Uncertainty and the transmission of fiscal policy
The case of omitted variable bias

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Summary

This paper shows that by omitting uncertainty when estimating the effects of a government spending shock on GDP could lead to biased estimates. The fiscal multiplier is how much an increase in government spending increases gross domestic product (GDP). There are two main theoretical views of looking at the economy: the neoclassical and the new Keynesian view. Neoclassical models predict multipliers that can be positive and negative depending on, among other things, the taxation system, because consumers determine their consumption based on their lifetime budget constraint. In Keynesian models the size of the multiplier depend on the consumer’s the marginal propensity to consume and these models predict positive multipliers.

The model used in this paper is a structural vector autoregression model (SVAR), this is a system of simultaneous equations. To estimate the effect of fiscal policy shock one must identify the system of equations. There are different ways to do this and there is wide disagreement among economist which approach is the best one. The first approach, and also the one used in this paper, is the approach introduced by Blanchard and Perotti in 2002, they use institutional information about the government to make the assumption that it takes more than one quarter for policymakers to react to changes in GDP. Then they use the Cholesky decomposition of matrices to identify the equation system and order government expenditure before output. This approach yields a positive multiplier, and finds that consumption rises in response to a government expenditure shock. This is in line with the New Keynesian view. Ramey and Shapiro (1998) use another approach, they use dates that are associated with large increases in military spending and see these as exogenous to the rest of the state of the economy to identify the equation system. Consumption actually falls in response to a government spending shock in this approach due to the negative effect taxes has on wealth. This is in line with the neoclassical view.

There are some challenges to these identification approaches; one of them is fiscal foresight. If a consumer foresees a change or a change in fiscal policy is announced consumers can alter their behavior before the change is implemented and the whole effect of a change in in consumption in response to a fiscal policy shock might not be captured. Blanchard and Perotti (2002) find that the response of output to a government spending shock was larger once they took account of the anticipation effects. Another problem is simultaneity bias created if a change in GDP affects expenditure. This will lead to inconsistent estimates. Other factors that influence the size of the multiplier is the composition and persistence of the shock, how monetary policy is conducted, the size of the automatic stabilizers, exchange rate system, the development level of the country, debt and the openness of the economy. In some rare cases a fiscal contraction has actually had expansionary effects, this is known as the “Austerity myth”. Sutherland (1997) uses a model and shows that a fiscal expansion will have Keynesian effects at lower levels of debt, but at high levels of debt, on the other hand, a fiscal expansion can have contractory effects. This is because the consumers have finite lives and high levels of debt makes it very likely that a fiscal consolidation will take place in their lifetime. Keynes introduces the term “Animal spirits” to explain how changes in economic agents sentiment can lead to downturns and Bloom (2009) shows that uncertainty often jumps after large shocks like oil-price shocks and terrorist attacks. This leads to a drop in aggregate demand and employment in the short run, since firms’ pause/postpone their investment decisions. Higher uncertainty can cause consumers to increase their saving in order to prepare for a more uncertain future, this is known as “precautionary saving” (Carroll 1992). Also investment decisions are affected by higher uncertainty because it makes firms more cautious and therefore makes firms less responsive to stimulative policies (Bloom 2009).

The structural VAR used in this paper is based on the model in Caldara and Kamps (2008) and the Cholesky decomposition is used to identify the system of equations. As mentioned the identification approach used in this paper is the same one used in Blanchard and Perotti (2002), which turns the
structural VAR into a recursive VAR. I have used MATLAB and performed the misspecification tests using the econometrics toolbox. The MATLAB code was obtained from the MATLAB file exchange, but minor changes have been made to the code. For the US I obtain a positive multiplier on impact and a negative cumulative multiplier for both models. In this case the multiplier is less negative when the volatility index measuring uncertainty is included in the model, which implies a that uncertainty has a negative bias on the effect a expenditure shock has on GDP. For the data from the United Kingdom I estimate a negative multiplier both on impact and cumulatively for both the models. However the multiplier is more negative when uncertainty is included in the model, by looking at the correlation between the volatility index and government expenditure I find a slightly negative correlation which means that uncertainty has a negative bias on the effect a expenditure shock has on GDP. In the case of Japan I estimate a positive multiplier in both of the models on impact and for the longer horizon. The multiplier is larger when uncertainty is included in the model, which implies that uncertainty has a negative bias on the effect a expenditure shock has on GDP. In the case of Norway I obtain an overvaluation of the multiplier due to uncertainty. But this is most likely because the measurement used to measure uncertainty is like the Norwegian economy correlated with the price of oil, which will be positive for the Norwegian economy, but more of a disadvantage to the other countries in the sample. For the United States, United Kingdom and Japan uncertainty has a negative bias on the estimated multiplier, this makes the estimate undervalued.

Woodford (2010) shows how important monetary policy and the central bank’s response to changes in inflation is to determine the fiscal multiplier. Christiano et al. (2009) find that the fiscal policy has greater effect when the interest rate is low, this could explain the larger multiplier estimated for Japan because their Long-term interest rates have been very low compared to the interest rate in the other countries in the sample.

In this paper the omission of uncertainty led to negatively biased estimates for the multiplier in Japan, the UK and the US. I used the identification approach used by Blanchard and Perotti (2002). The identification approach used by Ramey and Shapiro (1998) estimates lower multipliers than Blanchard and Perotti (2002) but one might argue that during war uncertainty is probably also high. As far as I know they have not taken account of uncertainty in their model and this might be one of the causes for the lower multiplier. This would be consistent with my findings for Japan, the United States and United Kingdom, but not for Norway. Even though I obtain a negative bias for Japan, the US and the UK it is important to note that the effect of government expenditure is small also when uncertainty is controlled for.
Preface

Writing this thesis has been an interesting and challenging process, and it marks the end of my master degree in Economics at the University of Oslo.

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Despite my efforts, errors might occur, these are my sole responsibility.

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# List of Figures


5.1 The effect of a one percent increase in government expenditure on expenditure, the United States.  
5.2 The effect of a one percent increase in government expenditure on GDP, the United States.  
5.3 The effect of a one percent increase in government expenditure on GDP, the United States.  
5.4 The effect of a one percent increase in government expenditure on on volatility, the United States.  
5.5 The effect of a one percent increase in government expenditure on expenditure, the United Kingdom.  
5.6 The effect of a one percent increase in government expenditure on GDP, the United Kingdom.  
5.7 The effect of a one percent increase in government expenditure on GDP, the United Kingdom.  
5.8 The effect of a one percent increase in government expenditure on on volatility, the United Kingdom.  
5.9 The effect of a one percent increase in government expenditure on expenditure, Japan.  
5.10 The effect of a one percent increase in government expenditure on expenditure, Japan.  
5.11 The effect of a one percent increase in government expenditure on GDP, Japan.  
5.12 The effect of a one percent increase in government expenditure on on volatility, Japan.  
5.13 The effect of a one percent increase in government expenditure on expenditure, Norway.  
5.14 The effect of a one percent increase in government expenditure on GDP, Norway.  
5.15 The effect of a one percent increase in government expenditure on GDP, Norway.  
5.16 The effect of a one percent increase in government expenditure on on volatility, Norway.  
5.17 VOL shock on GDP, USA.  
5.18 VOL shock on GDP, UK.  
5.19 Volatility index shock on GDP, Japan.  
5.20 Volatility index shock on GDP, Norway.  

A.1 Figure displays quarterly data for GDP in the US from 1980 till 2011.  
A.2 Figure displays quarterly data for government expenditure in the US from 1980 till 2011.  
A.3 The effect of a one percent increase in government expenditure on expenditure, the United States.  
A.4 Figure displays quarterly data for GDP in the UK from 1980 till 2011.  
A.5 Figure displays quarterly data for government expenditure in the UK from 1980 till 2011.  
A.6 The effect of a one percent increase in government expenditure on expenditure, the United Kingdom.  
A.7 Figure displays quarterly data for GDP in Japan from 1980 till 2011.  
A.8 Figure displays quarterly data for government expenditure in Japan from 1980 till 2011.  
A.9 The effect of a one percent increase in government expenditure on expenditure, Japan.  
A.10 Figure displays quarterly data for GDP in Norway from 1980 till 2011.  
A.11 Figure displays quarterly data for government expenditure in Norway from 1980 till 2011.  
A.12 The effect of a one percent increase in government expenditure on expenditure, Norway.
Chapter 1

Introduction

As governments tried to handle the Great Recession fiscal stimulus packages were put together increasing government spending or cutting taxes. This led to higher debt levels in many countries. Now, as the world handles the debt crisis in Europe, the questions of how well fiscal stimuli works, and the size of the fiscal multipliers has become very relevant. There is wide disagreement in academic circles on the existence and size of the fiscal multipliers and different studies give different results.

Neoclassical models predict multipliers that can be positive and negative depending on, among other things, the taxation system (Ramey 2011). Ramey and Shapiro (1998) uses war dates to identify the effects of a fiscal policy shock, this approach usually finds that GDP increases while consumption decreases in response to a fiscal policy shock which is consistent with the neoclassical view. In Keynesian type models, on the other hand, the multiplier depends heavily on the consumers’ marginal propensity to consume and these types of models predict positive multipliers. Blanchard and Perotti (2002) that the multiplier is positive when we have a positive government spending shock. However the size of the multiplier depends on the type of government spending, the size and persistence of the expenditure shock and how this increase in spending is financed by the government (Ramey 2011). Some economists argue that in some cases fiscal contractions may be expansionary. The phenomenon of an expansionary fiscal contraction is called “The expansionary fiscal consolidation” hypothesis. Giavazzi and Pagano (1990) have found evidence of this. During and after the Great Recession uncertainty has increased. Uncertainty in the economy could affect how changes in fiscal policy affect the economy.

If a fiscal expansion leads to increased debt and a larger deficit this will increase the uncertainty in the economy and most likely influence the effect of the fiscal expansion. Sutherland (1997) show that when debt reaches extreme levels, we can see contractory fiscal expansions because the consumers will realize that is very likely that a fiscal consolidation will take place and taxes will be raised. There is also wide disagreement on the identification of fiscal shocks; the identification approach used plays an important role when estimating multipliers. Blanchard and Perotti (2002) uses institutional information to deduce that it takes policymakers more than one quarter to respond to a GDP shock. This is the approach used in this paper. An alternative is a different approach initially used by Ramey and Shapiro (1998). They use war-dates to estimate the effect of exogenous fiscal policy shocks. These are used because they are seen as exogenous to the state of the economy. However a reason why this approach estimates a lower multiplier might be because at these dates uncertainty is high. Bloom (2009) shows that uncertainty shocks lead to a drop in aggregate output and employment because consumers and firms will postpone their investment and hiring.

Therefore high uncertainty can dampen the estimated fiscal multiplier and the effects of fiscal expansion, if episodes of high uncertainty coincide with episodes of fiscal expansion. This seems very likely for the war-dates studied by Ramey and Shapiro (1998). On the other hand if nothing is done to smooth changes in output, the result could be even worse and a fiscal expansion can work to reduce the effects of high uncertainty. Bachmann and Sims (2011) show that multipliers are larger during recessions and that a government spending shock during a recession actually improves confidence.

The purpose of this paper is to investigate uncertainty and the transmission of government expenditure shocks. I will compare the size of the multiplier when I control for uncertainty opposed to the baseline case with only expenditure and GDP included in the model. This will indicate whether omitting uncertainty when estimating the effect of a government expenditure shock will lead to biased estimates.
To measure confidence and uncertainty I will use a Volatility Index (VOL) introduced by Bloom (2009) to measure uncertainty and analyze 4 countries from 1980 till 2008. The countries are the United States, United Kingdom, Japan and Norway.

For the US I obtain a positive multiplier on impact and a negative cumulative multiplier for both models. In this case the multiplier is less negative when the volatility index measuring uncertainty is included in the model, which implies that uncertainty has a negative bias on the effect a expenditure shock has on GDP. For the data from the United Kingdom I estimate a negative multiplier both on impact and cumulatively for both the models. However the multiplier is more negative when uncertainty is included in the model, by looking at the correlation between the volatility index and government expenditure I find a slightly negative correlation which means that uncertainty has a negative bias on the effect a expenditure shock has on GDP.

In the case of Japan I estimate a positive multiplier in both of the models on impact and for the longer horizon. The multiplier is larger when uncertainty is included in the model, which implies that uncertainty has a negative bias on the effect a expenditure shock has on GDP. Norway is the only case where I find that uncertainty has a positive bias on the effect a expenditure shock has on GDP, but the multipliers are negative in both the models.

The results of the estimation show that uncertainty does lead to biased estimates. In the case of Norway I obtain an overvaluation of the multiplier due to uncertainty. But this is most likely because the measurement used to measure uncertainty is like the Norwegian economy correlated with the price of oil, which will be positive for the Norwegian economy, but more of a disadvantage to the other countries in the sample.

For the United States, United Kingdom and Japan uncertainty has a negative bias on the estimated multiplier, this makes the estimated effect of a government spending shock on GDP undervalued.

The rest of the paper is organized as follows. Chapter 1 gives a survey of the literature on the size of the fiscal multiplier, theory about fiscal policy and a part on fiscal policy and uncertainty. Chapter 2 presents different ways of identifying fiscal shocks and presents the model used in this paper. Chapter 3 describes the data and countries used in the estimation of fiscal multipliers. It also gives a little more detail on the volatility index. Chapter 4 presents and discusses the results from the estimation. Chapter 5 concludes.
Chapter 2

Literature review

2.1 Fiscal stimulus

The government part of aggregate demand is described by fiscal policy and it is the choice between taxes and government spending/expenditure. Government spending is the purchase of goods and services by the state and local governments. Changing fiscal policy to stabilize aggregate demand is called discretionary fiscal policy. When a government increases its taxes or reduces spending we call it a fiscal contraction. A decrease in taxes and or increase in spending on the other hand are a fiscal expansion (Blanchard 2009).

2.1.1 Theory

There is little consensus between experts about the effects of fiscal policy on growth. The traditional Keynesian view yields multipliers that are greater than one. While the more Weak Keynesian view yields positive multipliers that are between zero and one. The Neoclassical view yields multipliers that are lower or equal to zero and the Non-Keynesian view yields multipliers that are close to zero or negative (Briotti 2005).

The Neoclassical view

In Neoclassical models fiscal policy affects the private economy through wealth effects, intertemporal substitution and distortions to first-order conditions (Ramey 2011). To obtain funds the government can choose to raise taxes or issue bonds (debt). Ricardian equivalence is a famous result that shows that it is irrelevant if governments issue debt or raise taxes. Only the quantity of government purchases, not the division between debt and taxes. If this holds then cutting taxes during a recession will not increase consumption and stimulate the economy.

The neoclassical model is a permanent income/life-cycle hypothesis type model with government, taxation and debt. Taxes are lump sum therefore they are non-distortionary. This model assumes perfect capital markets, that the consumers have an infinite horizon and that the consumers are forward-looking.

The consumers maximize their intertemporal utility function subject to his/her lifetime budget constraint. The results will be the same as when the government is left out because the time path of consumption is unaffected by the lump-sum taxation. While the level of consumption will be lower due to the wealth effects of the lump-sum tax.

Now assume the government wants to leave their purchase-path unchanged, but lower the taxes for one period. They issue debt of the same size as the tax decrease. The governments refinancing scheme will not affect the consumer. Every inflow in the budget constraint is matched by an equal outflow, leaving the life-time budget constraint unchanged. But the savings behavior of the consumer will be affected. When the government cuts current taxes and issues debt, the rational consumer will see that future
taxes must rise to pay the issued debt plus interest. He/she can use the tax rebate to buy government bonds that will help pay for the future tax obligations. Demand for private savings will move one-to-one with the changes in supply of public debt. So in the neoclassical model optimal level of government spending is zero, because it leads to crowding out and prevents consumption and increases the disutility of labour (Woodford 2010).

Will this result hold in practice? New households enter the economy and the ones having to pay the higher tax for the issued bond might not be the ones that are alive when the bond is issued. On the other hand if the current generation cares about the welfare of future generations financing decisions may be irrelevant (Romer 2006). Barro (1974) transformed the finite horizon model into a model of infinite horizon by assuming that people regard their children as an extension of themselves (Seater 1993). The model also assumes that the old dissave when retired, but the evidence of this is mixed and usually the old do not dissave as much as the model predicts. Evidence also point to the fact that consumers are not as forward-looking as the model predicts and respond only when anticipated changes actually occur. It is not clear if leaving altruistic bequests for children occur often enough to see this as evidence for Ricardian equivalence.

Another argument against Ricardian equivalence is liquidity constraints. A consumer could be induced to spend more when current taxes are lowered and future taxes increased, but this effect depends very much on why the constraint occurs (Seater 1993). Governments might be able to borrow at lower rates than consumers and therefore the present value of the government debt would be less than the value of the current tax reduction, which leads to an increase in net wealth and Ricardian equivalence will not hold (Seater 1993). If the steady-state growth rate of the economy is higher than the steady-state interest rate then the government can continue to issue debt and never collect taxes to pay back interest or the principal on the claims. The base, which the government borrows against, will always be larger than the amount borrowed (Seater 1993).

Ricardian equivalence will fail when the increase in government spending is financed by distortionary taxes. Baxter and King (1993) calibrate and find that the multiplier is lowest when the spending shock is temporary and distortionary taxes are raised at the same time to keep budget balanced. It can be as low as negative 2.5. If the increase in government spending is financed by a increase in debt the multiplier is a little larger, but is still below one.

An increase in government spending is usually followed by an increase in distortionary taxes. Through intertemporal substitution (consumers know taxes will be higher in the future and supply more labor in the current period when taxes are relatively low) this leads to higher short run multipliers. The neoclassical model predicts that the multiplier can be either negative or positive depending on the timing and extent of the distortionary taxes (Ramey 2009). Foreign ownership of debt, childless families and distribution effects may also cause Ricardian equivalence to fail (Seater 1993).

The persistence of the spending shock also matters for the size of the multiplier Baxter and King (1993) use a neoclassical model to decide the effects of a temporary and permanent increase in government spending. They show that a permanent increase in government spending has a negative wealth effect on the consumers and the consumers decrease their consumption and leisure so labour supply increases. Their estimate for the multiplier on impact, when the spending increase is permanent, is 0.86, while for a temporary increase it is 0.56. This can be explained by a larger wealth effect for permanent increases in government spending and the fact that persistence in spending limits the opportunities for intertemporal substitution. They argue that these results will hold in any neoclassical model assuming that the permanent income hypothesis holds and that the intratemporal efficiency condition between consumption and labour is obeyed. This must be true because consumption falls by more when shocks are persistent and for the efficiency condition to be true labour supply must increase more when shocks are persistent. On the other hand Barro (1981) argue that temporary increases in government spending exert larger output effects than permanent changes because they believe the substitution effect dominates the wealth effect.

Keynesian view

In a static IS-LM model with fixed prices, an exogenous fiscal contraction (increase in taxes or decrease in public spending), will have a negative effect on output through the demand side and multiplier mechanism. A tax increase for example will reduce the disposable income and therefore decrease
consumption. This causes a fall in output and income. The fall in demand will be met with a fall in interest rates due to lower demand for money, but this will not be enough to offset the effect of higher taxes. In the traditional Keynesian type model, when interest rates are held constant, the multiplier is given by \( \frac{1}{1 - \text{mpc}} \) (Ramey 2011), where:

\[
\text{mpc} = \frac{\Delta c}{\Delta y}
\] (2.1)

The marginal propensity to consume is how much desired consumption (c) increases when disposable income (y) increases. Simply put it shows how much of increased income the consumer will spend on consumption. In this type of model consumption depends current disposable income and not lifetime resources (Gali et. al 2007). The size of the multiplier depend on crowding-out effects (accelerator effects of investment), level of interest rate (a rise in market interest rate lowers the multiplier), degree of openness in economy (marginal propensity to import), the exchange rate and price flexibility (Briotti 2005). Even with these considerations the multiplier still depends largely on the marginal propensity to consume. The new-keynesian type models build on neoclassical principles, but with sticky prices and wages, and this leads to prediction of much smaller multipliers compared to the Keynesian view. But still higher than in neoclassical models (Ramey 2011). This is because when wages and prices are sticky monetary policy will have real effects, and the size of the multiplier depends on the monetary policy response (Woodford 2010).

In the baseline new Keynesian model a spending shock will increase labour demand and the real wage will increase inducing higher consumption (Perotti 2007). In a dynamic Keynesian model, with a longer horizon, the size of the multiplier might be dampened due to expectations about the future disposable income.

Gali, Lopez-Salido and Valles (2007) extend the standard new Keynesian model to include rule of thumb consumers. These consumers spend all of their current income in one period. When Gali et. al (2007) incorporate rule of thumb consumers they show that for a high number of these consumers included in the model, private consumption, real wages and employment all increases in response to a fiscal spending shock.

This happens through higher employment, rise in the real wage and labour income and increased consumption by the rule of thumb consumers. Their contribution will raise aggregate demand, output and employment even further leading to the traditional Keynesian multiplier effects. This effect is dependent on the response of taxes and expected long-term real rate (Gali et al. 2007). In this paper the authors find multipliers as high as 2.0 when making the following assumptions: Half of the consumers are rule of thumb consumers and therefore have a very high marginal propensity to consume. These consumers don’t act optimally according to their lifetime budget constraint. Secondly they assume that employment is demand-determined meaning that workers are always willing to supply as many working hours as demanded by the employer. These assumptions turn the model into a traditional Keynesian model.

Cogan et. al (2009) estimate one new Keynesian model and one old Keynesian model, and study the effects of a one percent of GDP permanent increase in government spending. The initial increase is debt financed. The multiplier in the new Keynesian model is estimated to only be one third of the multiplier in the old Keynesian model. They argue that new Keynesian models are better at evaluating policy because they are empirically estimated and capture how agents expectations and microeconomic behavior change over time in response to policy interventions.

### 2.1.2 Evidence

What estimates one gets for the fiscal multiplier depends on the assumptions made, the identification approach used, how monetary policy is conducted and other aspects of the economy considered. Iztzki et.al (2011) discover that the exchange rate regime, development level, level of debt and openness to trade all affect the size of the multiplier.
CHAPTER 2. LITERATURE REVIEW

Identification and fiscal foresight

When empirically investigating the size of fiscal multipliers the identification approach you choose will influence the results you obtain. Blanchard and Perotti (2002) use a structural VAR and identify it by assuming that it takes at least one quarter for policymakers to react to changes in GDP. Their estimates for the multiplier, under a deterministic trend for data for the US, is 0.84 at impact then falls before reaching its peak 1.29 in quarter 15. They also find that consumption increases in response to a government spending shock, this is consistent with the new Keynesian view.

The approach used by Ramey and Shapiro (1998) uses war dates to identify the effects of a fiscal policy shock. These shocks, they argue, are exogenous because it is unlikely that these events respond to other events in the economy. This approach usually finds that GDP increases (although by less than what Blanchard and Perotti (2002) estimate), while consumption decreases in response to a fiscal policy shock. This result is consistent with the neoclassical view that consumption falls in response to a government spending shock due to the negative effect taxes has on wealth.

Fiscal policy is subject to two different types of lags. “Decision lags” is the first one and these are the lags it takes for policy to change in response to a shock. There are also “implementation lags”, which means that it takes some time for policy changes to be effective. Implementation lags are a problem because what we see as a policy shock in a sample could be a previous policy change that not yet has become effective and therefore is already anticipated by the consumers. If consumers know about a change in fiscal policy they might alter their behavior today and not when the policy is implemented (Blanchard and Perotti 2002). Ramey (2009) shows timing is crucial to what the estimated effect of fiscal shocks will be. Fiscal foresight means that if consumers are informed about changes in fiscal policy before these changes are implemented, then they might alter their behavior now and not in the future when the policy is implemented. It is essential to identify when news become known to be able to capture the whole effect. Big increases in military spending are anticipated long before it actually occurs. So failing to incorporate the anticipation leads to differences in empirical results (Ramey 2009) When Ramey includes world war one the multipliers is estimated close to one. When world war one is excluded the multiplier is estimated to be a little lower, between 0.6 and 0.8. Ramey shows that almost all volatility in government spending can be attributed to defense spending. Defense spending is a large part of the variation of government spending around trend and it is very unlikely to interact with private consumption.

Blanchard and Perotti (2002) do take fiscal foresight into account and find that the response of output to a government spending shock is larger once they take account of the anticipation effects. However when Caldara and Kamps (2008) control for the differences in identification and they obtain very similar multipliers for the different identification approaches after this. They find that real GDP, private consumption and real wage all increase in response to a government spending shock, while private employment remains the same. This is most consistent with the results obtained by Blanchard and Perotti (2002).

Role of monetary policy

Izetkzi et. al (2011) also discover that countries with flexible exchange rate have multipliers close to zero while countries with fixed exchange rates have a non-zero multiplier, but this is due to a more active use of monetary policy to offset effects of fiscal policy shocks and therefore more like evidence that the response of the central bank to fiscal shocks is very important when determining the multiplier. This would make stimulus in countries with an inflation target less effective. Christiano et. al (2009) find in their paper that the size of the fiscal multiplier depends on the interest rate. When the zero nominal bound on interest rates (interest rates can’t be negative) binds fiscal policy will have a greater effect. They also find that in countries where it is costly to be in the zero nominal interest bound the multiplier will be even larger. When output falls we will see a drop in marginal costs and prices, consumers will form expectations about future deflation. If the nominal interest rate is zero and the government increases their spending output will rise and marginal costs will rise, so will the expectations about future inflation. An increase in expected inflation will reduce the real interest rate and increase private consumption. This increase in consumption will further increase output, marginal costs and inflation expectations and reduce the real interest rate even further. The increase in government consumption will offset the deflationary spiral usually associated with the zero nominal bound on the interest rate.
When the central bank uses a Taylor-rule to determine the nominal interest rate Christiano et. al (2009) find that the multiplier is less than one. Another result from this paper is that the multiplier is larger when the nominal interest rate isn’t used to react to the fiscal spending shock. In this case the multiplier peaks at 2.3.

Composition

Composition of the spending cut also play an important role. Which instrument, taxes or spending, is most effective to stimulate aggregate demand? The New Keynesian view is that government spending has a stronger effect because it affects GDP directly while consumers might save some of their surplus from a tax decrease. On the other hand high spending can lead to lower investment (crowding out), higher saving and higher interest rates. Economists disagree on this issue and it is very politically charged, because it is a debate about the size and role of government. Eggertson (2006) studies a stochastic general equilibrium model with sticky prices and rational expectations. He obtains positive multiplier both for real government spending and deficit financed spending increase, however the increase in deficit spending is more effective when it comes to decreasing deflation and boost aggregate demand, but deficit spending is only effective if monetary and fiscal policy are coordinated. This is because the deficit financed spending works through the expectation of future interest rates and if policy is coordinated then higher nominal debt should imply higher inflation expectations since this implies an incentive for a permanent increase in the money supply. Alesina and Ardagna (2009) find that tax cuts are more expansionary than spending increases. This might be because it is a more direct way to influence the consumers’ budget constraints. Fiscal adjustments that include cutting spending will lead to moderation in wage claims and therefore help stimulate employment and growth. Eggertson (2009) on the other hand finds that tax cuts actually can deepen a recession if the short-term nominal interest rate is zero. An example of this is a cut in capital taxes because this encourages consumers to save more and a cut in wage tax can deepen deflationary pressures. He argues that fiscal policy aimed directly at aggregate demand works better.

Automatic stabilizers

Automatic stabilizers means that output fluctuations are smoothed due to changes in taxes and other transfers so that disposable income is less volatile than income (Fatas and Mihov, 2001). The Laffer curve is an example of this it shows the possible tax revenue at different levels of tax rates. If the tax level is too high workers will be discouraged from working more, because so much of their income will be spent on taxes. Therefore a high tax rate doesn’t necessarily yield the highest tax revenue (Begg et. al 2008). This is an example of an automatic stabilizer. Automatic stabilizers reduce the multiplier and therefore reduce the change of output in response to demand shocks (Begg et. al 2008). As a consequence of the automatic stabilizer’s role in the tax and social security system the government budget deficit rises when economic activity falls and the deficit falls when activity rises (Carlin and Soskice, 2006). Dolls et al. (2010) discover that automatic stabilizers absorb 38% of an income shock in the EU and 32% in the US.

Lesser effect of fiscal policy

Perotti (2002) analyzes 5 OECD countries to see what effect fiscal policy has on GDP, prices and interest rates. He uses the Blanchard and Perotti approach and discovers that the effects of fiscal policy on GDP have become weaker over the last 20 years. He finds that in the pre 1980 period multipliers are positive, but usually below one, after 1980 however multipliers are usually negative. He explains this partially by arguing that a more closed economy yields higher multipliers and the role of monetary authorities. Bilbiie et. al (2008) also reach similar results and defend this by pointing to the difference in conducting monetary policy after 1980, that fiscal policy in itself has changed and that financial liberalization has made household more able to smooth consumption over time. This fits well with the findings presented later in this paper.

Evidence shows that many households are liquidity constrained and that transitory income has effects on aggregate consumption. The indirect evidence of Ricardian equivalence is inconclusive (Seater 1993).
2.2 Austerity

In some cases there has been signs of a fiscal contraction that has had expansionary effects. This is known as “The Austerity myth”. There is little theory to back this myth, however Sutherland (1997) uses a model to show how a country’s debt level can influence how fiscal policy changes influence consumption. This paper is very related to the theme in this paper if a fiscal expansion leads to increased debt and a larger deficit; this will increase the uncertainty in the economy and most likely influence the effect of the fiscal expansion. Consumers might be more careful and will increase their saving, so that the expansion doesn’t give the wanted effect of higher consumption and investment (Midtjell 2010). At low levels of debt Sutherland (1997) shows that a fiscal expansion will have the traditional Keynesian effects, but at higher levels of debt a fiscal expansion financed by an even higher deficit can have contractionary effects. The mechanism in the model creating this effect is the link between current fiscal policy and future expected taxes. A crucial assumption in the model is that consumers have finite lives. In the model measures are taken to stabilize debt when it reaches extreme levels and taxes are increased. At low debt levels we will see the traditional Keynesian effects because consumers find it very unlikely that a fiscal consolidation will take place in their lifetime. At extreme levels of debt, however, a fiscal expansion can have contractionary effects because it is very likely that a fiscal adjustment will take place soon and the consumers prepare themselves for an increase in the tax rate. Evidence in Iyetki et.al (2011) supports Sutherland’s model. They estimate multipliers when debt is high (60% of GDP or higher) and obtain a negative multiplier or an multiplier equal to zero when debt is large. They find that higher debt than 60% of GDP is actually the tipping point for when the multiplier turns negative. Briotti (2005) uses a neo-classical model and identifies three ways for a fiscal contraction to be expansionary. The consumers have to base their consumption not only on current, but also future income. Taxes have to be distortionary so that a current fiscal adjustment reduces expectations of a larger adjustment in the future. The fiscal adjustment also has to be unexpected for it to have expansionary effects. The ability of a fiscal adjustment to change the Debt-to-GDP ratio depends on the size of the fiscal adjustment and not on it composition.

An expansionary contraction can happen when consumers see a fiscal tightening as a sign that it eliminates the need for larger and more painful fiscal adjustment in the future. This generates a positive wealth effect. Fiscal policy changes might also affect the expectations about future interest rates. If the adjustment lowers the risk of government default the interest rate on government bonds will fall. A fall in interest rates on government bond could cause the real interest rate to fall and stimulate consumption and investment. A lower interest rate leads to increased value of stocks and bonds and the financial wealth of consumers increase (Alesina 2010). A fiscal adjustment can also influence labour supply and therefore affect through the supply side depending on which effect taxes and spending has on labour supply. If the fiscal consolidation is based on lower government employment or lower government wages we can see this having positive effects on the economy because it raises unemployment and gives unions less bargaining power. This leads to lower wages and prices (Ardagna 2004). Ardagna (2004) studies fiscal adjustment programs in the OECD and the economy’s response to fiscal adjustments. She identifies a third channel that a fiscal contraction can lead to higher growth: A cut in government spending could lead to higher private investment, if private and government investment are substitutes and private investment is more effective than public investment. She shows that whether a fiscal adjustment is expansionary depends on its composition, more accurately said a cut in public spending leads to higher GDP-growth rates compared to tax increases. A related result found by Alesina and Ardagna (2009) show that fiscal adjustments based on spending cuts are less likely to cause recessions. Perotti (2011) on the other hand present four cases were fiscal adjustments have led to an fiscal expansion and argue that in only one of these was the expansion driven by internal demand. He argues that most these cases (Denmark 1983-1986, Ireland 1987-1989, Finland 1992-1998 and Sweden 1993-1998), the exchange rate played an important role in the increased growth after the fiscal consolidation. Denmark was the only case where the expansion was driven by internal demand, though it was helped by increased exports due to a depreciation of the currency, a fall in interest rates and the fact that house prices and the stock market boomed.
2.3 Fiscal policy and uncertainty

Keynes (1936) argued in *General theory Employment Interest and Money* (1936) that changes in investor sentiments could lead to economic downturns, he called this “animal spirits”. Animal spirits is a term used to capture the notion that aggregate demand could be driven by waves of optimism and pessimism (Blanchard 2009). The idea is that the sentiment of the agents in the economy determines spending which then determines aggregate output (Bachmann and Sims 2011). More recently a related is the “Sunspot” framework used in Farmer (2009). Here the economy has more than one equilibrium and affecting confidence by increasing spending could cause the economy to shift into a more desirable equilibrium.

Bachmann and Sims (2011) look at consumer and business confidence and the transmission of fiscal policy. More specifically they use the Michigan Survey of Consumers polls to measure consumer uncertainty and Conference Board’s CEO Confidence Survey to measure business confidence. They use a SVAR and the same identification approach used in this paper. They divide the effect of an expenditure shock on GDP into two effects; the direct effect due to expenditures contemporaneous effect on output and the indirect effect of an expenditure shock on confidence, which then again affects output. They isolate the direct effect and compare this to the actual impulse response, after this they extend the model to allow for non-linearities. In the baseline case, which is very similar to the estimation done in this paper, they find that confidence does little to affect the transmission of fiscal policy shocks and estimate multipliers that are just below one. In the non-linear case where they divide the sample into times of recession and normal times, they discover that spending multipliers are much larger in recessions. This finding is evidence that government-spending shocks restore confidence and reduce uncertainty. The impact multiplier is about the same in both cases, but the multiplier, in the recession case, rises substantially after a few quarters. Evidence suggests that multipliers are much larger in recessions and the cumulative multiplier is about two or three times larger opposed to the linear case (Bachmann and Sims 2011). They argue that in recessions government spending is more focused on investment and this could explain the increases in productivity following a spending shock. In the appendix of their paper Bachmann and Sims (2011) look briefly at the effects of uncertainty and the transmission of fiscal policy. They use the standard deviation from a survey measuring confidence to measure uncertainty. Their main findings are that a surprise increase in government expenditure leads to a decrease in consumer uncertainty and this effect is larger in a recession. If they take the uncertainty effect out the effect on output is weaker and even weaker in normal times. Bloom (2009) shows that uncertainty often jumps after large shocks like oil-price shocks and terrorist attacks. This leads to a drop in aggregate demand and employment in the short run, since firms’ pause/postpone their investment decisions. In the longer run the increased volatility in shocks lead to shaper recessions or recoveries. Bernanke (1983) argues that higher uncertainty gives firms incentive to delay investment and employment decisions, it also increases the cost of finance. If all firms follow the same logic aggregate demand will fall and we have a recession. Policy uncertainty can also slow recovery after a recession because uncertainty about future taxes, interest rates and employment can cause postponement of consumers’ investment decisions. They might choose to save and wait and see opposed to spending now. Baker et. al try to find out if this statement indeed is true. They do this by constructing a measure for economic policy uncertainty and examine it from 1982. The index is constructed from three components: references of economic uncertainty in 10 newspapers, the number of federal tax code provisions set to expire in future years and the extent of disagreement among economic forecasters. This index spikes around major events like presidential elections and terrorist attacks. They also use a VAR model to estimate the response to policy related uncertainty shocks. The results show that a rise in uncertainty is followed by a drop in GDP by 3.2%. Private investment falls by 16% and a 2.3 million people become unemployed.

Consumption and uncertainty

How do consumers decide on how much to consume? Expectations and how foresighted the consumer is play a crucial role in the spending decision. Milton Friedman introduced the permanent income theory of consumption in the 1950’s; in this theory the consumers look beyond their current income. Friedman assumes that consumers dislike fluctuations in consumption and due to diminishing marginal utility prefer to smooth consumption. He argues that consumption depends on consumers’ average long-run income and not on current disposable income (Begg et. al 2008). Franco Modigliani introduced the life cycle theory of consumption where consumers take their lifetime income into account. Modigliani...
assumes that consumers make a lifetime consumption plan, but doesn’t assume complete consumption smoothing (Begg et. al 2008). Consumption is an increasing function of total wealth and current income. Total wealth is the expected present value of future income and financial wealth. Expected present value of future income can also be called human wealth and depends on expectations of future labour income, real interest rates and taxes (Blanchard 2009). For example if there are expectations of higher output in the future this will affect current consumption through an increase in expected future income and the human wealth is increased. This in turn leads to higher consumption. Expectations of higher output in the future also affects the non-human or financial wealth if the consumers has these kinds of assets. Expected future dividends go up and stock prices increase. The financial wealth increases and consumption goes up (Blanchard 2009). The consumption decision is dependent on expectations which will make consumption respond less than one-to-one to changes in current income and might even cause it to change despite of unchanged income (Blanchard 2009). Increased uncertainty in the economy could cause uncertainty about the evolution of total wealth and therefore cause changes in consumption. If movements in income are seen as temporary we expect to see smaller changes in consumption as opposed to permanent changes. For example in a recession we see less than one-to-one changes in consumption in response to lower income because consumers expect the recession to be temporary. In the paper “Precautionary savings in the Great Recession” Mody, Ohnsorge and Sandri (2012) find that increased uncertainty has increased the savings rates and therefore lowered consumption and lowered GDP growth. Their results also agree with Carroll (1992) that greater uncertainty about labour income leads to higher saving. They also extend their analysis to also include global factors, and find significant results. Expected future growth decreases the savings rate, and stress in the interbank market increases saving. Countries that have accumulated deficits trying to help the economy out of the recession have stimulated aggregate demand, but this effect is partly offset by higher private savings. Therefore it is important to try and keep labour income uncertainty low, by for example leaving social benefits unchanged, to avoid an even larger drop in consumption.

**Investment and uncertainty**

Investment is also one of the driving forces of aggregate demand and fiscal policy affects investment through taxes and the real interest rates (Blanchard 2009). We can divide investment into two groups, nonresidential investment (purchases made by firms of new plants and machines) and residential investment (private consumers who purchases houses and apartments). Firms buy new equipment to produce output in the future and consumers buy houses and apartments to get housing services in the future. The decision to invest depends on the return these investments will yield in the future, and therefore very much on the expectations about the future (Blanchard 2009). Investment depends positively on expected present value of future profits and negatively on higher expected real interest rates. Higher expected output affects investment positively because it increases future expected profits and therefore increases investment (Blanchard 2009).

Bloom, Floetto and Jaimovich (2010) build a model where uncertainty is the change in variance of innovations to productivity. They present two sources of uncertainty; the first is uncertainty about the evolution of microeconomic shocks from individual firms and industries and the second is uncertainty about the evolution of macroeconomic variables. These are both strongly countercyclical. Policy ineffectiveness occurs because uncertainty makes firms very cautious in responding to any stimulus. Bloom (2009) discovers that uncertainty shocks drive business cycles and uncertainty is strongly countercyclical. Increased uncertainty leads to drops in economic activity and hiring and investment is paused. It also leads to falls in productivity because it reduces the reallocation of capital and labour across firms. He also argues that uncertainty makes firms cautious and therefore reduces the response of the economy to stimulative policy, leading to pro-cyclical policy multipliers. Bloom et. al (2010) analyze policy in presence of uncertainty. In the model the policy used is reducing the effective wage paid by firms to stimulate hiring, a 1% wage bill subsidy in period zero. The result shows that under low uncertainty the effects of the stimulus is as expected and stimulates hiring and increases output for two periods then returning to the long run trend level. If the policy is introduced at the exact time that the uncertainty shock hits the economy we see an immediate drop in output and a rebound and overshoot after two quarters. In the absence of any policy shock (just a uncertainty shock) we see an even larger fall in output. The difference between the last two cases is policy’s impact during an uncertainty shock. It is clear that uncertainty reduces the effects of policy opposed to an economy in the normal, low uncertainty case. In this case it reduces the effect by almost 60%.
Chapter 3

Methodology

3.1 The Model

In 1980 Christopher Sims introduced a new macroeconometric framework called vector autoregressions (VARs for short). A single variable autoregression is a model where the variable depends on its own lagged values. A VAR is a multivariate autoregression, meaning that we have more than one equation and variables. This is a model where the value of a variable, \( u \), is explained by its own lag and by the current value and lags of the \( n-1 \) variables included in the model (Stock and Watson 2001). I will use a structural VAR (SVAR). In this case we use economic theory to identify the equation system. In this paper I will follow Blanchard and Perotti (2002) and assume that policymakers use more than one quarter to respond to changes in aggregate demand. In a way this turns the SVAR into a recursive VAR. In general the VAR can be written as (from Favero 2001):

\[
A \left( \begin{array}{c} Y_t \\ M_t \end{array} \right) = C(L) \left( \begin{array}{c} Y_{t-1} \\ M_{t-1} \end{array} \right) + B \left( \begin{array}{c} \nu^Y_t \\ \nu^M_t \end{array} \right)
\]

(3.1)

where \( Y \) and \( M \) are vectors for macroeconomic variables. Matrix \( A \) describes the relation between the variables in the current period. \( C(L) \) shows the variables cross-effects and own-effects of lags on the current observation. \( \nu \) is a (unobserved) vector of structural disturbances. The matrix \( B \) allows disturbances to directly affect more than one endogenous variable in the system. However this structural is not directly observable and we need the reduced form of the underlying structural model:

\[
\left( \begin{array}{c} Y_t \\ M_t \end{array} \right) = A^{-1}C(L) \left( \begin{array}{c} Y_{t-1} \\ M_{t-1} \end{array} \right) + \left( \begin{array}{c} u^Y_t \\ u^M_t \end{array} \right)
\]

(3.2)

\( u \) is the (observed) VAR residual vector and is normally independently distributed with full variance-covariance matrix \( \Sigma \). The relation between \( u \) and \( \nu \) is given by:

\[
A \left( \begin{array}{c} u^Y_t \\ u^M_t \end{array} \right) = B \left( \begin{array}{c} \nu^Y_t \\ \nu^M_t \end{array} \right)
\]

(3.3)

\[
u_t = A^{-1}Bu_t
\]

(3.4)

We use this relationship to derive the variance-covariance matrices of \( u \) (observed) and \( \nu \) (unobserved).

\[
E(u_tu'_t) = A^{-1}BE(\nu_t\nu'_t)B'A^{-1}
\]

(3.5)

By substituting the population moments with sample moments we obtain:

\[
\hat{\Sigma} = \hat{A}^{-1}B\hat{B}'\hat{A}^{-1}
\]

(3.6)
Σ contains \( n(n+1)/2 \) different elements, this number of elements is also the maximum number of identifiable parameters in matrices A and B. Therefore for identification to occur the maximum number of parameters in the two matrices is equal to \( n(n+1)/2 \). Another way of putting this is that the number of equations must be greater than or equal the number of unknown in the system. Identification also requires that no equation is a linear combination of any of the other equations in the system (Favero 2001). We need to impose restrictions on matrices A and B to achieve identification. The Cholesky decomposition is a way to do this and the most endogenous variable is ordered last (Favero 2001). In this case government spending is ordered before output. Because we assume that it takes more than one quarter for policymakers to react to changes in output (Ilzetzki et.al 2011) The matrix A shows the possible simultaneous effects between the endogenous variables, the assumption of reaction time for policymakers makes the matrix A look like:

\[
A = \begin{pmatrix}
1 & 0 \\
A_{21} & 1
\end{pmatrix}
\]  

\( (3.7) \)

### 3.1.1 First model with two variables

The objective of this paper is to estimate following system of equations (Caldara and Kamps 2008):

\[
Y_t = \mu_0 + \mu_1 t + \sum_{k=1}^{K} A(L)Y_{t-k} + u_t
\]  

\( (3.8) \)

where \( \mu_0 \) is a constant, \( t \) is a linear time trend (deterministic trend) and \( A(L) \) is a fourth order lag polynomial \( u_t \) is a vector of reduced form residuals. With the assumptions:

\[
E(u_t) = 0
\]  

\( (3.9) \)

The expectation of the disturbance is equal to zero.

\[
E(u_t u_t') = \Sigma_u \text{ where } \Sigma_u = PP'
\]  

\( (3.10) \)

\( P \) is a diagonal matrix and the elements on the main diagonal are equal to the standard deviation of the shock. So \( PP' \) is the variance of the shock.

\[
E(u_t u_t') = 0 \text{ for } s \neq t
\]  

\( (3.11) \)

This assumption implies that there is no covariance between the residuals. \( Y \) is a vector of government expenditure and GDP and it look like this:

\[
Y_t = \begin{pmatrix}
g_t \\
y_t
\end{pmatrix}
\]  

\( (3.12) \)

\[
Y_{t-k} = \begin{pmatrix}
g_{t-k} \\
y_{t-k}
\end{pmatrix}
\]  

\( (3.13) \)

In order to avoid correlated disturbances the reduced form model must be transformed into a structural form model. This is done by multiplying the equation by the \( (k\times k) \) matrix \( A_0 \), this yields the following equation:

\[
A_0 Y_t = A_0 \mu_0 + A_0 \mu_1 t + A_0 A(L)Y_{t-1} + B\epsilon_t
\]  

\( (3.14) \)
where $B_{et} = A_0u_t$ describes the relation between the structural disturbances ($e_t$) and the reduced form disturbances ($u_t$). The structural disturbances are uncorrelated by assumption. The variance-covariance matrix $\Sigma_e = DD'$. $D$ is a diagonal matrix and the elements on the main diagonal are equal to the standard deviation of the shock. So $DD'$ is the variance of the shock. $A_0$ is a matrix showing the cross-effects and own-effects of $k^{th}$ lag on the current observation. To identify the system restrictions must be placed on $A_0$ and $B$. Here restrictions are placed on $B$ to make it a diagonal identity matrix. $A_0$ is restricted to a lower triangular matrix with a unit diagonal. Which implies that the variance-covariance matrix will look like this:

$$
\Sigma_u = A_0^{-1}\Sigma_e(A_0^{-1})' 
$$

(3.15)

The approach used here to identify the system is Cholesky decomposition, $\Sigma_u = PP'$, this means defining a diagonal matrix $D$ that has the same diagonal as $P$ and specify:

$$
A_0^{-1} = PD^{-1} 
$$

(3.16)

$$
\Sigma_e = DD' 
$$

(3.17)

This approach means giving the variables a certain order. Spending is ordered first, and then output. This means that the relationship between the disturbances takes the form:

$$
\begin{pmatrix}
1 & 0 & 0 \\
-a_{yg} & 1 & 0 \\
-a_{VOL,g} & -a_{VOL,y} & 1
\end{pmatrix}
\begin{pmatrix}
\begin{pmatrix} u_{gt}^g \\ u_{yt}^y \\ u_{VOL_t}^VOL
\end{pmatrix}
\end{pmatrix}
= 
\begin{pmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{pmatrix}
\begin{pmatrix}
\begin{pmatrix} e_{gt}^g \\ e_{yt}^y \\ e_{VOL_t}^VOL
\end{pmatrix}
\end{pmatrix}
$$

(3.18)

In this ordering we assume that government spending doesn’t react to shocks to other variables within this period, but output reacts to shocks to spending. It is only in this period that output shocks don’t affect spending, not in previous periods. This is justified by the fact that it takes time for policy makers to react to changes in output.

### 3.1.2 Second model with three variables

In the second model the volatility index is included as a variable to capture the effect uncertainty has on GDP. The assumptions are quite similar compared to the first model. The equation system:

$$
Y_t = \mu_0 + \mu_1 t + \sum_{k=1}^{\infty} A(L)Y_{t-k} + u_t
$$

(3.19)

We have a new variable in the $Y$ vector:

$$
Y_t = \begin{pmatrix} g_t \\ y_t \\ VOL_t \end{pmatrix}
$$

(3.20)

$$
Y_{t-k} = \begin{pmatrix} g_{t-k} \\ y_{t-k} \\ VOL_{t-k} \end{pmatrix}
$$

(3.21)

The assumptions about the reduced form residuals are the same and the Cholesky decomposition will also be the same, but the matrices will look a little different due to the new variable.

$$
\begin{pmatrix}
1 & 0 & 0 \\
-a_{yg} & 1 & 0 \\
-a_{VOL,g} & -a_{VOL,y} & 1
\end{pmatrix}
\begin{pmatrix}
\begin{pmatrix} u_{gt}^g \\ u_{yt}^y \\ u_{VOL_t}^VOL
\end{pmatrix}
\end{pmatrix}
= 
\begin{pmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{pmatrix}
\begin{pmatrix}
\begin{pmatrix} e_{gt}^g \\ e_{yt}^y \\ e_{VOL_t}^VOL
\end{pmatrix}
\end{pmatrix}
$$

(3.22)
By using this order I assume that government spending needs more than one period to react to shocks in output or the Volatility index. I also assume that it that output will be affected by government spending shocks in this period, but not by shocks in the Volatility index. The Volatility index, being ordered last, will be affected by all the shocks to all variables in the model. To improve and check the robustness of the model one could have experimented with different ordering in the SVAR and see if the results differ with different ordering. However this has not been done in this paper.

### 3.2 Model specification

Optimal level of lags is, by using the Akaika and Bayesian information criteria test, found to be four. This is also the same number of lags many other papers like Ilzetzki et.al (2011), Caldara and Kamps (2008) and Blanchard and Perotti (2002) use. Given the level of lags equal to four I have tested for heteroskedasticity using an ARCH Engel test. Heteroskedasticity means that the sample doesn’t have a constant variance, this leads to different probability distributions. The null hypothesis was rejected in only one case, the data for the US without including the Volatility index in the model. I also tested for autocorrelation because autocorrelation can cause standard errors to be underestimated and therefore t-values to be overestimated. Using the Ljung and Box test of autocorrelation between residuals, result was that we can not reject the null hypothesis in any of the cases; there is no autocorrelation between the residuals. I have used MATLAB\(^1\) to estimate the model and the econometrics toolbox to conduct the misspecifications tests.

### 3.3 Limitations of VARs

There are discussions among economists about the usefulness and disadvantages of the VAR-model approach. An advantage using a VAR model is that it can capture co-movements that can’t be detected in univariate and bivariate models. However it can’t capture non-linearities, conditional heteroskedasticity and breaks in parameters (Stock and Watson 2001). SVARs with few variables are often unstable and can therefore be poor predictors. The results of estimation in a SVAR crucially rely on the identifying assumptions used. Small changes can create large changes in the impulse responses. Research has uncovered misspecification in constant parameter VAR-models due to change in policy (Stock and Watson 2001). A weakness in all econometric models is the possibility of omitted variables. This can lead to biased estimates. An estimator is unbiased if, after repeated sampling, the mean of the sample is in fact equal to the true mean of the population. Another way of putting this is that the expected value of an estimator is equal to the mean if the estimator is unbiased. In cases where we have a number of unbiased estimators the most desirable estimator is the one with the lowest variance. The estimator with the lowest variance is called the best unbiased estimator or the most efficient (Kennedy 2009) If a relevant explanatory variable (a variable that has a coefficient that is non-zero) is excluded from the model, we obtain a biased estimator. This is known as omitted-variable bias (Hill et. al 2008). When a variable is omitted it’s influence is expressed through the disturbance term. If the omitted variable then is correlated with the included explanatory variables then the included explanatory variable is correlated with the disturbance term. Including more variables is not necessarily the solution because including irrelevant variables will inflate the variance of your estimates (Hill et. al 2008).

When dealing with a system of simultaneous equations all endogenous variables are correlated with all the disturbance terms in that system (Hamilton 1994). In this case that means that not only does government spending affect GDP, but also spending is influenced by changes in GDP. In a boom government spending should go down because of automatic stabilizers, if tax rates are constant then government revenue should go up and because of the the budget surplus should increase (Alesina et al. 2008). Countercyclical behavior is often found in OECD countries, which all countries in the sample are (Alesina et al. 2008). This behavior creates a simultaneity bias, which leads to inconsistent estimates.

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\(^1\) Code based on source code from Paolo Zagaglia, found at: http://www.mathworks.com/matlabcentral/fileexchange/34358-a-small-structural-var-package-for-impulse-response-analysis
3.4 The challenge of identifying fiscal shocks

The SVAR approach is criticized because most changes in government spending and taxes are anticipated and therefore can give false results when expectations have not been taken account of. Also it can be shown (done by Caldara and Kamps (2011)) that small changes in the assumed elasticities of taxes and government spending can lead to large changes in the estimated multiplier (Ramey 2011). Ramey and Shapiro (1998) show that the VAR approach captures the shock too late and therefore misses the initial decline in consumption and real wages. VAR models which don’t include expectations and may therefore be subject to the Lucas critique (Favero 2001). Among professional economist there is disagreement not only about the size of the fiscal multipliers, but also about the identification of fiscal shocks. This identification problem arises due to two reasons. (i) Government spending could affect output and (ii) output could affect government spending through automatic stabilizers (act to reduce the size of fluctuations in a country’s GDP and/or policy rules.)

Differences in identification approaches and therefore the estimated size of automatic stabilizers can account for the very different results of estimating the effects of fiscal policy using a vector auto regression approach. When Caldara and Kamps (2008) control for differences in identification they yield very similar results. Sign of multiplier can depend on the identification approach that is chosen. Results of the estimation yields the same results for the different identification strategies; GDP rises persistently in response to a government spending shock in a hump-shaped pattern. The results show that the multiplier peaks after 3-4 years. This could be because it takes a little time for the economy to react to the shock. Caldara and Kamps (2008) also discover that the size of the automatic stabilizers is very influential to what result you obtain regardless of the identification approach. Recursive approach and the Blanchard and Perotti approach assume quite small automatic stabilizers compared to the sign restriction approach. In the case where the increase in government spending is deficit financed then taxes remain unchanged. Caldara and Kamps (2008) find that the effects of the recursive and the Blanchard and Perroti approach are quite similar. Output, private consumption and real product wage increases in response to a deficit financed spending shock, while employment remains the same. These results are inconsistent with the standard neoclassical model with non-distortionary taxes.

A buildup of military spending is often anticipated long ahead. Officials usually go through a long process before deciding what kind of weapons they will purchase. So failing to incorporate the anticipation leads to differences in empirical results (Ramey 2009) When Ramey includes world war one the multipliers is estimated close to one. When world war one is excluded the multiplier is estimated to be a little lower, between 0.6 and 0.8. In the neoclassical model it is the value of the government purchases that matters, not the timing. Ramey (2009) argue that if government services are more efficient than private, then an increase in government spending can lead to wealth effects which may alter the life-time budget constraint used in neoclassical models. It is essential to identify when news become known to be able to capture the whole effect. Blanchard and Perotti (2002) found that the response of output to a government spending shock was larger once they took account of the anticipation effects. If consumers foresee changes in government spending then omitting this fact leads to incorrectly identified spending shocks. The VAR is not capturing the timing of news.

3.5 Alternative identification approaches

There are several ways to identify fiscal policy shocks. The following is a summary of the approaches mentioned and some alternative ones.

1. The Sign restriction approach: The number of shocks need not equal the number of variables, and restrict the sign for the impulse responses. Mountford and Uhlig (2005) restrict the sign of the impulse response to identify shocks; they require the impulse response from a government spending shock to be positive for at least 4 quarters after the initial shock. These assumptions are crucial to what result they end up with. Their estimation shows a spending shock only weakly stimulate output and consumption does not rise significantly in response to the shock.

2. Blanchard and Perotti uses institutional information to estimate cyclically adjusted taxes and government expenditures. Then uses this information to estimate the fiscal policy shocks. By studying evidence about how fiscal policy is conducted they find that it takes policymakers more
than one quarter to learn about a GDP shock, decide the reaction and pass this reaction through the system and actually implementing the reaction (Blanchard and Perotti, 2002). This approach yield a multiplier of 0.84 on impact.

3. The event-study approach: Used by Ramey and Shapiro (1998). They try to avoid the identification problem in the structural VAR and only look at episodes that are exogenous to the state of the economy. They argue that military spending buildups to the Korean war, the Vietnam war and Reagan military buildup are exogenous events. Ramey shows that almost all volatility in government spending can be attributed to defense spending. Defense spending is a large part of the variation of government spending around trend and it is very unlikely to interact with private consumption. These shocks are used because they are assumed to be least likely to respond to economic events and therefore are exogenous shocks. Also it is very unlikely that military spending enters the production function or had an effect on private consumption (Ramey 2011). Ramey and Shapiro (1998) focus on shocks where Business Week started to forecast large increases in government spending. These events were unrelated to the state of the U.S. economy. Using this type of identification consumption is lowered, investment is raised the lowered after one quarter and lower real wage in response to an expenditure shock

4. Fisher and Peters (2009) suggests using stock returns to identify government spending shocks. The approach is linked to the Ramey-Shapiro approach because they use the excess returns of company’s that have large contracts with the US military. Stock prices are a leading indicator and can therefore be a good estimate. They assume that disturbances to military spending can be seen as exogenous. If military spending is shocked then the current and future earnings of these firms will change. Forward-looking agents will incorporate this into their valuation of the asset and the returns will be altered. Disadvantages with this approach are that military contractors also sell their goods to the private sector and therefore are vulnerable to changes in the state of the economy. Their estimate for the multiplier after an increase in military spending is 1.5 over 5 years.

3.6 Definitions of the fiscal multiplier

The fiscal multiplier is how much for example one dollar of tax cuts or spending increases affect output/GDP (Alesina and Ardagna, 2009). If a government increases it’s spending of 1 dollar and this causes a 50 cent increase in GDP then the multiplier is 0.5.

There are several ways to measure the multiplier. I will follow Ilzetzki et.al (2011) and use the impact multiplier and the cumulative multiplier.

The impact multiplier:

\[
\frac{\Delta y_0}{\Delta g_0}
\]  

Measures the change in output to change in government expenditure at the impact time. The cumulative multiplier has a longer time perspective. Measuring the impact from time of impulse till a certain horizon.

Cumulative multiplier:

\[
T = \frac{\sum_{t=0}^{T} \Delta y_t}{\sum_{t=0}^{T} \Delta g_0}
\]  

In the calculation of the cumulative multiplier I use a horizon of 24, which is six years.
Chapter 4

Data

4.1 Macro data

The data used in this paper are from the OECD and have been seasonally adjusted. The inputs are quarterly data for GDP and quarterly data for general final government expenditure. The data is in millions of US dollars, at current prices, current purchasing power parity and annual levels. The sample consist of United States, United Kingdom, Japan and Norway and the sample period for the two variable model is from 1980:1-2011:4 and the sample period for three variable model is from 1980:1-2008:4. The countries were chosen because I wanted to compare the largest economies in the world and at the same time thought it would be interesting to include a smaller economy. At the same time access to data was an important criterion for choosing these countries. The baseline model includes GDP and expenditure, while the second model in addition also includes an index for market volatility explained below. I experimented with different treatments of the data, but ended up taking the natural logarithm following Caldara and Kamps (2008) and Perotti (2007). I did this with all the observations for GDP, expenditure and Volatility index. Government expenditure in the US has overall increased during the entire sample period, except for a fall in 2007:4 till 2008:2, when it started to increase again (see figure A.1 in the appendix). GDP also has a positive trend, and a sharp fall at the end of 2007 and started growing again at the end of 2009 (figure A.2 in the appendix). Government expenditure in the UK (figure A.5 in the appendix), on the other hand, is a little more volatile, but still has a positive trend. The same goes for GDP, but here we have a sharp fall in at the end of 2007 and till the end of 2008 (figure A.4 in appendix). Japan’s government expenditure has a positive trend, almost like a straight line (figure A.8 in appendix). Data for GDP for Japan has a more interesting shape; it increases until the beginning of the 1990s where it flattens out until 2007 where it starts to fall (figure A.7 in appendix). Government expenditure in Norway has a positive trend the entire sample period, displayed in figure A.11 in the appendix. There are some sharp falls in GDP at 2000-2001 and at the end of 2008 till the 2009 (figure A.10 in appendix). I used MATLAB to estimate the model and the econometrics toolbox to conduct the misspecifications tests.

4.2 Volatility index

The volatility index (displayed in figure 4.1) used to measure uncertainty is obtained from Bloom (2009), he shows that measured uncertainty is highly correlated with time-series stock market volatility (Bloom 2009). He further justifies this by showing that stock-market volatility is strongly linked to other measures of uncertainty. The series is based on the Chicago Board of Options Exchange Vix index of percentage implied volatility. As the Vx index was unavailable before 1986 this part of the series is based on the monthly standard deviation of the daily S&P500 index. After 1986 it is based on a hypothetical at the money S&P100 option 30 before expiration (Bloom 2009).

\[\text{www.oecd.org}\]
Figure 4.1: Volatile index 1962-2008, constructed data 1962-86. The index spikes at major events like wars, Black Monday in 1987, 9/11 in 2001 and the credit crunch in 2008.
Chapter 5

Results and discussion of SVAR

The next section will present the results of the estimation and some country specific traits that might explain the results. I compare the traits with research done by others to try and explain the size of the multiplier. The economic data used here is taken from the IMF World Economic Outlook Database (updated April 2012) and the OECD database accessible from the organizations’ homepage.

The upper and lower impulse responses in the figures are confidence bands estimated at a 95% confidence level using 2500 Monte Carlo simulations. The red line is the point estimates for the impulse response, while the blue line is the median of the impulse response distribution (these are for the most part on top of each other and hard to tell apart). The impulse response shows a one percent increase in one of the VAR errors. The error term returns to zero and stays there for all the subsequent periods. All the other error terms are equal to zero. The figures show what effect a shock from a given variable has on the variable in question. The axes on the figures are divided into quarters. On the y axis we see the effect of a one percent increase increase in the expenditure error term on a given variable. The horizon for the impulse responses are 40 quarters.

The model is stable and the effect of the shocks die out in all cases except maybe the three variable model in Japan where it takes a long time for the effect of the shock to die out. EXP is government expenditure, GDP is gross domestic product and VOL is the market volatility index measuring uncertainty.

5.1 United States

Model with two variables

After expenditure is hit by a shock (see figure 5.1), equal to a one percent increase in expenditure, the growth rate initially starts to increase an reaches its peak 1.2 in quarter three. Before falling and eventually turning back to the initial growth rate. The confidence bands in the figure are quite wide especially after the first year, which makes the estimates more uncertain. This is also reflected in the fact that the estiamtes are significantly different from zero, at a 95% significance level, the first 12 quarters, but not after.

As seen in figure 5.2 the impact effect of a government expenditure shock on GDP is positive at 0.13, however after quarter three the effect of the government spending shock on GDP turns negative and continuous to be negative through out the impulse response horizon which leads to a negative cummulative multiplier of -0.52. Unfortunately this effect is not significantly different from zero, at a 95% significance level, in any of the quarters estimated.

Model with three variables

As the effect of a expenditure shock on expenditure is very similar to the two variable model I have not included it here, but it can be found in the appendix figure A3. On impact the effect of an expenditure shock on GDP is lower than the two variable case 0.084, and it turns negative already in the second
CHAPTER 5. RESULTS AND DISCUSSION OF SVAR

Figure 5.1: The effect of a one percent increase in government expenditure on expenditure, the United States.

Figure 5.2: The effect of a one percent increase in government expenditure on GDP, the United States

quarter (see figure 5.3). The cumulative multiplier is less negative than in the two variable model, at -0.24, which implies that uncertainty has a negative bias on the estimated effect of government spending on GDP, which makes the multiplier in the two model case underestimated. This estimate like in the two variable model is not significantly different from zero in any of the quarters estimated.

When looking at figure 5.4 we see that a one percent increase government spending has a positive effect on the volatility index of 0.7 on impact. This effect is also positive over time at 0.11. This effect is significantly different from zero, at a 95% significance level, in quarters 3-6, but not in any of the other quarters estimated.

Blanchard and Perotti (2002) uses the same identification approach and estimate a multiplier of 0.84 (on impact) for the US economy, which is a lot higher than the estimate obtained in this paper, however they do also include taxes in their model which may be a reason for the different multipliers. Their sample period is also different, it ranges from 1947:1 till 1997:4. Perotti (2002) on the other hand obtain
lower estimates for the multiplier, with an impact multiplier of 0.07 and which peaks at 0.49 in quarter 3 for estimates from 1980 till 2000.

The residuals in the two-variable model have given sign of heteroskedasticity which means that the residuals don’t have a constant variance. This could lead to false estimates of the multiplier. This does not occur in the three variable model when the volatility index is included.
CHAPTER 5. RESULTS AND DISCUSSION OF SVAR

5.2 United Kingdom

Model with two variables

After expenditure is hit by a one percent shock to expenditure (see figure 5.5) the growth rate initially starts to fall, before increasing reaching its peak at 1.02 in quarter 4. Eventually the growth rate goes back to the same level as before the shock hit. This effect is significantly different from zero, at a 95% significance level, from quarter 1 till quarter 18.

![Figure 5.5: The effect of a one percent increase in government expenditure on expenditure, the United Kingdom](image)

On impact the effect of a government expenditure shock on GDP (figure 5.6) for the UK is slightly negative at -0.063. The growth rate fall further in quarters two and three before slowly increasing and stabilizing, the cumulative multiplier is negative 0.18. This effect is not significantly different from zero, at a 95% significance level, which is not surprising looking at the confidence bands and seeing that zero is within the confidence bands for almost the entire impulse response.

Model with three variables

Including the volatility index in the model yields very similar results for the effect of a government expenditure shock on expenditure so this figure is in the appendix (figure A6). Figure 5.7 displaying the effect of a government spending shock on GDP is also quite similar, but the estimate for the multiplier a little different. On impact the effect is -0.08 and cumulatively it is negative 0.23. This means that including the volatility index yields and even lower multiplier and gives evidence that uncertainty has a positive bias on the effect of a government spending shock on GDP which leads to an overestimation of the multiplier. Like in the US this effect is not significantly different from zero, at a 95% significance level, in the three variable model either.

The impact effect of an government expenditure shock on the volatility index, shown in figure 5.8, is 0.73 and the effect over the entire impulse response horizon is very close to zero, but slightly positive at 0.004. This estimate is significantly different from zero in the first quarter, but not after.
5.3 Japan

Model with two variables

Expenditure starts falling immediately after the shock occurs and the overall effect is positive for the entire impulse response horizon, this is shown in figure 5.9. This effect is significantly different from zero until the tenth quarter at a 95% significance level.

On impact the effect of a government expenditure shock on GDP (see figure 5.10) is positive at 0.188. GDP grows quite rapidly reaching its peak at 0.53 before stabilizing and slowly falling. The cumulative multiplier is also positive at 1.3. This effect is significantly different from zero, at a 95% significance level, after quarter 2 and throughout the impulse response horizon.
CHAPTER 5. RESULTS AND DISCUSSION OF SVAR

Figure 5.8: The effect of a one percent increase in government expenditure on volatility, the United Kingdom

Figure 5.9: The effect of a one percent increase in government expenditure on expenditure, Japan

Model with three variables

The figure displaying the effect of an expenditure shock on expenditure is available in the appendix (see figure A9). The effect of a government spending shock on GDP is on impact positive at 0.22, this is displayed in figure 5.11. GDP initially starts falling before growing fast, which leads to a large positive cumulative multiplier of 1.8. This implies, like the case of the US, that uncertainty has a negative bias on the estimated effect of government spending on GDP, which makes the multiplier in the two variable model case underestimated. This effect is significantly different from zero, at a 95% significance level, from the tenth quarter and throughout the impulse response horizon. This is also the most unstable impulse response estimated, as this is the estimate displaying the least transitory behavior.

The effect of a government spending shock on the volatility is initially negative at -0.35, but makes a sharp hike to 1.196 in quarter 12 before slowly returning to its initial value (see figure 5.12). The effect
over the whole impulse response horizon is 0.9. This effect is significantly different from zero, at a 95% significance level, in quarter 3 and quarters 9-17.

5.4 Norway

Model with two variables

After expenditure is hit by a shock equal to a one percent increase in expenditure it immediately starts falling and after year three it turns negative before returning to it’s initial value (figure 5.13). This effect is only significantly different from zero, at a 95% significance level, in the first 4 quarters.

On impact the effect of a government spending shock has a small and negative effect at GDP of -0.047, this is shown in figure 5.14. GDP falls until year 2 when it starts to grow again before returning to its
CHAPTER 5. RESULTS AND DISCUSSION OF SVAR

Figure 5.12: The effect of a one percent increase in government expenditure on volatility, Japan.

Figure 5.13: The effect of a one percent increase in government expenditure on expenditure, Norway

initial value. The cumulative multiplier is -1.22. Unfortunately this effect is not significantly different from zero, at a 95% significance level, in any parts of the impulse response.

Model with three variables

The shape of the impulse response when uncertainty is included in the model is very similar, therefore the figure A12 displaying the effect of an expenditure shock on expenditure can be found in the appendix. On impact the effect of a government spending shock on GDP (figure 5.15) is negative at -0.05, which is slightly more negative than in the two variable model. Cumulatively it is also more negative at -1.3. This means that uncertainty has a positive bias on the effect a government spending shock has on GDP, which makes the multiplier overestimated. Like in the case of the US and the UK, this effect is not significantly different from zero, at a 95% significance level, in the three variable model either.
Initially the effect of a government spending shock on the volatility index is positive, but after impact it fall sharply before slowly increasing to its initial value. This is shown in figure 5.16. Unfortunately this effect is not significantly different from zero, at a 95% significance level.
5.5 The effect of uncertainty on GDP

The findings for the US and Japan point to a downward omitted variable bias. A possible explanation to this could be a negative effect of the volatility index on GDP and the positive correlation between the expenditure shock and the volatility index. It’s hard to see the effect of a volatility shock on GDP, because the index is a lot more volatile than government expenditure and GDP, so that a 1% shock to the variable is not a whole lot. Therefore I increase the volatility shock to a 10% increase in the variable.

USA

As seen in figure 5.17 the impact multiplier is zero, which is not surprising since the identification approach assumes that GDP doesn’t react to a change in volatility the first quarter. The cumulative multiplier is -0.09. For the US I estimate a positive correlation between expenditure and uncertainty at 0.4. This shows that we have a negative bias due to uncertainty on the effect a government spending shock has on GDP. This effect is significantly different from zero, at a 95% significance level, in quarter 2, but not in the other quarters estimated.
UK

The cumulative multiplier of an uncertainty shock on GDP is 0.108 for the UK, this is displayed in figure 5.18. This effect is significantly different from zero, at a 95% significance level, from quarter 11 till the end of the impulse response horizon at quarter 40. The correlation between expenditure and the volatility index is given by -0.163. This implies that uncertainty has a negative bias on the effect a government spending shock has on GDP.

Japan

Also in the case of Japan I estimate a positive effect of a uncertainty shock on GDP, the cumulative multiplier is 0.11 (see figure 5.19).

The correlation between government expenditure and uncertainty is negative and estimated to be -0.157. This means that also in this case does uncertainty have a negative bias on the effect a government spending shock has on GDP. However it can not be shown that this effect is not significantly different from zero and therefore this estimate is uncertain.
Norway

The effect an uncertainty shock has on GDP in Norway is negative over the whole impulse response horizon, at -0.46 (see figure 5.20). This effect is not significantly different from zero, at a 95% significance level.

The correlation between government expenditure and the volatility index is -0.134, which means that an uncertainty shock actually has a positive bias on the effect a government spending shock has on GDP. This is the only case I obtain a positive bias due to uncertainty, although this might not be because the volatility index is very influential in Norway. The volatility index and the Norwegian economy are both very affected by the oil price. A shock to the volatility could mean a higher oil price and a higher oil price is good news for the Norwegian economy, which is a large oil exporter.

5.6 Limitations of the model

There are many issues that have not been taken account of in the preliminary analysis, one if these issues is the anticipation of the shocks, which could cause problems if consumers know about a change in fiscal policy and alter their behavior today and not when the policy actually is implemented. Blanchard and Perotti (2002) and Ramey (2009), as mentioned earlier, both show how timing can alter the estimates of the multiplier and behavior that might be taken to be shocks might be alteration of behavior to announced changes in policy. The composition, length and how changes in fiscal policy are financed has not been taken account of in the model and this could lead to different results for the multiplier. I have only looked at the overall effect, not how a shock affects consumption or investment specifically. Also I could also have taken the persistence of the shocks into account because Baxter and King (1993) estimates different multipliers based on the persistence of the shock. They estimate a multiplier on impact, when the spending increase is permanent, to be 0.86. While for a temporary increase it is 0.56.

The sample used in this paper is quite short and maybe could the model be improved by using a longer sample. At the same time Perotti (2002) shows that the effects of fiscal policy on GDP have become weaker over the last 20 years. He finds that after 1980 multipliers are usually negative. He argues this might be caused by the fact that more economies are open, shocks are less persistent and monetary authorities are less responsive to changes in fiscal policy. Bilbiie et. al (2008) also reach similar results.

As shown omitting uncertainty in the model leads to biased estimates, this being said there might be other variables that should have been included in the model which might have been omitted and leads to biased estimates. Favero and Giavazzi (2007) show that omitting debt feedback can result in wrong estimates of dynamic effects of fiscal shocks. Blanchard and Perotti (2002) also take taxes into account in their model, this has not been done in this paper. The possibility of simultaneity bias, that GDP
affects expenditure, will also lead to biased estimates of the multiplier. Inflation and interest rate are other variables that might be worth considering including in the model.

5.7 Discussion

The results obtained in this paper differs are inconclusive in supporting one or the other of the theories presented earlier in this paper. The multipliers are small and sometimes even negative, which is more in line with the neoclassical view than the Keynesian. For the UK and Norway the multipliers are negative on impact and cumulatively. While for the US I estimate a small positive impact multiplier, but positive while it over time becomes slightly negative. With positive impact and cumulative multipliers Japan is the case with slight evidence of the Keynesian view, still the multipliers are small compared to estimations in other papers. The theoretical models include a lot of rather unrealistic assumptions. The neoclassical model assumes lump-sum taxes, but the Ricardian equivalence result fails when taxes are distortionary. New Keynesian model assumes that what is demanded in the economy will be produced and that supply is infinitely elastic.

Woodford (2010) shows the important role monetary policy plays when determining the fiscal multiplier. He uses a new Keynesian model and finds that countries with a strict inflation target have a multiplier equal to the neoclassical multiplier that is a multiplier lower than one. This is because monetary policy is used actively to prevent the increase in inflation following a fiscal expansion. Both Norway’s and the UK’s central banks have inflation targets, of 2.5% and 2%, although not as strict as Woodford uses in his theoretical paper, still this can account for the low multiplier.

A country using the Taylor rule to determine the interest rate, which many central banks use at least as a reference (Norway does this) when setting the interest rate, monetary policy reacts less to changes in fiscal policy. The multiplier is higher since inflation is allowed to rise a little in response to fiscal stimulus before the central bank reacts. If the central bank reacts extremely strong to either changes in inflation or the output gap then the multiplier will be like in the strict inflation target case (Woodford 2010). If a country uses a Taylor rule where the central bank responds to output above or below trend then monetary policy reacts stronger and the multiplier is even lower than in the neoclassical case. This is because the sticky prices makes the real interest rate rise more than under flexible prices (Woodford 2010).

So Woodford concludes that large fiscal multipliers only occur in new Keynesian models where monetary policy is accommodating and the central bank can handle an increase in inflation without moving the interest rate. This is the case when the interest-rate is constrained by the zero lower bound. Japan is an interesting example to look at in this context. The country has had deflation since 1995 and the real interest rate has been higher than the nominal interest rate. Long-term interest rates have steadily fallen and average at 2.66, which is very low compared to the other countries in the sample. A low interest rate could lead to a higher multiplier. Christiano et. al (2009) find that the fiscal policy has greater effect when the interest rate is low, in fact they estimate that the multiplier can exceed 2.

The US is the largest economy in the world. The country endured a recession at the beginning of the sample period that lasted till 1982. Reagan who was president at the time cut taxes and increased military spending, as a consequence the deficit increased. This started fears of growing inflation, but Chairmen of the Federal Reserve, Volcker and later Greenspan, acted by adjusting the interest rate. In the 1990’s the economy turned increasingly healthy and both interest rates and inflation were low. Iizetki et.al (2011) discover that countries with flexible exchange rate has multipliers close to zero while countries with fixed exchange rates have a non-zero multiplier, but this is due to a more active use of monetary policy to offset effects of fiscal policy shocks and therefore more like evidence that the response of the central bank to fiscal shocks is very important when determining the multiplier, consistent with Woodford (2010) and Christiano et. al (2009).

The UK experienced rather high GDP growth in the first part of the sample and it peaked in 1988 at 5%. Margaret Thatcher was prime minister and her policy was hard on inflation and the public sector. Growth started to decline in the 1990’s and for the last part of the sample period growth varied between 1.6%-3%. The public sector in the UK is quite large, government expenditure as a percentage of GDP averages at 40.9% over the whole sample period. A large public sector can limit economic growth because this usually implies a high tax rate which can discourage saving and investment (Gray et.al 2007). Savings rates in the UK are positive except for the period 2004-2008. Although it is positive on
average it is quite low compared to the other countries in the sample at 2.4. The estimated multiplier for the UK is small and negative, this contradicts the fact that low saving and therefore a high number of rule of thumb consumers should lead to higher multipliers.

Japan had an amazing economic performance after world war two, and up until 1974 the growth rate averaged at 7.4% and after that it averaged at 4% until the 1990s when growth dropped till under 1%. This is known as the Japanese slump (Blanchard 2009). Fiscal policy was used extensively to stimulate aggregate demand and this raised the country’s debt. Japan has high debt, total central government debt as percentage of GDP has averaged at 88% in the sample period. This is the highest debt level of the countries in the sample. This could explain the low multiplier. Iyetzki et.al (2011) find that when debt is higher than 60% of GDP, the multiplier becomes zero or even negative.

Norway has natural resources like oil and gas. In many resources economies the policymakers can be tempted to run expansionary fiscal policy and extract more of the natural resource. This policy might alter the expectation of the future tax burden and lead to more precautionary saving (Thøgersen 1997). If Norwegian consumers expect the oil resource to be used up and that taxes will be increased in the future in response to a tax cut or increased government spending, this could explain the negative multiplier related to a fiscal expansion. Household savings rates have averaged at 3.78 and are mostly positive except for a sharp fall 1985-1988. This savings rate is lower than the US and in Japan. Carroll (1992) argues that high unemployment and therefore high uncertainty about future labour income leads to higher savings. Unemployment in Norway has averaged at 3.7 in the sample period, this is quite low and I would not expect precautionary saving to be the reason for the low multiplier. An explanation could be the openness of the Norwegian economy, Perotti (2002) shows that the effects of fiscal policy on GDP have become weaker over the last 20 years and he argues that this partly due to more open economies. The largest multiplier estimated in this paper is found in Japan. The savings rate in Japan average at 6.2 over the whole sample period, which is quite high compared to the other countries in the sample. Uncertainty about the economic situation in the sample period could explain this.

In this paper the omission of uncertainty led to negatively biased estimates for the multiplier in Japan, the UK and the US. I used the identification approach used by Blanchard and Perotti (2002). The identification approach used by Ramey and Shapiro (1998) estimates lower multipliers than Blanchard and Perotti (2002) but one might argue that during war uncertainty is probably also high. As far as I know they have not taken account of uncertainty in their model and this might be one of the causes for the lower multiplier. This would be consistent with my findings for Japan, the United States and United Kingdom, but not for Norway. Even though I obtain a negative bias for Japan, the US and the UK it is important to note that the effect of government expenditure is small also when uncertainty is controlled for.
This paper has studied the effects of fiscal policy and uncertainty using VAR-model. The starting point was the great disagreement about the size of the fiscal multiplier and effects of government spending shocks on the economy. A challenge in this type of analysis is the identification of the shocks; different identification approaches can yield very different results. I have used the Cholesky decomposition and assumed that it takes more than one quarter for policymakers to react to changes in output. In this paper I have estimated the effect of government spending on GDP in a baseline case with only GDP and expenditure, and another case where I have included the a volatility index too try and see if including uncertainty in the model leads to different results. I have done this for the United States, United Kingdom, Japan and Norway.

For the US I obtain a positive multiplier on impact and a negative cumulative multiplier for both models. In this case the multiplier is less negative when the volatility index measuring uncertainty is included in the model, which implies a that uncertainty has a negative bias on the effect a expenditure shock has on GDP. For the data from the United Kingdom I estimate a negative multiplier both on impact and cumulatively for both the models. However the multiplier is more negative when uncertainty is included in the model, by looking at the correlation between the volatility index and government expenditure I find a slightly negative correlation which means that uncertainty has a negative bias on the effect a expenditure shock has on GDP.

In the case of Japan I estimate a positive multiplier in both of the models on impact and for the longer horizon. The multiplier is larger when uncertainty is included in the model, which implies that uncertainty has a negative bias on the effect a expenditure shock has on GDP.

Norway is the only case where I find that uncertainty has a positive bias on the effect a expenditure shock has on GDP, but the multipliers are negative in both the models.

The results of the estimation show that uncertainty does lead to biased estimates. In the case of Norway I obtain an overvaluation of the multiplier due to uncertainty. But this is most likely because the measurement used to measure uncertainty is like the Norwegian economy correlated with the price of oil, which will be positive for the Norwegian economy, but more of a disadvantage to the other countries in the sample.

The results in this paper show that uncertainty has, although small, a negative bias on the estimated effect of government spending shock on GDP in the US, the UK and Japan. This makes it likely to assume that higher uncertainty affects GDP negatively, and that volatility is positively correlated with government spending. So by including the uncertainty variable in the model I obtain a higher estimate of the effect of an expenditure shock on GDP. However it is important to note that the effect of a government expenditure shock on GDP is small even when uncertainty is controlled for.
Bibliography


Appendix A

Figures

A.1 USA

Figure A.1: Figure displays quarterly data for GDP in the US from 1980 till 2011.
Figure A.2: Figure displays quarterly data for government expenditure in the US from 1980 till 2011.

Figure A.3: The effect of a one percent increase in government expenditure on expenditure, the United States.
A.2 UK

Figure A.4: Figure displays quarterly data for GDP in the UK from 1980 till 2011.

Figure A.5: Figure displays quarterly data for government expenditure in the UK from 1980 till 2011.
Figure A.6: The effect of a one percent increase in government expenditure on expenditure, the United Kingdom.

A.3 Japan

Figure A.7: Figure displays quarterly data for GDP in Japan from 1980 till 2011.
Figure A.8: Figure displays quarterly data for government expenditure in Japan from 1980 till 2011.

Figure A.9: The effect of a one percent increase in government expenditure on expenditure, Japan.
A.4 Norway

Figure A.10: Figure displays quarterly data for GDP in Norway from 1980 till 2011.

Figure A.11: Figure displays quarterly data for government expenditure in Norway from 1980 till 2011.
Figure A.12: The effect of a one percent increase in government expenditure on expenditure, Norway.