	0.36	0.42	0.60	0.72	0.82	0.47	0.47	0.46	0.35

Table 3.1 Fundamentalness test results of three(EVAR:four) variate VAR

		Principal Components														
	lag	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
# of PC																
1	1	0.90	0.47	0.67	0.18	0.25	0.26	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	4	0.98	0.29	0.46	0.13	0.07	0.08	0.04	0.10	0.03	0.03	0.01	0.01	0.01	0.00	0.00
2	1	0.97	1.00	0.86	0.94	0.43	0.54	0.32	0.24	0.23	0.22	0.29	0.37	0.45	0.06	0.09
	4	1.00	1.00	1.00	1.00	0.95	0.98	0.83	0.45	0.54	0.28	0.12	0.20	0.30	0.18	0.12
3	1	1.00	1.00	1.00	1.00	0.15	0.23	0.32	0.12	0.16	0.21	0.27	0.33	0.40	0.20	0.26
	4	1.00	1.00	1.00	1.00	0.92	0.94	0.96	0.29	0.46	0.39	0.18	0.24	0.34	0.39	0.17

Table 3.2 Adding PCs: Fundamentalness test results of SVAR + PCs

		Principal Components														
	lag	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SVAR																
1960-2010	1	0.88	0.38	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.73	0.31	0.31	0.02	0.01	0.02	0.03	0.05	0.06	0.01	0.02	0.02	0.04	0.05	0.08
1969-2010	1	0.98	0.07	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.84	0.16	0.25	0.02	0.04	0.06	0.09	0.07	0.09	0.04	0.05	0.05	0.09	0.12	0.19
1982-2010	1	0.86	0.18	0.14	0.03	0.05	0.08	0.13	0.19	0.21	0.28	0.35	0.43	0.10	0.13	0.11
	4	0.91	0.10	0.08	0.10	0.13	0.21	0.31	0.13	0.09	0.02	0.05	0.07	0.09	0.07	0.07
EVAR FE																
1969-2010	1	0.88	0.69	0.63	0.49	0.63	0.06	0.02	0.03	0.03	0.04	0.06	0.05	0.06	0.05	0.07
	4	0.88	0.82	0.84	0.08	0.10	0.03	0.05	0.07	0.05	0.09	0.12	0.11	0.17	0.27	0.25
1982-2010	1	0.86	0.10	0.14	0.02	0.02	0.03	0.01	0.01	0.03	0.04	0.05	0.07	0.09	0.06	0.03
	4	0.66	0.04	0.06	0.02	0.01	0.01	0.04	0.07	0.11	0.21	0.32	0.39	0.42	0.46	0.19
EVAR FN																
1969-2010	1	0.79	0.96	0.96	0.97	0.57	0.61	0.43	0.42	0.40	0.50	0.47	0.52	0.45	0.32	0.40
	4	0.82	0.94	0.99	1.00	1.00	1.00	1.00	0.97	0.91	0.94	0.97	0.98	0.97	0.97	0.98
1982-2010	1	0.89	0.60	0.80	0.75	0.86	0.90	0.85	0.88	0.93	0.95	0.54	0.57	0.65	0.68	0.39
	4	0.75	0.83	0.87	0.70	0.30	0.27	0.47	0.44	0.61	0.64	0.67	0.73	0.58	0.67	0.20

Table 3.3 Fundamentalness test results: Federal spending with three(EVAR:four)-variate VAR

		Principal Components														
	lag	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SVAR																
1960-2010	1	0.91	0.84	0.82	0.90	0.72	0.78	0.84	0.63	0.71	0.69	0.77	0.55	0.57	0.65	0.68
	4	0.41	0.56	0.33	0.14	0.18	0.33	0.17	0.02	0.03	0.05	0.07	0.13	0.07	0.06	0.05
1969-2010	1	0.94	0.99	0.97	0.99	0.99	0.94	0.97	0.90	0.94	0.96	0.98	0.82	0.72	0.77	0.82
	4	0.49	0.72	0.40	0.14	0.20	0.34	0.24	0.05	0.08	0.18	0.24	0.35	0.29	0.41	0.33
1982-2010	1	0.69	0.49	0.56	0.73	0.77	0.82	0.89	0.92	0.90	0.82	0.84	0.80	0.76	0.81	0.85
	4	0.45	0.74	0.48	0.64	0.67	0.70	0.82	0.87	0.88	0.93	0.82	0.90	0.95	0.95	0.95
EVAR FE																
1969-2010	1	0.93	0.33	0.53	0.26	0.35	0.21	0.12	0.16	0.22	0.30	0.38	0.44	0.36	0.42	0.46
	4	0.85	0.33	0.35	0.24	0.08	0.15	0.13	0.00	0.00	0.01	0.00	0.01	0.01	0.03	0.04
1982-2010	1	0.63	0.50	0.60	0.72	0.65	0.77	0.82	0.85	0.90	0.76	0.83	0.88	0.82	0.86	0.89
	4	0.47	0.67	0.93	0.75	0.55	0.58	0.55	0.55	0.61	0.67	0.36	0.33	0.39	0.40	0.35
EVAR FN																
1969-2010	1	0.74	0.93	0.94	0.98	0.70	0.77	0.57	0.68	0.70	0.78	0.85	0.90	0.85	0.84	0.86
	4	0.81	0.95	0.99	1.00	0.99	0.99	0.97	0.97	0.95	0.98	0.99	1.00	0.99	0.99	1.00
1982-2010	1	0.56	0.79	0.78	0.74	0.69	0.80	0.71	0.79	0.61	0.69	0.68	0.74	0.80	0.85	0.80
	4	0.30	0.38	0.69	0.86	0.77	0.59	0.24	0.29	0.20	0.21	0.32	0.37	0.36	0.55	0.46

Table 3.4 Fundamentalness test results: five (EVAR:six)-variate VAR

Chapter 4

Discussion and conclusion

In this thesis, we discussed two types of government spending shocks according to fiscal foresight. In Chapter 2, we investigated the effects of change in the expected present value of government spending. This shock has two important features: first, this news shock is the change in expectations about future government spending. It is orthogonal to the "information set" of agents, not to current and past observations of data. Second, with considerations on the wealth effect, the perceived change of the future path of government spending, not the one-time shock, was identified in this shock. According to the wealth effect view, if a new policy is implemented, agents will consider the whole path of spending and incorporate it in their decisions for future activities. Therefore, as mentioned in Ramey (2011b), to test the wealth effect hypothesis, constructing a

present value measure of expectation is crucial.[1] In Chapter 3, we investigated the effects of the unanticipated change in government spending. In contrast, unanticipated shock is the change in government spending as an observable, not as an expectation. Extracting the foreseen part from the changes is the essence of research methodology.

With respect to the importance of expectation in the transmission of policy, we suggest a comparison of these two shocks as a way to enhance understanding government spending policy. The news and unanticipated shock describe the role of expectation in the policy by comparing the consequences of shocks with and without anticipation. We reloaded the impulse responses of two shocks and highlight some interesting points: First, the responses to government spending are clearly diverse. Government spending has almost no impact response to news shock, but after 4 or 5 quarters, the impact response increases steadily. Unlike news shock, government spending rises quickly to the unanticipated shock and goes down slowly. Second, GDP, hours, and total consumption and its components show similar patterns of response to both shocks, but the response to news shock is more notable. Although the unanticipated shock also has non-negative effects, the news shock appears to be better stimulate the economy. Moreover, the investment components are divided and show positivity to the news shock.

These two shocks conceptually identify the exogenous changes of govern-

[1]Present value measure has its strong point with regard to capturing more information. Each policy demands different amounts of time to implement; consequently, the foresight period should be different according to the news. Formation of present value enables more flexibility about the foresight period.

ment spending with and without expectation. The news shock is the shock on the expectation measure, but it is followed by actual change of government spending with a pattern that is consistent with the news shock hypothesis. To these shocks, government spending itself shows different responses, and the GDP and its components also are differentiated in terms of significance.

With a closer look at the relation between the anticipation process and components of government spending, we suggest a potential explanation about the difference. The changes in expectation are more likely to occur when the policy has a long implementation lag so that the possibility of anticipation is higher. Unanticipated shock may be applied in the opposite case. With respect to the length of the implementation lag, we focus on the ratio of government investment and consumption. Leeper et al. (2010) investigated the effects of government investment related to implementation delays and fiscal financing and showed that if government investment is productive, the length of delays for government investment can be pivotal to the pattern of economic response, especially private investment. Bachmann and Sims (2012) focused on the relative portion of government investment and consumption with regard to the productivity of government spending and suggested that government spending during a recession tends to lean toward investment rather than consumption and that the confidence that captures the changes in productivity may be more informative in a recession.

Consistent with these studies, we find that the measure used in the identification of news shock has a tendency to be higher when the ratio of government

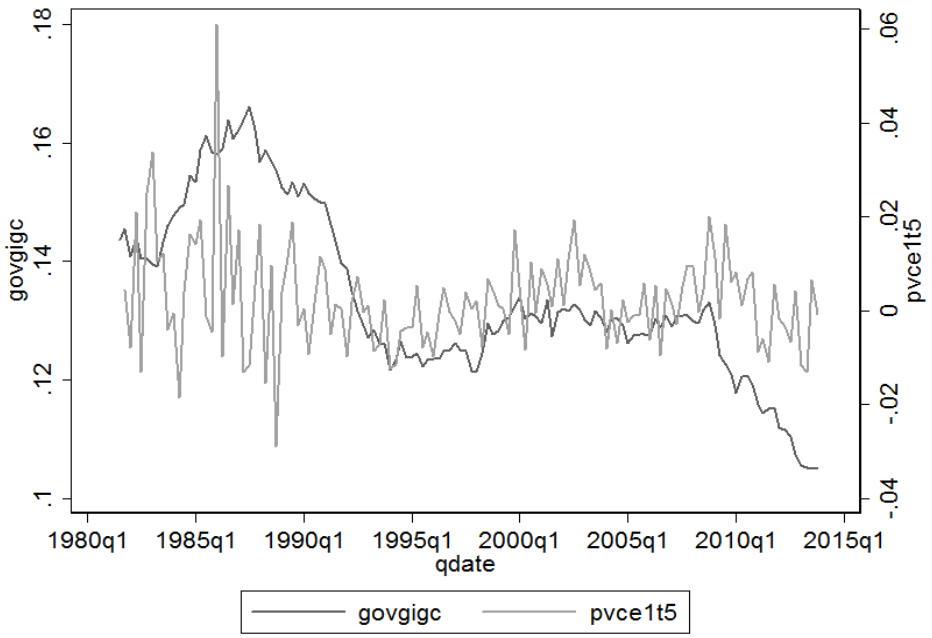

Figure 4.1 SPF news shock and government investment-consumption ratio

The standard error bands for 68 % and 95 % are displayed.

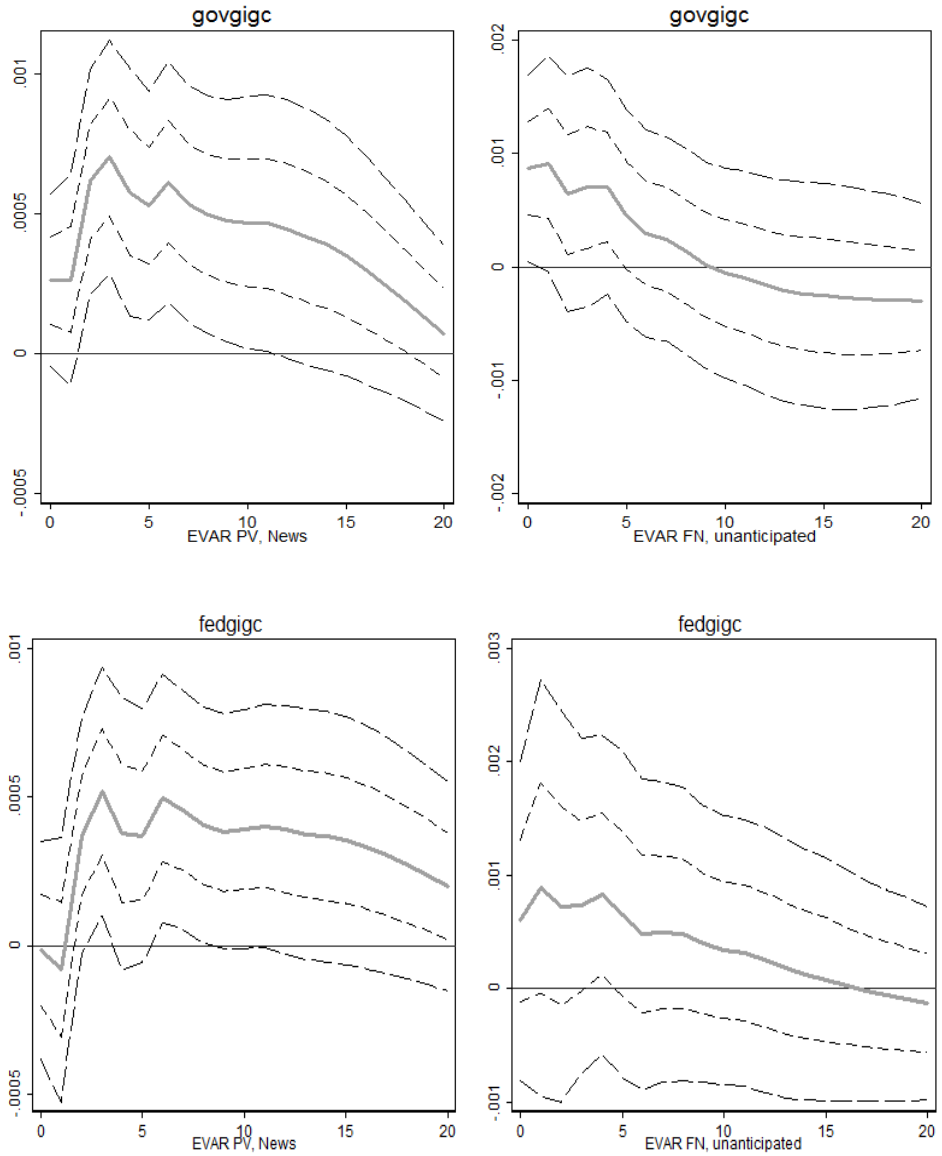

Figure 4.2 Government spending: government investment vs. government consumption

The standard error bands for 68 % and 95 % are displayed.

investment to consumption is high. Figure 4.1 shows the path of news measures included in Chapter 2 and the ratio between government investment and consumption. Interestingly, the news measure showed significantly large fluctuations when the ratio of investment and consumption was relatively high. The higher portion of government investment may enable agents to have fluctuations in expectations of government spending. We also compared the impulse response of the government investment–consumption ratio to both news and unanticipated shocks. In Figure 4.2, the ratio significantly increased in response to news shock but stayed near the normal level in response to the unanticipated shock.

With understanding about different effects of government spending shocks according to the nature of foresight, we leave several issues for future research. For theoretical analysis, more generalized structure of information can be addressed. For empirical analysis, one can investigate the different nature of government spending shocks with consideration of other issues related to fiscal policy, such as fiscal financing.

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국 문 요 약

이 논문은 재정 예측에 따른 정부 지출 충격의 효과가 어떻게 달라질 수 있는지 분석하였다. 전통적으로 정부 지출 충격의 영향에 대한 다양한 연구가 활발히 진행되어 왔다. 최근 재정 정책이 시장행위자에 의해 미리 예측되어 시장행위자의 행동함수에 반영될 가능성, 즉 재정 예측이 재정정책의 효과를 분석하는 데 있어 중요하게 다루어져야 한다는 연구가 진행되었다. 이에 따라, 재정 예측의 특성을 고려하여 예측 여부에 따라 정부 지출 충격이 경제에 미치는 영향이 어떻게 달라지는 지 분석하였다.

2장에서는 예측된 충격을 어떻게 식별해야 할 것인지에 대한 논의와 함께 미국의 분기별 자료를 이용하여 예측된 충격의 효과를 식별하였다. 3장에서는 기존 문헌에서 비예측 충격의 식별 조건으로 제시되었던 모형을 비교, 분석하여 어떤 모형이 더 바람직한 모형인지 이론 모형과 실증 분석을 통해 제시하였다. 이후 미국의 분기별 자료를 이용, 비예측 충격의 효과를 식별하였다.

정부 지출 충격 중에서 시장행위자가 미래에 이루어질 것으로 미리 예측한 충격의 경우, 경기 확장적인 효과가 있는 것으로 나타났다. 미리 예측되지 않은 충격의 경우, 마찬가지로 경기 확장적인 효과가 있으나 예측된 충격의 경우보다 상대적으로 적은 확장 효과를 가져오는 것으로 나타났다.

주요어: 구조 VAR, 재정정책, 정부지출충격, 재정예측, non-fundamental representation, 뉴스, SPF

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