NEWS AND
GOVERNMENT EXPENDITURE EFFECTS
IN FINLAND

Katja Tuulia Haavanlammi
University of Helsinki
Faculty of Social Sciences
Economics
Master’s Thesis
February 2016
The theory about fiscal foresight suggests that, when it is present, the econometric analysis will face substantial challenges; and the shocks received can be nonfundamental if the information in the model is not sufficient.

This thesis introduces fiscal foresight into a conventional vector autoregression (VAR) analysis and examines the dynamic effects of unanticipated and anticipated government expenditure shocks with Finnish data. However, since VAR models base only on present and past information, including a forward looking variable into a VAR may cause issues that lead to misspecifications of the model and into wrong conclusions. To measure government expenditure anticipations I create a news variable by using Bank of Finland’s government expenditure forecast data. The idea is that this variable should capture the effects when the future government expenditure increase is anticipated by the forecasters and assumably by the agents in the economy. By including this news variable in the VARs information set the recovered shocks should describe more accurately the identified shocks in the economy.

I show with a simple example and with information sufficiency tests that this news variable overcomes the issues that fiscal foresight may cause to the VAR analysis and that this variable makes the VAR analysis more accurate. I will investigate if including this news variable in a conventional VAR model will change the outcomes on government expenditure, tax revenues, private consumption, private investment and output; first when the unanticipated government expenditure shock causes the shock and second when the positive shock comes from the news that can be interpreted to be an anticipated government expenditure increase.

In most cases the literature either supports the Keynesian or neoclassical theory since there exist disagreements on the government expenditure effects on private consumption and investment. These effects are also in the centre of my thesis and the first result is that whether or not the news variable is included to the VAR model the unanticipated government expenditure shock does not crowd out private economic activity. Instead the effects are positive and persistent and they support the Keynesian view. Second result is that when the shock to the system comes from the news, the effects on private economic activity are quite the opposite and they support the neoclassical view. This would mean that if government expenditure increase is anticipated by the agents, they will postpone their consumption and investment decisions until the government expenditure increase is implemented and the expenditure starts to return back to its unshocked path.

Results all together suggest that government expenditure increase as an expansionary fiscal policy action is effective if the increase is not anticipated by the agents in the economy. If announcements on future government expenditure increases is done, the hoped expansionary effect after implementation can actually retard the economy for a few years.
1 Introduction

Empirical results on government expenditure effects do not seem to find a common line. Particularly, there seems to be a lot of disagreements with the responses of private consumption and investment. Even at the theoretical level, Keynesian and neoclassical models compete with the same output components and their responses on government expenditure shocks. In all cases the main question is that should government intervene in the market; is it worthwhile to increase government expenditure or not. Vector autoregression (VAR) is a common way to proceed when examining the dynamics of the economy and usually different outcomes can be at least partly explained by different sample periods, possible sign restrictions, ordering of the VAR variables and different approaches to identify the underlying government expenditure shocks. However, these ignore the possibility that the identified government expenditure shocks in the economy could have been anticipated by the agents, and therefore, the shocks received from the model can be nonfundamental and they do not describe the identified shocks in the economy.

Indeed this is the case when fiscal foresight is present. Agents foresee fiscal events and are able to adapt their economic activity with respect to the new information they have received. Thus, agents’ information set includes information about the past and the present but also about the future whereas an econometrician is restricted to consider only past and present in a VAR analysis.

Beaudry & Portier (2004) consider that stock prices can be seen as news about future technological opportunities. They find that a shock in stock prices increases private economic activity via changes in productivity. So even though, fiscal foresight has been a well known phenomenon, only in the last few decades econometricians’ have started to find ways to overcome the problems that foresight imposes to the fiscal analysis with a VAR framework. The previous literature on fiscal policy effects has shown that conventional VAR models without anticipations seem to recover shocks with a delay, and if anticipations can be correctly included to the VAR, the responses should become more accurate (Ramey, 2011). Problem, however, is that one can not just add for example rational ex-
pectations in the VAR since it may induce noninvertible moving average representation. Also it may cause that conventional causal VAR approach is not the correct way to proceed, if the dependent variables depend on past and present error terms but also on future error terms. The question to be raised here is that how to address fiscal foresight correctly to the VAR. (Leeper et al. (2008).)

In this thesis fiscal foresight is considered to be anticipations on Finland’s government expenditure. To describe such a foresight I follow the example of Caggiano et al. (2014) and create a government expenditure news variable from government expenditure forecast revisions. This variable should capture the effects when the future government expenditure increase is anticipated by the forecasters and assumably by the agents in the economy. This variable does not cause invertibility problems and its information content is such that it makes the conventional VAR model and shocks that it recovers more accurate. I will investigate if including this news variable in a conventional VAR model will change the outcomes on government expenditure, tax revenues, private consumption, private investment and output; first when the unanticipated government expenditure increase causes the shock and second when the positive shock comes from the news that can be considered to be an anticipated government expenditure increase.

The results show that when the shock to the economy comes from the unanticipated government expenditure increase the main interpretations do not differ whether or not the news variable is included in the model. No crowding out effect of private economic activity is to be seen and the effects on private consumption and investment are positive and persistent and the shock boosts the economy. However, seems that the impulse responses from the model which does not include the news variable could be inaccurate and underestimated. When it comes to the effects of the positive news shock, can be seen that clearly private consumption and investment are crowded out, also output declines. What these results suggest is that for example in a recession government expenditure increase is worthwhile if it can be done without announcements - which however contradicts the principle of policy transparency and may cause bad knock on government’s credibility. If government expenditure increase is anticipated by the agents, the policy action can retard
the economy even more for a few years.

The remainder of this thesis is organized as follows. Section 2 reviews the previous literature which concentrates on dynamic effects of fiscal policy shocks and takes fiscal foresight and news variables into discussion. Section 3 presents the three issues that fiscal foresight may cause to the VAR analysis, and also shows an example of how these issues can be overcome in a simple bivariate VAR model. Section 4 presents the dataset and discusses on macroeconomic forecasts produced by Bank of Finland. Section 5 will explain the empirical strategy of the thesis by introducing the VAR models and news variables used. Section 6 presents the results and section 7 discusses on the robustness and also completes some unclear outcomes. Section 8 concludes and discusses if the news variable approach was a sufficient assumption for agents’ anticipations on government expenditure.

2 Review of the Previous Literature

The course of fiscal effects in the economy has been an extremely debatable topic through the last century because the discovered fiscal effects from various empirical models are quite heterogenous. Actually the debate starts already from the two main theory approaches, Keynesian and neoclassical, and their disagreements on government expenditure effects and from the question that should government intervene in the market. Both theories predict positive effect of government expenditure on output so examining output effects is not sufficient to discriminate between these competing theories (Caldara and Kamps, 2008). The main divergence is that Keynesian models predict positive effect on private consumption whereas neoclassical models predict negative effect or crowding out effect of private consumption. On private investment these theories are not that straightforward. Keynesian models predict government expenditure effect on private investment to be positive but if the interest rate increases persistently the effect may be negative. Neoclassical models predict private investment to increase if the increase in government expenditure is persistent and taxes are sufficiently nondistortionary, which in practice refers to lump-sum taxes. However, if expenditure shock is temporary and taxes are dis-
tortionary, as in reality this is the usual case, the effect of government expenditure shock on private investment is negative. (Blanchard and Perotti (2002)).

In economics one variable usually depends on its own past values but also on current and past values of other variables and modeling this kind of relationships is possible with VAR models. Thus, the use of VAR models has become an established practice to examine fiscal policy effects. Still the approaches, how to identify fiscal shocks from the dependent variables, diverge through the literature which may explain the heterogenous results. Also a few simpler reasons for heterogeneity is for example sample periods, possible sign restrictions and ordering of the VAR variables. But in earlier empirical works the research question has commonly only focused on unanticipated (surprise) fiscal shocks. In the last few decades researchers have considered more the fact that agents can foresee fiscal events so that there exists also anticipated fiscal shocks. And when fiscal foresight is present, the conventional VARs are not able to recover fiscal shocks in time but they come with a lag as for example Leeper et al. (2008) and Ramey (2011) have shown. Thus, fiscal foresight causes a fundamental problem of nonfundamental residuals in the VAR model.

2.1 Unanticipated government expenditure shocks

Ramey and Shapiro (1998) investigate sector-specific effects on changes in government expenditure in a two-sector dynamic general equilibrium model. They use a narrative approach\(^1\) to identify government expenditure shocks, and particularly, U.S.’s war dates to create military dummies to describe the changes in government expenditure. What they find is that positive government expenditure shock increase both total and private output for few quarters but private output turns even negative after two years. Consumption on nondurables and services fall significantly after the shock but investment increases.\(^2\)

These results support the neoclassical theory on crowding out effect of private consump-

\(^1\)Also called as event study approach which aims to discover exogenous fiscal shocks for example from news papers, official government documents, or from significant dates (Blanchard and Perotti (2002), Ramey and Shapiro (1998), Ramey (2011)).

\(^2\)Consumption on durables increases significantly on impact and then turns negative. This is argued to be caused by a panic shopping when Korean War started (Ramey and Shapiro, 1998).
tion, where a positive government expenditure shock causes a negative wealth effect on private sector - consumption and net taxes decrease and labor supply increases.

In the seminal paper of Blanchard and Perotti (2002), they use a mixed structural VAR (SVAR) and narrative approach by gathering institutional information on taxation systems to identify the fiscal shocks. They argue that taxation and government expenditure are dependent and cannot be investigated separately, hence, both of them need to be included in the SVAR. Even though, there occurs implementation lags after the fiscal policy announcements, there is no significant anticipation effects on the economy, and the shocks can be considered as on surprise shocks. Blanchard and Perotti (2002) agree with Ramey and Shapiro (1998) that positive government expenditure shock increases output. However, Blanchard and Perotti disagree with the behave of private consumption and investment, because in their SVAR approach private consumption increases and investment decreases after the expenditure shock. These results suggests that there would be no crowding out effect on private consumption but on investment.

Virkola (2014) follows the SVAR approach of Blanchard and Perotti (2002) but investigates the fiscal effects in small open economies which have similar underlying economic environments but different monetary policy regimes. The regime is the exchange rate which is fixed in Finland and floating in Sweden. For Sweden he finds that positive government expenditure shock increases output but decreases net taxes, which speaks in favor of private consumption’s crowding out effect. However, for Finland he finds that positive government expenditure shock increases both output and net taxes significantly, which in turn suggests that crowding out does not apply for Finland.

Lehmus (2009) examines labour taxation and employment effects in Finland with an empirical macroeconomic model (EMMA) that is developed at the Labour Institute for Economic Reasearch. He uses quarterly series from 1990:1 to 2007:4. His main research

3Blanchard and Perotti (2002) consider also the possibility of anticipation shocks and investigate if anticipations could have effect on their model. This is discussed more in section 2.2.
4Since Finland is a small euro area county, can be assumed that Finland alone does not have effect on the euro exchange rates, and thus, exchage rate can be assumed to be fixed for Finland.
5This result for Finland was achieved with the quarterly time series covering time from 1996:4 to 2011:4.
question is what are the effects of tax cuts on employment and economic growth but he analyses also the effects of public expenditures. Lehmus (2009) has two set ups, first one is that policy changes are debt-financed which means that government deficit is not controlled, and second one is budget-neutral approach in where tax cuts are financed by reducing government expenditures. When the positive government expenditure shock is debt-financed the effects on output and employment are positive but only in the short run. This also causes inflationary effects on prices and government deficit to increase. Next the budget-neutral approach is simulated with a negative government expenditure shock which allows government to cut contemporaneously income taxes. This shock increases output and employment in the long run but in this set up wage pressures are lower and prices deflate. And since this is a budget-neutral approach, government deficit stays stable.

Kuismanen and Kämppi (2009) use two methods to analyse fiscal policy effects in Finland: SVAR and the Vector Stochastic Process with Dummy Variables (VSPD). In their SVAR approach they use five variable VAR, total tax revenues, government expenditure, private investment, private consumption and GDP, respectively. They find that government expenditure increase crowds out both private consumption and investment. The different results between Virkola (2014), Lehmus (2009) and Kuismanen and Kämppi (2009) can be mostly explained with the different model set ups and sample periods. Neither Virkola (2014) or Lehmus (2009) examined the government expenditure effects directly on private consumption or investment but they assume that if shock causes either output or tax revenues to increase there has to be some increase also in private economic activity, which necessarily is not a sufficient assumption with respect to Caldara and Kamps (2008).

Seems that especially these studies disagree, as does the two main theories, with the government expenditure effects on private consumption and investment. This question is crucial when it comes to reviving the economy. One explanation for these heterogenous results is that they depend on approaches and sample periods that has been used which is understandable. However, can be argued that the information in these studies has not been
sufficient to perfectly describe the identified shocks in the economy. Agents foresee the future and they are able to adapt their economic activity to correspond their anticipations.

2.2 Evidence of fiscal foresight

Fiscal foresight describes the idea that agents in the economy have anticipations on future fiscal policy actions. These anticipations are formed for example from government budget proposals, policy briefings, news, or media in general, forecasts and so on. The theory about fiscal foresight suggests that, when it is present, the econometric analysis will face substantial challenges. Ramey (2011) shows that timing matters when identifying government expenditure shocks. Leeper et al. (2008) argue that neither of these main identification methods, conventional VARs nor narratives, can ever correctly recover the identified fiscal shocks as long as agents’ information sets include foresight but econometrician’s does not. In addition, Leeper et al. (2008) state that their analytical study of the econometric implications of fiscal foresight is the first one that literature got to offer.

The study of Leeper et al. (2008) focuses on foresight about taxes, but the same problems occur also in case of government expenditure foresight. Both are caused by different sizes of information sets, and both can lead to representation which has noninvertible equilibrium. Leeper et al. (2008) give an analytical example with a standard growth model and with different periods of tax foresight. They show that without foresight they get the usual result that tax rates will not have effect on capital accumulation. When there is some degree of foresight assumed they find the exact opposite. With one period of foresight the tax shocks affect contemporaneously on capital, and with larger number of foresight periods the problem of noninvertible moving average polynomial appears.

What if the foresight is ignored by the econometrician and she proceeds with the conventional VAR analysis? Leeper et al. (2008) note that it is obvious that ignoring something leads to misspecification of the model, which creates misleading variance decomposition and impulse responses which will not describe the identified dynamics of the economy. On the other hand, if the fiscal foresight is not correctly addressed in the VAR it "can seriously distort many of the inferences that macroeconomists draw from empirical work"
(Leeper et al., 2008). Also fiscal foresight may cause instantaneous causality between the residuals so that econometrician is not able to separate the shocks from each others.

Ramey (2011) compare two mostly used identification methods, when only surprise shocks are assumed: SVAR in Blanchard and Perotti (2002), and narrative approach based on war dummies in Ramey and Shapiro (1998). As already mentioned in the last section, the results of Blanchard and Perotti, and Ramey and Shapiro are different. Ramey (2011) find that the Blanchard-Perotti SVAR shocks were actually several quarters too late compared to Ramey-Shapiro shocks, and that war dates Granger-cause Blanchard-Perotti government expenditure and defence expenditure variables, but not the other way around. Then she performs a test with the lags of the Survey of Professional Forecasters’ (SPF\(^6\)) government expenditure forecast, and find that even these have predictive power on Blanchard-Perotti government expenditure shocks. These results indicate that Blanchard-Perotti SVAR has on omitted variable bias, and Ramey and Shapiro got the timing more right than Blanchard and Perotti. The reason for narrative’s better timing probably lies behind the fact that the narrative approach could have accidentally included also events that were by the time just announcements and this way the foresight aspect could have been included at least partly in the narrative.

After finding evidence on fiscal foresight, Ramey (2011) creates a post-Korean War news variable based on SPF’s forecasts and includes it to her VAR model. She constructs the news variable by using the difference between the actual and predicted government defence expenditure growth rates:

\[
\text{Defence news} = \Delta g_t - (E_{t-1}g_t - E_{t-1}g_{t-1}),
\]

where \(\Delta g_t\) is the change in government expenditure growth rates from time \(t - 1\) to time \(t\) and \((E_{t-1}g_t - E_{t-1}g_{t-1})\) is the difference between growth forecasts for periods \(t\) and \(t - 1\) made at time \(t - 1\). Ramey (2011) finds that positive defence expenditure news shock

leads government expenditures to a temporary increase before it begins to decline and turns even negative after two quarters. What follows this temporary increase of government expenditures, is decline in output, hours worked, consumption, and investment, which all return to normal after three years. This result is neoclassical since it suggests that anticipated increase in government defence expenditure has contractionary effects on private economic activity.

Gambetti (2012) uses the same government expenditure forecast by SPF as Ramey (2011) but investigates government expenditure effects in the open economy. His news variable is the difference between the forecast at time $t$ and the forecast of the same variable at time $t-1$.

$$f_t = E_t g_{t+4} - E_t g_{t+2};$$
$$f_{t-1} = E_{t-1} g_{t+4} - E_{t-1} g_{t+2};$$
$$r_t = f_t - f_{t-1}.$$

Gambetti (2012) tests and finds out that the forecast revision variable, $r_t$, predicts government expenditure, $g_t$, and thus, conveys useful information. If forecasters expect government expenditure to increase in the future, $r_t$ is positive, and negative, if to decrease. Revision variable is ordered first in the VAR, and the first shock in a Cholesky decomposition is interpreted as the anticipated government expenditure shock. He finds that the positive anticipated government expenditure shock appreciates the real exchange rate to about 0.5% on impact and to its maximum 1.5% after one year. Trade balance stays stable on impact but worsens slowly about 0.1% after five years. Seems that the government expenditure shock is most important for the real exchange rate and imports in the set up of open economy.

Blanchard and Perotti (2002) also consider in their paper if the fiscal anticipations may

---

7Gambetti (2012) uses the sum of two to four periods ahead forecast because forecasts with longer horizons are not available in the SPF.
have an effect on their analysis. They estimate current and one period ahead tax and government expenditure shocks and include them to their initial SVAR. However, their approach to anticipations is quite narrow because they only test the effects on output, and find that there were only minor, not statistically significant, differences between anticipated and surprise shocks.

Virkola (2014) follows Blanchard-Perotti SVAR approach but augments the model with quarterly government expenditure forecast errors, as the recent literature has been mostly suggested. Virkola uses quarterly forecasts for government consumption and investment with sample periods 1987:1-2005:4 and 2000:1-2011:4 for Finland and Sweden, respectively. Finnish data is produced by the Research Institute of the Finnish Economy (ETLA) and Swedish data by the National Institute for Economic Research (NIER). Particularly, his anticipated government expenditure measure, $f_t$, is a weighted forecast error of the present and the following year forecasts made in quarter $t$. 

$$f_t = E_t[\gamma_q g_t + (1 - \gamma_q)g_{t+1}] - [\gamma_q g_t + (1 - \gamma_q)g_{t+1}],$$

where $\gamma_q \in \{\frac{3}{4}, \frac{2}{3}, \frac{1}{2}, 0\}$ is a quarterly weighting factor when $q$ is quarters 1 to 4, respectively. Main properties of Virkola’s measure are that forecast horizon can be a maximum of two years, and anticipated fiscal policy shocks can be discounted by the agents so that news about distant future gets smaller weights than news that are implemented near in the future. After creating foresight measures for both countries Virkola tests if they make his model’s informative content better by checking whether the foresight measure Granger causes the government expenditure shocks in the underlying four variable SVAR model. He finds that this indeed is the case in both countries, and this kind of measure could be used to improve the accuracy of the model.

Virkola (2014) find that the effects of anticipated shocks\(^8\) are different in Finland (fixed exchange rate) and in Sweden (floating exchange rate). In Finland, positive anticipated government expenditure shock declines the output in the announcement period, but af-

\(^8\)Shocks that comes from the news variables.
After the implementation of the fiscal policy, the output behaves similarly as in case of a surprise shock, and begins to increase. However, in Sweden, the positive output effect starts immediately after the initial anticipated government expenditure shock and continues positive even after the implementation. Also the effects are significant and persistent in both countries. In addition, Virkola (2014) tests the effects of unanticipated government expenditure shock in the model where news variable is included and compares it to the effects from the model without the news variable. His conclusion is that when real-time information, in this case news, is added to the model the effects from unanticipated shock are more expansionary than in the basic SVAR model.

The results of Virkola (2014) are interesting, but as Blanchard and Perotti (2002), Virkola only investigated the anticipated government expenditure shocks on output. The explanations about the different outcomes between Finland and Sweden left without empirical support. Still, there can be seen a link between Virkola (2014)’s and Gambetti (2012)’s studies where Sweden in Virkola’s paper would correspond to the open economy in the Gambetti’s paper. However, Virkola shows that fiscal foresight matters also in Finland.

3 Issues that Fiscal Foresight May Cause

3.1 Nonfundamentalness

Conventional (causal) VARs can be perfectly valid and produce correctly specified impulse responses for the selected variables in \( \mathbf{y}_t \). However, VAR shocks may not be the shocks of econometrician’s interest if possibly significant anticipations are omitted from the \( \mathbf{y}_t \). The identified shocks, \( \mathbf{\epsilon}_t^* \), are called nonfundamental if they can not be retrieved from the observed variables. \(^9\) (Lütkepohl (2012).)

\(^9\)Here the process \( y_t \) is nondeterministic, and MA-roots on the unit circle, or cointegrated processes, or any kind of nonstationarities are not considered. Leaving these out for now will not change the main arguments of fundamental/nonfundamental processes. (Lütkepohl (2012).)
Consider a VAR for $\vec{y}_t$,

$$\vec{y}_t = \Phi_1 \vec{y}_{t-1} + \Phi_2 \vec{y}_{t-2} + \cdots + \Phi_p \vec{y}_{t-p} + \vec{\epsilon}_t. \quad (1)$$

By definition the VAR error terms $\vec{\epsilon}_t$ are $\vec{y}_t$-fundamental, regardless of the coefficients $\Phi_1, \Phi_2, \ldots, \Phi_p$. However, the identified shocks $\vec{\epsilon}_t^*$ are $\vec{y}_t$-fundamental only if there is a lag order $p$ and coefficients $\Phi_1, \Phi_2, \ldots, \Phi_p$ such that $\vec{\epsilon}_t^* = \vec{\epsilon}_t$ in (1). The identified shocks, $\vec{\epsilon}_t^*$, are white noise processes, but if the VAR is misspecified, it may be the case that the shocks $\vec{\epsilon}_t^*$ are not.

Actually the main argument for nonfundamentalness through the literature is that econometrician’s information set is smaller than agents’, which leads to the fact that estimated VAR, as in (1), can not contain enough relevant information to perfectly describe the economy’s responses to identified shocks.

### 3.2 Noninvertibility

The VAR in (1) can be written as an MA-representation,

$$\vec{y}_t = \Theta(L) \vec{\epsilon}_t, \quad (t \in \mathbb{Z}). \quad (2)$$

If we assume that the shock $\vec{\epsilon}_t$ in (2) is fundamental, the determinant of the MA lag polynomial, $\Theta(L)$, is nonzero for $|z| \leq 1$, which means that the roots of the polynomial lie outside the complex unit circle.

$$|\Theta(z)| \neq 0 \quad \text{for} \quad |z| \leq 1 \quad (z \in \mathbb{C}), \quad (3)$$

The above conditions define the invertibility of the MA-polynomial. If these hold, the MA-representation in (2) is invertible to the stable autoregressive representation,

$$\Phi(L) \vec{y}_t = \vec{\epsilon}_t,$$
such that $\Phi(L) = \Theta(L)^{-1}$, and $\tilde{\epsilon}_t$ can be calculated from the present and past values of $\tilde{y}_t$.

Now we can see that the presence of foresight can lead to nonfundamentalness/noninvertibility of the MA representation if the VAR shocks can not only be calculated from the present and past values of the dependent variables but also future values should be included (Forni and Gambetti, 2014). If future values is wrongly addressed to the VAR, the invertibility conditions in (3) will not hold because nonfundamental MA representation has roots (or some of them) inside the complex unit circle.

### 3.3 Noncausality

Lanne and Saikkonen (2010) in their paper explain how nonfundamentalness is closely related to noncausal VAR models. The VAR is noncausal if the solution of the VAR model depends on the future so that the process $\tilde{y}_t$ depends on both past and present error terms but also on future error terms. In noncausal case, the causal MA-representation in (2) will get another term on the right hand side.

$$\tilde{y}_t = \Theta(L)\tilde{\epsilon}_t + \Omega(L)\tilde{\epsilon}_t, \quad (t \in \mathbb{Z})$$

$$\Theta(L) := (I_m + \theta_1 L + \theta_2 L^2 + \theta_3 L^3 + \ldots),$$

$$\Omega(L) := (\omega_1 L^{-1} + \omega_2 L^{-2} + \omega_3 L^{-3} \ldots),$$

where lag operators in $\Theta(L)$ are with positive powers but lag operators in $\Omega(L)$ are with negative powers.

Hence, if the analysis uses conventional causal VAR approach with noncausal model the errors recovered can not be interpreted as the identified shocks. Therefore, Lanne and Saikkonen (2010) propose that noncausality tests could also be used to test nonfundamentalness. However, these kind of tests are not yet applied much in practice, and thus, they are also left outside of this thesis.
### 3.4 Example: How to overcome the issues?

Here is presented a simplified version of the example by Caggiano et al. (2014) which aims to clarify how fiscal foresight can be addressed correctly to the VAR model so that the above mentioned issues can be overcome. Consider a simple bivariate model

\[
y_t = \delta E_t y_{t+1} + g_t + \omega_t \quad (4)
\]

\[
g_t = \epsilon_{t-1} + \theta_1 \epsilon_{t-2} = \Theta(L) \epsilon_t, \quad (5)
\]

where \(|\delta| < 1\) and \(\theta_1 > 0\). The process \(y_t\) in (4) is forward looking and it is affected by the exogenous stationary process \(g_t\) plus a random, i.i.d., shock \(\omega_t\). In the process (5) only anticipated shocks \(\epsilon_{t-i}, i = 1, 2\), are considered, which means that shocks can be here anticipated at most two periods ahead.\(^{10}\) The invertibility of the MA-polynomial, here \(\Theta(L)\), defines the fundamentalness of the shock \(\epsilon_t\) and the invertibility condition in (3) says that the determinant of \(\Theta(L)\) needs to be nonzero for all \(|z| \leq 1\), which means that the roots of the lag polynomial has to lie outside the complex unit circle.

First \(y_t\) from (4) is calculated open:

\[
y_t = \delta E_t y_{t+1} + g_t + \omega_t
\]

\[
= \delta^2 E_t(y_{t+2}) + \delta E_t(g_{t+1}) + \delta E_t(\omega_{t+1}) + g_t + \omega_t
\]

\[
= \delta^3 E_t(y_{t+3}) + \delta^2 E_t(g_{t+2}) + \delta^2 E_t(\omega_{t+2}) + \delta E_t(g_{t+1}) + g_t + \omega_t
\]

\[
= \delta^2 E_t(g_{t+2}) + \delta E_t(g_{t+1}) + g_t + \omega_t
\]

\[
= \delta^3 \theta_1 \epsilon_t + \delta(\epsilon_t + \theta_1 \epsilon_{t-1}) + \epsilon_{t-1} + \theta_1 \epsilon_{t-2} + \omega_t
\]

\[
= \delta(1 + \delta \theta_1) \epsilon_t + (1 + \theta_1) \epsilon_{t-1} + \theta_1 \epsilon_{t-2} + \omega_t.
\]

Note that \(E_t(y_{t+h}) = 0\) when \(h \geq 3\). The previous equations (4) and (5) are written again and the vector moving average (VMA) representation of the vector \((y_t, g_t)\) is formed:

\[\]

\(^{10}\)To simplify the calculus, the unanticipated contemporaneous shock \(\epsilon_t\) has been left out of this example. Leaving this out will not harm the interpretation.
\begin{align*}
y_t &= \delta(1 + \delta \theta_1) \epsilon_t + (1 + \theta_1) \epsilon_{t-1} + \theta_1 \epsilon_{t-2} + \omega_t \\
g_t &= \epsilon_{t-1} + \theta_1 \epsilon_{t-2}
\end{align*}

\[
\begin{bmatrix}
y_t \\
g_t
\end{bmatrix} =
\begin{bmatrix}
\delta(1 + \delta \theta_1) & 1 \\
0 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_t \\
\omega_t
\end{bmatrix} +
\begin{bmatrix}
(1 + \delta \theta_1) & 0 \\
1 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_{t-1} \\
\omega_{t-1}
\end{bmatrix} +
\begin{bmatrix}
\theta_1 & 0 \\
0 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_{t-2} \\
\omega_{t-2}
\end{bmatrix}
\]

The roots are calculated using the formula $|A_0 + A_1 z + A_2 z^2| = 0$ and since they have to lie outside the unit circle, has to be that $|z| \neq 0$ and $\theta_1 < 1$. This VMA representation can be found to be nonfundamental because the roots are $z_1 = 0$ and $|z_2| = \theta_1^{-1}$. If estimations are continued with this $(y_t, g_t)$-VAR, the inferences would be incorrect.

What if $g_t$ is replaced in the VAR with some other variable, which is enough informative about the effects that the anticipated shocks in $g_t$ cause on endogenous variable $y_t$, and which is more suitable for VAR analysis? This is tried out with one-step ahead forecast $E_t g_{t+1} = \epsilon_t + \theta_1 \epsilon_{t-1}$:

\[
\begin{bmatrix}
y_t \\
E_t g_{t+1}
\end{bmatrix} =
\begin{bmatrix}
\delta(1 + \delta \theta_1) & 1 \\
1 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_t \\
\omega_t
\end{bmatrix} +
\begin{bmatrix}
(1 + \delta \theta_1) & 0 \\
\theta_1 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_{t-1} \\
\omega_{t-1}
\end{bmatrix} +
\begin{bmatrix}
\theta_1 & 0 \\
0 & 0
\end{bmatrix}
\begin{bmatrix}
\epsilon_{t-2} \\
\omega_{t-2}
\end{bmatrix}
\]

The root is $|z| = \theta_1^{-1}$, which is nonfundamental if $\theta_1 > 1$.

Seems that one-step ahead forecast is neither that good alternative to this VAR. How about the one-step ahead forecast revision variable $\eta_{11}$?
\[ \eta_{11} = E_t g_{t+1} - E_{t-1} g_{t+1} = E_t (\epsilon_t + \theta_1 \epsilon_{t-1}) - E_{t-1} (\epsilon_t + \theta_1 \epsilon_{t-1}) = \epsilon_t \]

\[
\begin{bmatrix}
 y_t \\
 \eta_{11}
\end{bmatrix}
= \begin{bmatrix}
 \delta(1 + \delta \theta_1) & 1 \\
 1 & 0
\end{bmatrix}
\begin{bmatrix}
 \epsilon_t \\
 \omega_t
\end{bmatrix}
+ \begin{bmatrix}
 (1 + \delta \theta_1) & 0 \\
 0 & 0
\end{bmatrix}
\begin{bmatrix}
 \epsilon_{t-1} \\
 \omega_{t-1}
\end{bmatrix}
+ \begin{bmatrix}
 \theta_1 & 0 \\
 0 & 0
\end{bmatrix}
\begin{bmatrix}
 \epsilon_{t-2} \\
 \omega_{t-2}
\end{bmatrix}
\]

from where we can get that \(|A_0 + A_1 z + A_2 z^2| \neq 0\) with all \(z\) and this VMA representation with one-step ahead forecast revision variable is fundamental.

Also it can be seen that forecast revision variable can be easily extended to cumulative forecast revision variable with higher forecast horizon than just one-step ahead, and it returns all the parameters back to the unanticipated shock \(\epsilon_t\) so that the VMA representation will always be fundamental.

\[
\eta_{1Q} = \sum_{q=1}^{Q} (E_t g_{t+q} - E_{t-1} g_{t+q})
\]

where \(Q\) is the highest foresight period and \(q\) is the \(q\)-step ahead forecast\(^{11}\). For an example, consider that government expenditure can be presented with four periods of foresight, \(Q = 4\):

\[ g_t = \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \theta_3 \epsilon_{t-3} + \theta_4 \epsilon_{t-4} \]

Using formula (6) we can define the cumulative forecast revision variable, \(\eta_{14}\):

\[
\eta_{11} = E_t g_{t+1} - E_{t-1} g_{t+1} = \theta_1 \epsilon_t \\
\eta_{12} = \eta_{11} + E_t g_{t+2} - E_{t-1} g_{t+2} = (\theta_1 + \theta_2) \epsilon_t \\
\eta_{13} = \eta_{12} + E_t g_{t+3} - E_{t-1} g_{t+3} = (\theta_1 + \theta_2 + \theta_3) \epsilon_t \\
\eta_{14} = \eta_{13} + E_t g_{t+4} - E_{t-1} g_{t+4} = (\theta_1 + \theta_2 + \theta_3 + \theta_4) \epsilon_t
\]

\(^{11}\)News variable here assumes that nowcasting \(E_t g_t - E_{t-1} g_t = 0\). If also nowcasting was taken into account the variable would be \(\eta_{0Q}\).
Cumulative forecast revision variable, $\eta$, is a sum of all new information from each future periods that comes available from time $t - 1$ to time $t$. Thus, $\eta$ can be called as a news variable and, from now on, the variable $\eta$ is refered with $News$.

4 Data

The data used is based on national accounts of Finland and the dataset includes quarterly GDP, general government consumption and investment, private consumption, private investment and total tax revenues including social security contributions. All series are seasonally adjusted and in real terms, and they are presented in log levels in Figure 1. The total tax revenues including social security contributions is disaggregated from annual observations to quarterly ones, and because this time series is only announced in nominal terms it has been calculated to real terms using GDP-deflator. Also forecasts on government consumption and investment is used which are produced by Bank of Finland\textsuperscript{12}.

4.1 Descriptive statistics

Here is listed the quarterly series and their descriptive statistics that are used in this thesis. Variables in Table 1 and Figure 2 are presented as percentages of GDP from 1996:4 to 2014:4. Government expenditure is a sum of government consumption and investment.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GE</td>
<td>73</td>
<td>0.251</td>
<td>0.282</td>
<td>0.323</td>
<td>0.016</td>
</tr>
<tr>
<td>TAX</td>
<td>73</td>
<td>0.403</td>
<td>0.430</td>
<td>0.465</td>
<td>0.016</td>
</tr>
<tr>
<td>CONS</td>
<td>73</td>
<td>0.480</td>
<td>0.513</td>
<td>0.551</td>
<td>0.021</td>
</tr>
<tr>
<td>INV</td>
<td>73</td>
<td>0.154</td>
<td>0.187</td>
<td>0.206</td>
<td>0.011</td>
</tr>
</tbody>
</table>

\textbf{Table 1:} Descriptive statistics from 1996:4 to 2014:4. Government expenditure (GE), tax revenues (TAX), private consumption (CONS) and private investments (INV) are presented as percentages of GDP.

(TAX) have been approximately 28% and 43% of GDP, respectively. From Figure 2 can\textsuperscript{12}At the end of the thesis, from Table 4, can be found a complete list of the data used.
Figure 1: GDP, government expenditure, tax revenues, private consumption and investment. All in real terms and in log levels from 1996:4 to 2014:4.
be seen the paths of these series described in Table 1. The maximum value of government expenditure, 32% of GDP, occurred at the third quarter of 1997 and the minimum value, 25% of GDP, at the fourth quarter of 2007. For tax revenues the maximum value, 47% of GDP, occurred at the second quarter of 2000 and the minimum value, 40% of GDP, at the second quarter of 2010. For private consumption (CONS) the maximum value, 55% of GDP, occurred at the fourth quarter 2012 and the minimum value, 48% of GDP, at the fourth quarter of 2000. For private investments (INV) the maximum value, 21% of GDP, occurred at the third quarter of 2001 and the minimum value, 15% of GDP, at the fourth quarter of 2014.

**Figure 2:** Government expenditure, tax revenues, private consumption and investment as percentages of GDP from 1996:4 to 2014:4.
4.2 Government expenditure forecasts

Forecasts used are government consumption and investment which summed up together are called government expenditure from now on. Forecasts are produced by Bank of Finland (BoF), twice a year for a current year and two years forward, and the produced forecasts will present the most feasible developments of these variables. All forecasts are dependent on presumptions, but to make a forecast, the most accurate current economic data that describes the present as well as possible, is used. Forecasts base also on consideration of the BoF’s economists and only such political decisions are taken into account which has been already made while compiling the forecast, thus forecasts can not be considered as scenarios. (Newby and Orjasniemi (2011).)

Bank of Finland has produced and developed macroeconometric models since the early-70s. The first essential forecast instrument was introduced in the autumn of 1996, the so called BOFMINI model. BOFMINI was specified and estimated in the mid-90s after which the Finnish economy faced major changes for example in production technology and in the age structure of the population, in addition, the policy concentration in Finland changed from monetary to fiscal. (Kilponen and Ripatti (2006).) All these changes created the need to develop a more advanced model, and thus, a dynamic stochastic general equilibrium model, Aino, was introduced in the spring of 2004. However, the initial Aino model had a nonlinear structure which meant for example that the set upped initial conditions had a substantive effects on the outcome. Since the spring of 2010 a new, estimated Aino model has been in use which now has a linear structure. (Newby and Railavo and Ripatti (2011).)

All these government expenditure forecast series from 1996:3 to 2014:4 has been gathered in one panel table in where the x-axis describes the announcement period and y-axis the forecastable period. Forecast series are quarterly series but they are announced with a semiannual frequency. This brought some challenges because the panel data was not complete since every other forecast series was missing. Thus, every other series had to be estimated by the arithmetic mean of the previous and next forecast series to have quar-
terly observations also on the x-axis. However, as one can imagine this estimation is a rough action and may produce biased results. Thus, estimations are done also with the semiannual data so that possible biases can be observed.

5 Empirical Strategy

The goal of this thesis is to examine if there is difference when the increase in Finnish government expenditure is anticipated or not, that is, if fiscal foresight has effect on the recovered impulse responses. To describe the anticipations on government expenditure I follow the example of Caggiano et al. (2014) and create a government expenditure news variable that was presented in equation (6). This variable should capture the effects of government expenditure shock when the implementation lag is larger than one quarter (Caggiano et al., 2014), in other words, when the future shock is anticipated by the forecasters and assumably by the agents in the economy.

The empirics consists two parts. First the impulse responses from unanticipated government expenditure shock is investigated in two different model set ups. First model is called 'No Fiscal Foresight' (NFF) -model and the second one is called 'Fiscal Foresight' (FF) -model, both of these models use quarterly time series from 1996:4 to 2014:4. Secondly the impulse responses from anticipated government expenditure shock, or otherwise called news shock, is investigated with the FF-model. Here the previously mentioned problem of estimated quarterly series is to be seen - government expenditure does not convincingly react on news shock as it is assumed to\(^{13}\), and thus, to examine anticipated effects the frequency used is changed to semiannual so that the series cover the time from 1997:1 to 2014:2. Even though, semiannual series behave as is assumed, has to be noted that the possible bias in this set up could rise from the amount of observations that is now half as much that it was when investigating unanticipated effects.

The analysis is based on conventional (causal) vector autoregressive models and Cholesky

\(^{13}\)These results are shown and discussed in the robustness analysis in section 7.2.
decomposition of the variance-covariance matrices is used to get orthogonalised reduced-form residuals. All but news variables are in log levels because of the possible cointegration relationships, and news variables are in cumulated terms to preserve the same order of integration as all other VAR-variables (Caggiano et al., 2014). All models include two lags, deterministic time trend and a constant. Lag structures were selected by the information criteria and by investigating the autocorrelation of the residuals.

5.1 VAR models

**NFF-model.** First the analysis starts with the basic trivariate VAR model including government expenditure (investment + consumption) \( (g) \), tax revenues \( (tr) \), and gross domestic product \( (y) \). Ordering goes respectively since can be assumed that the economic system starts from government budget constraint which has an impact on tax revenues, through for example taxation. Lastly, gross domestic product is a sum of all economic activity, and thus, ordered last (Kuismanen and Kämppi, 2009). Now for example only government expenditure has contemporaneous effect on other variables in the model but output does not affect any of these variables contemporaneously. The equation (1) would look like this when \( \vec{y}_t^{\prime} = (g, tr, y)^\prime \) and vector of constants, \( \vec{\alpha}^{\prime} \), is included:

\[
\begin{bmatrix}
g_t \\
tr_t \\
y_t \\
\end{bmatrix} =
\begin{bmatrix}
\alpha^g \\
\alpha^{tr} \\
\alpha^y \\
\end{bmatrix} +
\begin{bmatrix}
g_{t-1} \\
tr_{t-1} \\
y_{t-1} \\
\end{bmatrix} +
\begin{bmatrix}
g_{t-2} \\
tr_{t-2} \\
y_{t-2} \\
\end{bmatrix} +
\begin{bmatrix}
\epsilon_t^g \\
\epsilon_t^{tr} \\
\epsilon_t^y \\
\end{bmatrix}.
\]

Then by following the example of Burnside, Eichenbaum and Fisher (2003) additional variables are included in this model. However, too many or too few variables can not be added because of the problems of over-fitting and omitted variable bias. Thus Burnside, Eichenbaum and Fisher (2003) propose that additional variables should be included to the model one at a time. By following this proposition the NFF-model is augmented with private investment \( (i) \) and private consumption \( (c) \). These additional variables are ordered second last since both fiscal policy variables, government expenditures and taxes, have effect on private economic activity. GDP stays last as previously. Now, with private
consumption $\tilde{y}_t = (g, tr, c, y)'$:

$$
\begin{bmatrix}
g_t \\
tr_t \\
c_t \\
y_t
\end{bmatrix}
= \begin{bmatrix}
\alpha^g \\
\alpha^{tr} \\
\alpha^c \\
\alpha^y
\end{bmatrix} + \Phi_1 \begin{bmatrix}
g_{t-1} \\
tr_{t-1} \\
c_{t-1} \\
y_{t-1}
\end{bmatrix} + \Phi_2 \begin{bmatrix}
g_{t-2} \\
tr_{t-2} \\
c_{t-2} \\
y_{t-2}
\end{bmatrix} + \begin{bmatrix}
\epsilon^g_t \\
\epsilon^{tr}_t \\
\epsilon^c_t \\
\epsilon^y_t
\end{bmatrix},
$$

(8)

and with private investment $\tilde{y}_t = (g, tr, i, y)'$:

$$
\begin{bmatrix}
g_t \\
tr_t \\
i_t \\
y_t
\end{bmatrix}
= \begin{bmatrix}
\alpha^g \\
\alpha^{tr} \\
\alpha^i \\
\alpha^y
\end{bmatrix} + \Phi_1 \begin{bmatrix}
g_{t-1} \\
tr_{t-1} \\
i_{t-1} \\
y_{t-1}
\end{bmatrix} + \Phi_2 \begin{bmatrix}
g_{t-2} \\
tr_{t-2} \\
i_{t-2} \\
y_{t-2}
\end{bmatrix} + \begin{bmatrix}
\epsilon^g_t \\
\epsilon^{tr}_t \\
\epsilon^i_t \\
\epsilon^y_t
\end{bmatrix}.
$$

Note that these models with additional variables are only used when investigating the effects on these additional variables in question. For example, when investigating unanticipated government expenditure effects on output the trivariate NFF-model (7) is used, and when on private consumption the four variable NFF-model with private consumption is used (8).

**FF-model.** NFF-model does not include fiscal foresight which means that the impulse responses from government expenditure shock\footnote{Government expenditure shock in a NFF-model is always considered to be an unanticipated shock.} may be caused by both anticipated and unanticipated shocks. This in turn could mean that the recovered VAR shocks from NFF-model may not be the identified unanticipated shocks and thus they could be nonfundamental. To wipe off possible anticipation effects, the NFF model is augmented with the government expenditure news variable. The news variable is in cumulated terms as in Caggiano et al. (2014) and ordered last in the VAR as in Caggiano et al. (2014) and Virkola (2014). Virkola (2014) arguments this order selection with the paper of Leeper et al. (2013) in where they assume that future tax rate shocks do not have contemporaneous
effect on other fiscal variables or output and similar arguments can be said on future government expenditure shocks\(^{15}\). FF-model can now be considered to include the aspect of fiscal foresight; the information set includes past and present but also anticipations about future. Now \(\vec{y}_t = (g, tr, y, News)^t\):

\[
\begin{bmatrix}
  g_t \\
  tr_t \\
  y_t \\
  News_t
\end{bmatrix} =
\begin{bmatrix}
  \alpha^g \\
  \alpha^{tr} \\
  \alpha^y \\
  \alpha^{News}
\end{bmatrix}
+ \Phi_1
\begin{bmatrix}
  g_{t-1} \\
  tr_{t-1} \\
  y_{t-1} \\
  News_{t-1}
\end{bmatrix}
+ \Phi_2
\begin{bmatrix}
  g_{t-2} \\
  tr_{t-2} \\
  y_{t-2} \\
  News_{t-2}
\end{bmatrix}
+ \begin{bmatrix}
  \epsilon^g_t \\
  \epsilon^{tr}_t \\
  \epsilon^y_t \\
  \epsilon^{News}_t
\end{bmatrix}.
\tag{9}
\]

FF-model is also augmented with the same additional variables as the NFF-model. However, this time to avoid over-fitting, as Burnside, Eichenbaum and Fisher (2003) warned about, these additional variables are not added to the FF-model but they replace GDP one at the time. The equations are following: GDP is replaced with private consumption: \(\vec{y}_t = (g, tr, c, News)^t\)

\[
\begin{bmatrix}
  g_t \\
  tr_t \\
  c_t \\
  News_t
\end{bmatrix} =
\begin{bmatrix}
  \alpha^g \\
  \alpha^{tr} \\
  \alpha^c \\
  \alpha^{News}
\end{bmatrix}
+ \Phi_1
\begin{bmatrix}
  g_{t-1} \\
  tr_{t-1} \\
  c_{t-1} \\
  News_{t-1}
\end{bmatrix}
+ \Phi_2
\begin{bmatrix}
  g_{t-2} \\
  tr_{t-2} \\
  c_{t-2} \\
  News_{t-2}
\end{bmatrix}
+ \begin{bmatrix}
  \epsilon^g_t \\
  \epsilon^{tr}_t \\
  \epsilon^c_t \\
  \epsilon^{News}_t
\end{bmatrix},
\]

and GDP is replaced with private investment: \(\vec{y}_t = (g, tr, i, News)^t\)

\[
\begin{bmatrix}
  g_t \\
  tr_t \\
  i_t \\
  News_t
\end{bmatrix} =
\begin{bmatrix}
  \alpha^g \\
  \alpha^{tr} \\
  \alpha^i \\
  \alpha^{News}
\end{bmatrix}
+ \Phi_1
\begin{bmatrix}
  g_{t-1} \\
  tr_{t-1} \\
  i_{t-1} \\
  News_{t-1}
\end{bmatrix}
+ \Phi_2
\begin{bmatrix}
  g_{t-2} \\
  tr_{t-2} \\
  i_{t-2} \\
  News_{t-2}
\end{bmatrix}
+ \begin{bmatrix}
  \epsilon^g_t \\
  \epsilon^{tr}_t \\
  \epsilon^i_t \\
  \epsilon^{News}_t
\end{bmatrix}.
\]

\(^{15}\)Since different ordering may have effects on the results, different orders are tested in the robustness analysis. No significant differences were found.
5.2 Testing informative sufficiency

The creation of the government expenditure news variable will follow the example of Caggiano et al. (2014) that was presented in equation (6). This variable should capture the effects of government expenditure shock when the implementation lag is larger than one quarter (Caggiano et al., 2014).

So far there is not any proofs that the basic trivariate VAR model in equation (7) without the news variable were nonfundamental or if the FF-model in equation (9) would make it any better. I follow the informative sufficiency test proposed by Caggiano et al. (2014). First government expenditure \((g)\) is regressed with a constant \((\alpha_g)\), two lagged values of the dependent variable \((g)\), tax revenues \((tr)\), GDP \((y)\) and news variable \((\text{News})\)\(^{16}\).

\[
g_t = \alpha_g + \phi_{11}g_{t-1} + \phi_{21}g_{t-2} + \phi_{12}tr_{t-1} + \phi_{22}tr_{t-2} + \phi_{13}y_{t-1} + \phi_{23}y_{t-2} + \phi_{14}\text{News}_{t-1} + \phi_{24}\text{News}_{t-2} + \epsilon_t.
\]

This regression augments the government expenditure equation in the three variable VAR-model with the news variable lagged two periods\(^{17}\). I will test if the coefficients of the lagged values of news, \(\phi_{14}\) and \(\phi_{24}\), differ with statistical significancy from zero. Results are presented in Table 2 with Newey-West standard errors and with news variables of different forecast horizons. Column \((1, 3)\) refers to the \(\text{News13}\) variable which means that it takes into consideration all the new information for one, two and three quarters ahead. Column \((1, 4)\) refers to the \(\text{News14}\), and so on. Results do not support the ideal outcome that I was hoped, that is, clear statistical significancies in each or some of the news variable’s first lag. However, second lag of \(\text{News13}\) is statistically significant at 5% significance level and also the second lag of \(\text{News14}\) is statistically significant at 10% significance level. News variables that are included to \(\text{News13}\) and \(\text{News14}\) are not statistically significant except the second lag of the two step-ahead forecast revision variable, \(\text{News22}\)\(^{18}\).

\(^{16}\)This equation is the first equation in the four variable FF-model in equation (9).

\(^{17}\)Caggiano et al. (2014) use only one lagged value of their news variable.

\(^{18}\)For example \(\text{News13} = \text{News11} + \text{News22} + \text{News33} \).
Table 2: P-values of the news variables - first with quarterly data end next with semiannual data.
Underlying regression: government expenditure is regressed with two lags of dependent variable, tax revenues, GDP and news. Basic variables are in log levels but news variable is expressed in cumulated terms so that its order of integrations remains comparable with other variables in the regression. Newey-West standard errors are used. Significance levels are: 10% (*), 5% (**) and 1% (***)

<table>
<thead>
<tr>
<th></th>
<th>(0,0)</th>
<th>(1,1)</th>
<th>(2,2)</th>
<th>(3,3)</th>
<th>(4,4)</th>
<th>(1,3)</th>
<th>(1,4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value of the 1.lag</td>
<td>0.95</td>
<td>0.86</td>
<td>0.14</td>
<td>0.50</td>
<td>0.78</td>
<td>0.24</td>
<td>0.47</td>
</tr>
<tr>
<td>p-value of the 2. lag</td>
<td>0.65</td>
<td>0.41</td>
<td>0.05**</td>
<td>0.36</td>
<td>0.49</td>
<td>0.01**</td>
<td>0.07*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>(0,0)</th>
<th>(1,1)</th>
<th>(2,2)</th>
<th>(0,1)</th>
<th>(0,2)</th>
<th>(1,2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value of the 1.lag</td>
<td>0.01***</td>
<td>0.24</td>
<td>0.47</td>
<td>0.44</td>
<td>0.15</td>
<td>0.06*</td>
</tr>
<tr>
<td>p-value of the 2. lag</td>
<td>0.56</td>
<td>0.24</td>
<td>0.32</td>
<td>0.74</td>
<td>0.67</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Since the results received with the quarterly series are not convincing the same regression tests are also performed with the semiannual series. For example, column (0,2) in the semiannual row refers to the News02 variable that takes into consideration all the new information for current, and one and two half years ahead, whereas News12 does not take current period into account. With semiannual frequency the first lag of News12 is significant with 10% significance level whereas the second lags are never significant. Also the nowcast series News00 is significant with 1% significance level which implies that government expenditure in Finland is well known at least six months before the implementation. This coincides with the yearly budget proposal of the Finnish government which is done every autumn for the next year and accepted at the turn of the year.

However, News02 is not significant even though it includes the significant nowcast series, thus News12 is chosen to be the news variable when semiannual analysis is considered. The news variable used with quarterly analysis need to be chosen between News13 and News14. Both of these variables passed residual autocorrelation analyses\(^{19}\) and the results from impulse response functions did not differ when changing between News13 and News14. Thus, the News14 is chosen to continue with since it covers the same forecast horizon as does the semiannual News12.

\(^{19}\)Portmanteau tests and observation of autocorrelation and partial autocorrelation functions of the residuals. Autocorrelation and partial autocorrelation functions of News14 and News12 residuals are presented at the end of the thesis in Figure 7.
5.3 Government expenditure news variables

Figure 3 plots both of these news variables, News14 and News12, so that the left column presents the series in their original terms and right column in their cumulative terms. Series in cumulative terms are used in the VAR analysis to preserve the same order of integration as all other variables in the VAR model. Plots in upper row describe News14 which uses quarterly forecast series but every other observation is estimated. Plots in

Figure 3: Government expenditure news variables - News14 from quarterly data and News12 from semiannual data - both presented in their original and cumulative terms. News14 is a sum of the revisions of one, two, three and four step-ahead quarterly government expenditure growth forecasts with sample period 1996:4 - 2014:4. News12 is a sum of the revisions of one and two step-ahead semiannual government expenditure growth forecasts with sample period 1997:1 - 2014:2.
lower row describe the *News12* which uses semiannual forecast series and no estimations are needed.

The differences between the cumulative series is good to be noted. *News14* is mostly negative whereas *News12* is mostly positive and more stable than *News14*. In original series, when the news variable is positive forecasters have revised their forecast upwards, in other words, they believe that government expenditure is going to rise in the future more than they last time expected, and if the news variable is negative, vice versa. In the cumulative series these revisions are cumulated through time and here the negative trend of *News14* means that there has been more and larger negative forecast revisions than positive. This would imply that more often when government expenditure forecasts were firstly made they had been overestimated and then later revised to lower level. However, *News14* is the estimated series. *News12* in cumulative terms is more stable and positive than the similar *News14* which would imply that there actually is no systematic overestimation problem what the cumulative plot of *News14* suggests and actually forecasts firstly made are rather underestimated than overestimated which is a sign of caution.

### 6 Results

Firstly the dynamic effects from an unanticipated government expenditure shock is investigated in NFF and FF -models with quarterly time series and *News14* variable. Then the dynamic effects from a news shock, that can be interpreted to be an anticipated government expenditure shock, is investigated in the FF-model this time with semiannual time series and *News12* variable.

#### 6.1 Dynamic effects of the unanticipated government expenditure shock

Results from 1% unanticipated government expenditure shocks in the NFF and FF -models are presented in Table 3 and in Figures 4 and 5. The shock in both NFF and FF -models is temporary and falls immediately below 0.3 percentage points but stays
above the zero line throughout the horizon in both models. In the FF-model there is a small increase in government expenditure in the third quarter that can not be seen in the NFF-model. This is a peculiar result since news should not have effect on predetermined amount of government expenditure. Thus, this increase in the third quarter must be caused by some of the imperfect features of the News14 variable. However, same results were discovered when the same shock was carried out with semiannual time series and with News12 variable. Because quarterly series include twice as much observations as semiannual series, analysis of unanticipated government expenditure shock was decided to be continued with the quarterly series.

<table>
<thead>
<tr>
<th>Response</th>
<th>0 qrt</th>
<th>4 qrt</th>
<th>8 qrt</th>
<th>12 qrt</th>
<th>16 qrt</th>
<th>20 qrt</th>
<th>peak</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NFF</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE</td>
<td>1.00</td>
<td>0.13</td>
<td>0.07</td>
<td>0.05</td>
<td>0.05</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>TAX</td>
<td>0.06</td>
<td>0.00</td>
<td>0.15</td>
<td>0.12</td>
<td>0.06</td>
<td>0.06</td>
<td>0.15 (9)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.27</td>
<td>0.23</td>
<td>0.25</td>
<td>0.21</td>
<td>0.16</td>
<td>0.14</td>
<td>0.32 (1)</td>
</tr>
<tr>
<td>CONS</td>
<td>0.15</td>
<td>0.16</td>
<td>0.18</td>
<td>0.15</td>
<td>0.12</td>
<td>0.11</td>
<td>0.19 (7)</td>
</tr>
<tr>
<td>INV</td>
<td>-0.44</td>
<td>0.36</td>
<td>0.53</td>
<td>0.42</td>
<td>0.27</td>
<td>0.21</td>
<td>0.53 (8)</td>
</tr>
<tr>
<td><strong>FF</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE</td>
<td>1.00</td>
<td>0.08</td>
<td>0.08</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>TAX</td>
<td>0.11</td>
<td>0.08</td>
<td>0.11</td>
<td>0.11</td>
<td>0.08</td>
<td>0.07</td>
<td>0.15 (11)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.36</td>
<td>0.32</td>
<td>0.28</td>
<td>0.24</td>
<td>0.19</td>
<td>0.15</td>
<td>0.38 (1)</td>
</tr>
<tr>
<td>CONS</td>
<td>0.24</td>
<td>0.24</td>
<td>0.23</td>
<td>0.21</td>
<td>0.18</td>
<td>0.16</td>
<td>0.25 (5)</td>
</tr>
<tr>
<td>INV</td>
<td>-0.16</td>
<td>0.91</td>
<td>0.85</td>
<td>0.55</td>
<td>0.44</td>
<td>0.37</td>
<td>1.00 (6)</td>
</tr>
</tbody>
</table>

Table 3: First five rows: orthogonal impulse responses from an 1% unanticipated government expenditure shock in a VAR model without fiscal foresight (NFF-model). Last five rows: orthogonal impulse responses from an 1% unanticipated government expenditure shock in a VAR model with fiscal foresight (FF-model). Last column tells the size of the peak response and in parantheses the quarter when it occurs.

At first tax revenues drop negative in the NFF-model whereas in the FF-model tax revenues stay above the zero line throughout the horizon. However, wide confidence intervals which include zero lines show the uncertainty that lies behind the tax revenue series\(^20\). Still it seems that the uncertainty especially concerns the first two years since after that the effects stabilise above the zero line and the uncertainty diminishes extensively. Output

\(^{20}\)Tax revenue series is disaggregated from annual series to quarterly ones and GDP-deflator was used as a deflator.
Figure 4: Orthogonal impulse responses to the 1% unanticipated government expenditure shock. Left panel: VAR-model without fiscal foresight (NFF-model), and right panel: VAR-model with fiscal foresight, News14 (FF-model). Variables are in real terms and in log levels. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
Figure 5: Orthogonal impulse responses to the 1% unanticipated government expenditure shock. Left panel: VAR-model without fiscal foresight (NFF-model), and right panel: VAR-model with fiscal foresight, News14 (FF-model). Variables are in real terms and in log levels. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
and private consumption both respond positively to the shock which strongly supports the Keynesian theory. In the NFF-model the effects on private investment are negative at the beginning and turn to positive at the second quarter after the shock, in the FF-model this negative effect at the beginning can be ruled out. The positive effect on private investment after the positive government expenditure shock supports Keynesian theory since neoclassical model would predict private investment to increase if the government expenditure shock was persistent and taxes were nondistortionary, which clearly can not hold here (Blanchard and Perotti, 2002). These responses on output and private economic activity are similar in both models but the effects are larger, more significant and they peak two quarters earlier in the FF-model.

According to these results seems that the impulse responses from the unanticipated government expenditure shock when it could have been partly anticipated (NFF-model) can be inaccurate and underestimated. However, both of these models are in consensus that unanticipated government expenditure shock does not crowd out private consumption or investment - instead the effects are positive and persistent and the shock boosts the economy.

These give support to the Keynesian view in where positive government expenditure shock stimulates private economic activity and output. Thus, government expenditure increase is assumed to be an effective policy action in a recession. In addition, Virkola (2014) find that government expenditure shock has a positive effect on net taxes in Finland which would suggest that there is no crowding out effect of private economic activity. Virkola (2014) conclude that the effects from an unanticipated government expenditure shock are more expansionary when the news variable is included into the model. Kuismanen and Kämppi (2009) speak in favour of neoclassical views when they find evidence on crowding out effect of private consumption and investment. However, this difference is mostly caused by the different sample period, and thus, the results are not comparable. Lehmus (2009) also uses different sample period, and to make better comparisons to his results, my NFF and FF-models should also include tax rates and government deficit.
6.2 Dynamic effects of the news shock

The dynamic effects of the news shock is investigated with semiannual time series. The same analysis is done with quarterly series in the robustness analysis but, as there will be shown, the effect on government expenditure is biased if News14 is used to describe fiscal foresight. Otherwise this set up is exactly the same as the FF-model in the previous section but the frequency of the time series is semiannual and news variable is News12. The news shock can be interpreted to be an anticipated government expenditure shock. However, had to be noted that the quantitative interpretation of the news shock is not possible and here the news shock is normalised to one as in Caggiano et al. (2014). Also the wide confidence intervals, which result from the short time series, need to be noted since almost all impulse responses consist the possibility of zero effects. The results are shown in Figure 6.

News shock lasts about one year until it returns to its unshocked path and during this one year government expenditure does actually increase as it was anticipated. Also, private investment is clearly crowding out during the first one year until it starts to return towards its unshocked path at the same time as government expenditure starts to recover. Output can be thought to gather the net effects of all output components and in this model output seems to follow the negative development of private investment. These results support the neoclassical view for private investment. Agents in the economy postpone their investment decisions when they have anticipated government expenditure to increase.

The effects on private consumption are not clear since the path varies around the zero line. Tax revenues follow the increase of government expenditure for the first two quarters after the shock, after which they start to decrease following the paths of decreasing private investment and output. With respect to these results the anticipated government intervention has only retarded the economy for a few years.

These results coincides with the results received by Ramey (2011) but there exists discrepancies with the results received by Virkola (2014). He finds that after the anticipated
Figure 6: Orthogonal impulse responses from News12 shock normalised to one. All variables but News12 are in real terms and in log levels. News12 is in cumulated terms to preserve the same order of integration as all other variables in the VAR model. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
government expenditure shock output declines during the first one year and then starts to increase. When the effect on output turns positive Virkola compares it to the effects on government expenditure and concludes that the positive turn in output coincides with the implementation of the announced government expenditure increase. Also the positive effect on output is more expansionary than it was contractionary during the first one year, thus, the general effect is positive on output. Virkola concludes that the increase in government expenditure does not crowd out private economic activity but agents in the economy seem to postpone their investment and/or consumption decisions until the anticipated government expenditure increase is implemented - which is the exact opposite result that was received here. The flaw in Virkola’s model and its interpretations is that he investigates only effects on output and not directly on private consumption or investment. Thus, true events behind the behaviour of output leave unknown and, as Caldara and Kamps (2008) note, positive output effects alone are not sufficient for discriminating between Keynesian and neoclassical theories since they agree that positive government expenditure shock may have positive effects on output.

7 Robustness Analysis

7.1 Larger sample size

Dynamic effects from 1% government expenditure shock is estimated also with a basic VAR(2) model without fiscal foresight with sample period 1975:1 - 2014:4. Time series are in quarterly frequency, real terms and in log levels. The underlying VAR model is otherwise exactly the same as the NFF-model used before.

Results are shown in Figure 8. With larger sample size the government expenditure shock is highly persistent and significant. These results support the outcomes got from section 6.1. Only effects on tax revenues resemble more the responses got from FF-model than NFF-model since the effects are only positive. There is no evidence on crowding out of private economic activity and these results support strongly the Keynesian view.
7.2 News shock and quarterly series

The reason why the analysis of a news shock was carried out with the semiannual series and News12 variable is shown here. In section 4.2 was explained that the creation of a news variable with a quarterly frequency needed estimations - every other forecast series had to be estimated by the arithmetic mean of previous and next forecast series. Here the analysis of a news shock is performed with the previous FF-model that was used in section 6.1 which included News14 variable and the time series used were quarterly series. The shock coming from News14 is normalised to one, it is in cumulated terms and all other variables are in log levels. The results are shown in Figure 9.

The effects on government expenditure were crucial when deciding should quarterly or semiannual series be used in the main analysis. From the results received from quarterly analysis can be seen that government expenditure responds peculiarly to the news shock - it drops steeply at the first quarter, increases to positive at the second quarter and peaks positive at the third quarter. This steep negative drop at the first quarter in government expenditure causes shadow on this analysis. However, here the neoclassical negative effect on both output components, private consumption and investment, is clearly to be seen. All these results support the previous news shock results and confirm the crowding out effect on private investment and the decrease in output. Also these results suggest that the previously not clear effects on private consumption were actually strongly negative and crowds out similarly as private investment. These negative effects on private consumption and investment after the government intervention support the neoclassical theory which suggest that the economy were better off if government will not intervene in the market - at least if the intervention is announced before the implementation as the transparency principle of policy actions suggest.

Since the ordering of the VAR variables may cause different results, the analysis of a news shock with quarterly time series is performed with many different ordering. Figure 10 switches the order of tax revenues and government expenditure so that tax revenues is ordered first and government expenditure second. Figures 11 and 12 shows the results
when *News14* is ordered either first or second in the VAR. All results are robust to each other; government expenditure drops at the first quarter and increases at the second quarter after the shock, crowding out effect of private economic activity is confirmed, output drops and tax revenues increase for a one year and then starts to decline. These same ordering tests were also carried out in the semiannual analysis and the results were also robust to each other.

### 8 Conclusion

This thesis introduces fiscal foresight into a conventional vector autoregression (VAR) analysis and examines the dynamic effects of unanticipated and anticipated government expenditure shocks with Finnish data. First the resent theoretical and empirical literature is reviewed and heterogenous results from the effects of government expenditure shock are brought up. The literature in most cases disagrees with the effects on private consumption and investment; does the increase of government expenditure crowd out private economic activity? Actually the inconsistency rises already from the Keynesian and neoclassical schools which predict effects of opposite signs at least on private consumption but also in most cases on private investment. Then the limitations of VAR modelling and fiscal foresight are shown with the three issues that fiscal foresight may cause to the analysis. And with a simple bivariate VAR model it is shown how forecast revisions overcome these issues and at the same time bring the future aspect into the VAR model.

Government expenditure anticipations are measured in this thesis with a news variable which is created by using Bank of Finland’s government expenditure forecast revisions. News variables with different forecast horizons are tested so that can be concluded that the chosen news variable makes the information set of the econometrician more sufficient than what it was without the news variable. Results show that the conventional VAR model without the news variable seems to recover the dynamic effects inaccurately and underestimate them. Can be argued that the conventional VAR can not separate unanticipated and anticipated government expenditure effects, and therefore, adding an anticipa-
tion variable and causing an unanticipated shock to the system, the unanticipated effects will become more accurate.

Second result is that the effects of unanticipated government expenditure shock do not change whether or not the news variable is included to the VAR model. These effects support the Keynesian theory since unanticipated government expenditure increase boosts the economy. However, the third result on anticipated government expenditure increase, that is illustrated by the positive news shock, does not support Keynesian theory but neoclassical one. I find that the news shock crowds out both private consumption and investment, and also output declines. This result suggest that if the government expenditure increase is announced before the implementation, the agents in the economy will postpone their consumption and investment decisions until the government expenditure starts to return back to its unschocked path. With respect to all these results, government expenditure increase in Finland can be an effective policy action when reviving the economy, if the increase can be done without announcements. Otherwise, the effects can by quite adverse than what they were supposed to.

One could argue doubtfully, if the news variables, made from forecasts, describe the anticipations of the agents in reality. Of course this is not the case, but I think that both news variables used in this thesis, News14 and News12, are at least good approximations. I argue that when new economic forecasts and forecast revisions are announced, media will share this information with facts and speculations through different channels to the knowledge of the agents. The question that does agents in reality adjust their consumption and investment behaviour with respect to the new information, or do they smooth their consumption as Ricardian Equivalence suggest, can be a long debate. However, my results argue in favor that news matters in Finland, and to be precise, government expenditure forecasts can change the conventional outcomes of government expenditure changes.
References


Forni, Mario & Gambetti, Luca, 2014a. "Government Spending Shocks in Open Economy VARs," Center for Economic Research (RECent) 105, University of Modena and Reggio E., Dept. of Economics "Marco Biagi".


<table>
<thead>
<tr>
<th>Source</th>
<th>Used in the news variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>AINO</td>
<td>Gross domestic product in market prices, base year 2010, MEUR</td>
</tr>
<tr>
<td>AINO</td>
<td>Gross domestic product in market prices, MEUR</td>
</tr>
<tr>
<td>AINO</td>
<td>Private consumption, base year 2010, MEUR</td>
</tr>
<tr>
<td>AINO</td>
<td>Private investment, base year 2010, MEUR</td>
</tr>
<tr>
<td>AINO</td>
<td>2004:3 - 2014:4 General government investment, base year 2010, MEUR</td>
</tr>
<tr>
<td>AINO</td>
<td>2004:3 - 2014:4 General government consumption, base year 2010, MEUR</td>
</tr>
<tr>
<td>BOFMINI</td>
<td>1996:3 - 2004:1 General government consumption, base year 1990, MFIM</td>
</tr>
<tr>
<td>AINO</td>
<td>Received tax revenues and social security contributions, MEUR</td>
</tr>
<tr>
<td></td>
<td>- Received direct taxes, MEUR</td>
</tr>
<tr>
<td></td>
<td>- Received taxes from production and import, MEUR</td>
</tr>
<tr>
<td></td>
<td>- Received transfer taxes, MEUR</td>
</tr>
<tr>
<td></td>
<td>- Received social security contributions, MEUR</td>
</tr>
</tbody>
</table>

*Table 4: Data Descriptions.*
Figure 7: Autocorrelation and partial autocorrelation functions of the *News14* (first row) and *News12* (second row) residuals.
Figure 8: Robustness Analysis: larger sample size from 1975:1 to 2014:4. Government expenditure, tax revenues, GDP, private consumption and investment, all in log levels and in real terms. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
Figure 9: Robustness Analysis: Orthogonal impulse responses from News14 shock normalised to one. All variables but News14 are in real terms and in log levels. News14 is in cumulated terms to preserve the same order of integration as all other variables in the VAR model. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
Figure 10: Robustness Analysis: Alternative ordering of tax revenues (ordered first) and orthogonal impulse responses from News14 shock normalised to one. All variables but News14 are in real terms and in log levels. News14 is in cumulated terms to preserve the same order of integration as all other variables in the VAR model. Y-axis can be interpreted as deviations from unshocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
Figure 11: Robustness Analysis: Alternative ordering of the News14 and orthogonal impulse responses from News14 shock normalized to one. All variables but News14 are in real terms and in log levels. News14 is in cumulated terms to preserve the same order of integration as all other variables in the VAR model. Y-axis can be interpreted as deviations from unshocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.
Figure 12: Robustness Analysis: Alternative order of the News14 and orthogonal impulse responses from News14 shock normalised to one. All variables but News14 are in real terms and in log levels. News14 is in cumulated terms to preserve the same order of integration as all other variables in the VAR model. Y-axis can be interpreted as deviations from unschocked paths, measured in percentage points. Dashed lines are bootstrapped 68% confidence intervals with 2500 runs.