
Macroeconomic Effects of Fiscal Policy

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1. INTRODUCTION AND SUMMARY

Fiscal policy plays a key role in economic stabilisation policy – not least in Denmark where monetary policy cannot be used to stabilise the economy due to the fixed exchange rate policy. Therefore, it is important to understand the impact of fiscal policy on the economy. Within the academic literature, there is substantial disagreement on which, and especially how large an impact can be achieved through fiscal stimulus. The purpose of this article is to shed light, on an empirical basis, on the effects that can be expected from changes in government spending in Denmark. To that end, we provide an overview of existing empirical studies of fiscal policy, as well as a new empirical analysis of the impact of fiscal policy in Denmark.²

In response to the financial crisis, central banks across the world have lowered interest rates almost to zero. The possibilities of providing economic stimulus through the traditional interest rate channel have therefore been exhausted.³ At the same time, policymakers have turned to fiscal policy, which has been eased substantially in a number of countries. The significant easing of fiscal policy, in combination with the disagreement among economists about the impact of this easing, has led to a sometimes heated debate. A case in point is the USA, which adopted the *American Recovery and Reinvestment Act* in February 2009, introducing massive fiscal easing in the midst of the financial crisis and shortly after President Barack Obama took office. The calculations behind the fiscal stimulus were based on the assumption of a fiscal multiplier of 1.6, cf. Romer and Bernstein (2009). This means that a one-dollar increase in government spending leads to a rise in real gross do-

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² It should be emphasised that the focus of the article is on temporary, cyclical changes in fiscal policy, such as a temporary increase in public purchases of goods and services, and not on long-term structural reforms aimed at ensuring fiscal sustainability.

³ Since then, a number of central banks have introduced quantitative easing to supplement low interest rates, as described e.g. by Blomquist et al. (2011).

mestic product, GDP, of 1.6 dollars. This assumption has been challenged as being overly optimistic. It has been stated that there is no theoretical or empirical justification for a fiscal multiplier of this magnitude in the USA, cf. e.g. Barro (2009) and Cogan et al. (2010).

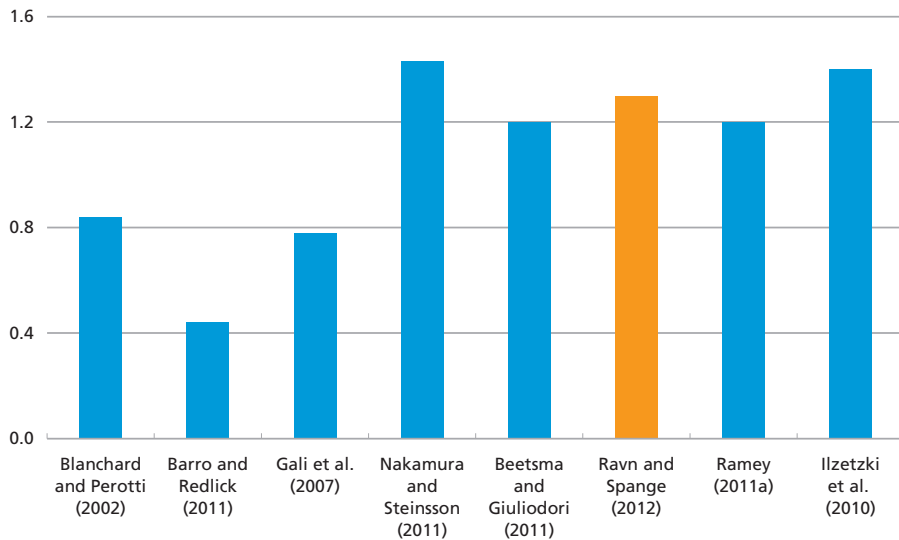
This debate has rekindled interest in new, empirical analyses of the effects of fiscal policy. These consist of direct effects, e.g. that an increase in public purchases of goods and services is reflected in higher employment in the firms supplying goods and services to the public sector, as well as more indirect effects. Indirect effects include e.g. that new employees receive higher income and are able to increase their consumption, and also changes in e.g. the consumption and savings behaviour of households and firms. Therefore, the aggregate economic effects of fiscal policy can be determined only through an economic model and all models are based on assumptions about economic relationships, which can be debated.

Consequently, it is useful to subject the economic effects of fiscal policy to analysis within various model frameworks, and a large number of empirical studies have been presented over the last few years. One focus area has been to examine the effects of fiscal policy under various economic circumstances, e.g. under different exchange rate regimes, during booms and recessions, or during periods of very low interest rates. Others have sought to compare the findings from different, econometric methods. Between them, the studies have helped to shed light on the background of the sometimes conflicting findings in the literature, which have been one of the reasons for the heated disagreement among economists about the effects of fiscal policy. It has become clear, in particular, that there is no unconditional fiscal multiplier, cf. e.g. Favero et al. (2011) and Parker (2011). Rather, the multiplier varies over time and place, depending on a number of economic conditions. The design of the specific fiscal stimulus package and, not least, its financing also influence the effect. For instance, the effect of fiscal policy depends on whether changes are made to the revenue or expenditure side; moreover, changes to different types of government expenditure may have different effects. This underlines the importance of examining the effect of fiscal policy in Denmark in a country-specific study, cf. section 5, rather than simply applying the results from other countries to a Danish context.

A number of recent, international studies have drawn on the significant body of analysis in this area to define what may be considered a kind of confidence interval for the fiscal multiplier. For example, Hall (2009) sums up that, under normal economic conditions, the multiplier of government spending is typically estimated to range between 0.7 and 1 for the USA.

FISCAL MULTIPLIERS IN SELECTED EMPIRICAL STUDIES

Chart 1.1



Note: The Chart summarises the main findings of the respective studies, which should be compared with caution. All of the multipliers shown relate to government spending. The multipliers in the two columns on the right (Ilzetzki et al., 2010 and Ramey, 2011a) show the *cumulative* multiplier, i.e. the cumulative increase in GDP relative to the cumulative increase in government spending over a number of years. The effects from the other studies show the multiplier during the period in which fiscal policy is changed. In the study by Ravn and Spange (2012), the impact multiplier and the cumulative multiplier are identical.

Ramey (2011b) specifies an interval between 0.8 and 1.5.¹ Recent studies indicate that the multiplier in a small open economy with a credible fixed exchange rate, such as Denmark, is typically at the high end of this interval. Some degree of uncertainty is attached to this conclusion, however, as the results in the literature for countries with fixed exchange rate regimes are typically based on information on a number of economies, some of which are not very similar to the Danish economy. Chart 1.1 compares the multiplier from some of the more prominent studies of the effects of fiscal policy in different countries. The Chart illustrates the considerable range of multiplier values in the literature. This may be attributed both to disagreement as to the effect of fiscal policy and to differences in the countries' economic structures.

This article also presents new, empirical results of the effect of fiscal policy in Denmark. The details of this study are outlined in a working paper by Ravn and Spange (2012). The main conclusion of this analysis is that unanticipated short-term changes in fiscal policy may have relatively large, but rather short-lived effects in Denmark. More specifically, the fiscal multiplier of government spending is estimated to be around

¹ In a meta study comparing the effects of a number of studies, Rusnak (2011) finds a multiplier of around 0.6. This study, however, does not include the findings of a number of recent contributions focusing specifically on the effect on small open economies with fixed exchange rates.

1.3, as illustrated in Chart 1.1. But the expansionary effect quickly dies out – much faster than in studies for other countries. Already after one year, the fiscal multiplier is no longer significantly greater than zero. Thus the effect on GDP of fiscal expansion gradually dies out as the stimulus itself is removed. This would indicate that the dynamic effects of changes in government spending are moderate in Denmark. In other words, the impact on economic activity of a fiscal stimulus package is largely equivalent to the direct effect of that package.

The very short-lived effect places high demands on the fiscal policy process and the *timing* of fiscal stimulus, which is often subject to some time lag, cf. e.g. Friedman (1962). First, the need for fiscal stimulus is to be identified, then the stimulus is to be designed and passed through the legislative procedure, and finally the effect of the fiscal stimulus is to kick in. In other words, measuring out fiscal stimulus so as to have the effect kick in at the desired time may be difficult. Hence, in practice, short-term discretionary fiscal policy is not a very suitable instrument for detailed fine-tuning of business cycle fluctuations in Denmark. Instead, fiscal policy should be designed with a stability-oriented objective over the medium term, so as to avoid both periods of overheating and periods of high unemployment. This ensures that there is room for the automatic stabilisers to work and thus contribute to ironing out short-term cyclical fluctuations.¹

The analysis also demonstrates that the effects of fiscal policy have increased in Denmark during recent decades relative to the 1970s and the 1980s, presumably because Denmark now pursues a credible fixed exchange rate policy. Previously, there was a risk that fiscal stimulus would result in a lack of confidence in the sustainability of public finances with an ensuing risk of rising interest rates. With a credible fixed exchange rate policy and sustainable public finances, this risk has been reduced. This improves the scope for fiscal policy to achieve the desired impact on the real economy.

Against this backdrop, it may be concluded that fiscal policy in Denmark may have significant impact. Since the implementation of fiscal stimulus measures is a time-consuming process, the short-lived effect entails, however, that actual fine-tuning of the economy through fiscal policy is hardly possible in practice. Instead, fiscal policy should be pursued with a medium-term objective. Moreover, expansionary fiscal policy during an economic crisis must be accompanied by willingness to tighten fiscal policy during good times, so as to conduct fiscal policy in a sym-

¹ Automatic stabilisers reflect that the tax revenue automatically increases when GDP rises because the tax base expands or that expenditure for unemployment benefits is lower during a boom, since unemployment is relatively low.

metric way. This ensures long-term fiscal sustainability, which is necessary to maintain the credibility of the Danish economy.

2. EMPIRICAL STUDIES OF FISCAL POLICY

This section includes an overview of recent empirical literature on the economic effects of fiscal policy.¹ Such studies are usually conducted within the framework of a vector autoregressive (VAR) model. VAR models are particularly useful for studying the dynamic relationships between several inter-dependent macroeconomic variables, for example between government revenue and expenditure, GDP, spending and investment. However, to perform a *ceteris paribus* calculation of the effects of fiscal stimulus, it is necessary to identify the underlying, discretionary fiscal policy changes, also known as structural fiscal shocks. This is typically achieved by imposing theoretically-based (i.e. structural) restrictions on the VAR model.

The most widely used structural VAR (SVAR) model for fiscal policy analysis was developed by Blanchard and Perotti (2002). The model builds on the assumption that it takes time for fiscal policymakers to change fiscal policy in response to changes in the economic environment. First, the need for fiscal stimulus is to be identified, then the stimulus is to be adopted through the legislative process, and finally it is to be implemented in practice. Blanchard and Perotti assume that altogether this process takes more than one quarter to complete. This does not mean that fiscal policy cannot change within a quarter. This is the case e.g. if various components of government spending grow faster than planned. Blanchard and Perotti only assume that the component of fiscal policy that is directly attributable to changes in the economic environment cannot be changed within a quarter, allowing for automatic stabilisers, however. The size of these can be calculated separately, cf. Olesen and Winther (2009). It is then possible to isolate the so-called discretionary fiscal policy changes and estimate their impact, cf. Box 2.1 for an outline of the technical aspects.²

Blanchard and Perotti (2002) use the method to study the effects of fiscal policy in the USA during the period 1960-97. They find substantial and statistically significant effects of fiscal stimulus. For government spending, the fiscal multiplier is around 0.8-0.9 during the first quarter

¹ The reader is referred to survey articles by Coenen et al. (2011) and Hebous (2011).

² When applying this method, it is key to base the analysis on quarterly data, as the discretionary component of fiscal policy can be changed e.g. in connection with the annual Finance Act negotiations, entailing that the underlying assumption is hardly met with annual data. However, recent studies indicate that the method may also provide a true and fair view based on annual data, see e.g. Born and Müller (2012).

TECHNICAL ASPECTS OF BLANCHARD AND PEROTTI (2002)

Box 2.1

Blanchard and Perotti (2002) construct and estimate the following VAR model:

$$Y_t = \sum_{i=1}^p A_i Y_{t-i} + U_t \quad (1)$$

Y_t is a vector containing the three variables: $Y_t = [T_t, G_t, X_t]'$. T_t is a measure of taxes net of transfers, G_t denotes government spending, and X_t denotes GDP. The matrices A_i are coefficient matrices obtained from the regression. A VAR model such as this assumes a linear relationship between the variables, and the coefficients are assumed to be constant. $U_t = [t_t, g_t, x_t]'$ contains the residuals of the regression of Y_t against its own lagged values p quarters back, where Blanchard and Perotti set $p = 4$.

To calculate the effect of a shock to fiscal policy, it is necessary to identify the structural shocks in the model. These shocks can be denoted by $\varepsilon_t = [e_t^t, e_t^g, e_t^x]'$. Blanchard and Perotti construct the following structural system of equations, relating the structural shocks to the residuals U_t :

$$t_t = a_1 x_t + a_2 e_t^g + e_t^t, \quad (2)$$

$$g_t = b_1 x_t + b_2 e_t^t + e_t^g, \quad (3)$$

$$x_t = c_1 t_t + c_2 g_t + e_t^x. \quad (4)$$

Equation (2) implies that unexpected, observed changes in net tax revenues within a quarter may be caused by movements in GDP, structural shocks to government spending or underlying structural changes in tax revenues. According to equation (3), the same applies to unexpected changes in government spending. Finally, equation (4) states that unexpected changes in GDP within a quarter may be caused by unexpected movements in taxes or in government spending or structural shocks to GDP. Examples of the latter could be technological advances or reforms to increase the labour supply.

The model is based on the assumption that policymakers cannot change government spending or taxes in response to economic events within the quarter in which the event occurs. More specifically, this entails that the parameters a_i and b_i , denoting how net tax revenues and government spending change in response to GDP changes, reflect only the effect of automatic stabilisers. Any discretionary changes in fiscal policy adopted as a result of a given change in GDP, will be zero within the period, and will only materialise in the following quarters. Thus a_i and b_i may be interpreted as the automatic elasticity of net tax revenues and government spending, respectively, with respect to changes in GDP. Blanchard and Perotti use information e.g. from the OECD on the elasticity of various types of taxes with respect to GDP, and use this information to compute an overall elasticity of tax revenues to GDP. For government spending, the automatic elasticity is set to 0, given that the measure of government spending employed is assumed not to include components that automatically rise or fall with GDP.

To identify the other parameters in the system above, Blanchard and Perotti calculate the cyclically adjusted residuals; $t_{cyc,t} = t_t - a_1 x_t$; and $g_{cyc,t} = g_t - b_1 x_t$. Since these are uncorrelated with the structural shock to GDP (e_t^x) they can be used as instruments for t_t and g_t in an instrumental variable regression of x_t against t_t and g_t , whereby the parameters c_1 and c_2 can be estimated.

CONTINUED

Box 2.1

Finally, the parameters a_2 and b_2 are to be found. These parameters describe how taxes respond to changes in government spending and vice versa. It is necessary to assume that one of these parameters is zero, implying that one of the two variables responds to the other, but not the other way around. Blanchard and Perotti demonstrate that the results are independent of which of the two parameters is set to zero. When one parameter is set to zero, the other may be estimated directly using a simple regression.

Once all parameters in the system have been identified, the structural shocks may be calculated based on the residuals. Structural shocks have a theoretical, economic interpretation, and therefore they may be used to draw meaningful *ceteris paribus* inferences.

the stimulus is implemented. This means that an increase in government spending of 1 dollar will lead to a rise in GDP of 0.80-0.90 cents.¹ The maximum effect on GDP does not materialise until 3-4 years after the stimulus was implemented, at which time the multiplier is around 1.3. Blanchard and Perotti find the fiscal multiplier of tax cuts to be somewhat lower, around 0.7 during the first quarter. The maximum effect is reached after 1-2 years, at which time the multiplier is around 0.8.²

Blanchard and Perotti also estimate an augmented VAR model in which various macroeconomic variables are added to the three variables specified above. This allows examination of the effect on these other variables. The findings of this study are e.g. that higher government spending leads to a moderate increase in private consumption, but a fall in private investment and exports. Blanchard and Perotti also find that tax cuts result in an increase in private consumption and a short-term rise in investment.

A large number of empirical studies apply this structural VAR approach, although typically extended to more than three variables, and frequently excluding taxes from the regression.³ Studies based on US data include e.g. Gali et al. (2007), Perotti (2007), Caldara and Kamps (2008) and Auerbach and Gorodnichenko (2012a). Overall, these studies find the fiscal multiplier of government spending to be between 0.7 and 1 during the first quarter after the implementation of the stimulus. The maximum effect is typically achieved after 1-2 years, at which time the

¹ See also Winther (2009) for a discussion of fiscal multiplier effects.

² These results are achieved when data in levels is employed, and the model includes a deterministic trend. If, instead, data in first differences is used (stochastic trend), the effects are largely the same during the first quarter. On the other hand, the multiplier of tax changes rises to about 1.3 after a couple of years, while the multiplier of government spending quickly decreases to around 0.6 and becomes statistically insignificant.

³ It should be noted that if taxes are excluded from the model, and under the maintained assumption that the elasticity of government spending with respect to GDP as well as the model's other variables is zero, then Blanchard and Perotti's method is identical to a standard Choleski decomposition.

multiplier is around or just over 1. Most of these studies also find that private consumption rises following an increase in government spending. Barro and Redlick (2011) apply a different approach, and find a multiplier of around 0.5 for rises in military spending in the USA.

For countries other than the USA, the results tend to be somewhat different. Perotti (2005) examines the effects of fiscal policy in the USA, Canada, the UK, Australia and Germany, using data from approximately 1960-2000. He finds the effect on GDP to be positive in all of these countries, although greater than 1 only in the USA and Germany.¹ Ravn et al. (2012) study a composite data set for Australia, Canada, the UK and the USA for the period 1975-2005 and find a multiplier of around 0.5 in the first quarter, although they find the effect to be relatively short-lived. Rusnak (2011) presents a meta study in which the estimates of a large number of studies are summarised. The conclusions are that the estimated effects for the USA are systematically higher than the estimates for other countries.

3. FISCAL POLICY IN A SMALL OPEN ECONOMY

A common feature of most of the studies mentioned above is that they are concerned with major economies, typically the USA, where foreign trade plays a less prominent role than in Denmark, and where the exchange rate is floating. Therefore, the results of these studies cannot simply be applied to a Danish context. In theory, the effects of fiscal policy in a small open economy with a fixed exchange rate differ significantly from those in a large and much more closed economy with a floating exchange rate. In a large economy, such as the US, the effects of higher government spending depend *inter alia* on the extent to which higher government demand will be at the expense of private, domestic activity, i.e. *crowding out*. This could be the case e.g. if higher government spending lowers private consumption, reflecting household expectations of future tax rises, cf. the *Ricardian Equivalence* theory. In a small open economy such as Denmark, this factor also has an impact on the effect of fiscal policy.

As far as Denmark is concerned, however, at least two other significant effects are at play. These two effects work in opposite directions in terms of the expected impact of fiscal policy in Denmark. Which effect prevails is ultimately an empirical question.

¹ If the analysis is limited to the period after 1980, Perotti finds the effect to be smaller, however, as the multiplier is found to be lower than 1 in the USA and Germany, and close to zero for the other countries.

Firstly, increases in government spending in an open economy such as Denmark will to some extent go to purchases of imported goods and services. This will also apply to tax cuts, which will be spent on higher private consumption, including consumption of imports. Other things being equal, this "leakage effect" entails that the fiscal multiplier is lower in a very open economy. Based on data for a number of EU member states, Beetsma and Giuliadori (2011) find that fiscal expansion is less effective in countries where imports and exports account for a large share of GDP than in countries with a lower import and export share. This indicates that the leakage effect is significant in Denmark, reflected in a low multiplier effect of fiscal stimulus.

On the other hand, the impact on *foreign* demand for Danish goods and services is crucial for the effect of fiscal expansion in Denmark. Since foreign demand is greatly influenced by the price of Danish goods, the choice of exchange rate regime is highly influential on the effects of fiscal policy in a small open economy. As described below, a credible fixed exchange rate pulls in the direction of a relatively large effect of fiscal stimulus, as the interest rate under a fixed exchange rate regime is determined by the interest rate in the country towards which the currency is pegged. The foreign interest rate does not change when domestic fiscal policy is changed. This indicates a high multiplier in Denmark.

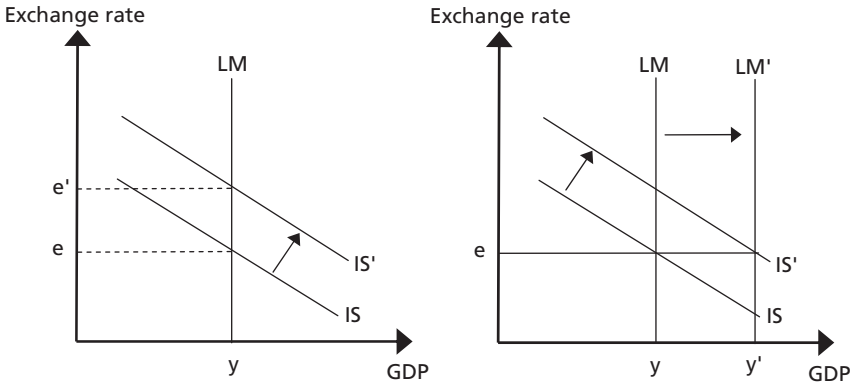
To illustrate the importance of the choice of exchange rate regime, it may be useful to consult the classic Mundell-Fleming model, cf. Fleming (1962) and Mundell (1963). Consider a temporary increase in government spending in a small open economy. In the short term, this will lead to higher output and upward pressure on interest rates and the country's exchange rate. Under a fixed exchange rate regime (provided it is credible), the central bank will counteract this pressure by increasing the money supply or lowering interest rates. This facilitates a large increase in GDP, which is reflected in a high fiscal multiplier as illustrated by the right-hand panel of Chart 3.1. Under a floating exchange rate regime, on the other hand, the central bank allows both the interest rate and the exchange rate to rise. The increase in the exchange rate causes the price of the country's exports to rise, leading to deterioration in the current account through a fall in exports that corresponds to the rise in government spending. In other words, over time, there is full crowding out and no effect on GDP, as illustrated by the left-hand panel of Chart 3.1. Thus the fiscal multiplier is zero.

At the heart of the explanation is what happens to interest rates when government spending is increased.¹ The same applies when the effect of

¹ Leeper (2010) and Davig and Leeper (2011) find that interest rate developments are also highly significant for the effects of fiscal policy in a more "closed" economy, such as the USA.

EXPANSIONARY FISCAL POLICY IN THE MUNDELL-FLEMING MODEL

Chart 3.1



Note: The left-hand panel shows the effect of fiscal expansion under floating exchange rates. The expansion shifts the IS curve to the right. As a result, the exchange rate rises, while GDP remains unchanged. The right-hand panel shows the corresponding situation under fixed exchange rates. Here, the expansionary fiscal policy is offset by an interest rate reduction or an increase in the money supply, shifting the LM curve to the right. As a result, the exchange rate remains unchanged, while GDP increases.

fiscal stimulus is analysed using modern general equilibrium models with forward-looking agents, see e.g. Corsetti et al. (2011), Nakamura and Steinsson (2011) and Pedersen (2012). Because of the dynamic nature of these models, a distinction is made between short-term interest rates, determined by the central bank, and long-term interest rates, determined by the financial markets. Under a fixed exchange rate regime, the short-term nominal interest rate is pegged to the foreign rate, possibly with an added risk premium. Given the high credibility of the Danish fixed exchange rate policy, this risk premium is quite small as far as Denmark is concerned. Therefore, we will disregard the risk premium in this study.

Consider a temporary increase in government spending. Such an increase will typically lead to higher inflation. With a credible fixed exchange rate regime under which the nominal interest rate is not changed, this implies a drop in the short-term real interest rate, resulting in a rise in economic activity. Therefore, the fiscal multiplier is relatively high. Note, however, that since we are considering only a *temporary* increase in government spending, this increase will not result in any changes in the relative prices between foreign and domestic goods in the long run. Under a fixed exchange rate, domestic relative prices must therefore fall back to their initial level sooner or later. This entails that the long-term real interest rate needs to rise to even out the initial fall in the short-term real interest rate. The rise in the long-term real interest rate dampens the level of economic activity also in the short term – and thus dampens the fiscal multiplier.

This can be compared with the effect of higher government spending under a floating exchange rate regime within the same, so-called New-Keynesian model framework. In this framework, it is often assumed that the central bank sets the short-term interest rate according to a *Taylor rule*. This entails that the central bank sets the interest rate with a view to stabilising inflation around a fixed inflation target and GDP around its potential level. If the government decides to increase government spending, this will lead to a rise in output as well as inflation in the short run. Consequently, the central bank will be compelled to raise short-term (nominal and real) interest rates to dampen economic activity. The higher the interest rate rise, the lower the fiscal multiplier. Corsetti et al. (2011) demonstrate that with a realistic size of the interest rate increase, the multiplier will therefore be lower under a floating than under a fixed exchange rate regime. Due to the floating exchange rate, the domestic price level does not have to return to its initial level. However, the long-term real interest rate will rise anyway, since, for a number of periods after the increase in government spending, the short-term real interest rate will be higher than usual due to the Taylor rule, cf. Corsetti et al. (2011).¹

Across the board, empirical studies of open economies find that fiscal policy has a stronger effect under a fixed exchange rate regime. A recent study by Ilzetzi et al. (2010) examines the effect on a large data set for 44 countries, including Denmark, comprised of quarterly data sets over periods of different lengths. The authors apply the method from Blanchard and Perotti (2002) described above. They find that in countries with fixed exchange rate regimes, the fiscal multiplier is greater than 1, while it is negative or, at best, zero under a floating exchange rate regime. More specifically, they estimate the *cumulative* government spending multiplier to be 1.4 in the long term for countries such as Denmark that have chosen a fixed exchange rate. The cumulative multiplier denotes the cumulative increase in GDP relative to the cumulative increase in government spending. In these countries, an increase in government spending hence leads to a rise in GDP which is significantly higher than the corresponding effect in countries with a floating exchange rate. Ilzetzi et al. (2010) also find support for the explanation that this difference may be attributed to a more accommodative interest rate environment in countries with fixed exchange rates than in countries with floating rates where interest

¹ Corsetti et al. (2011) also show, however, that if the temporary increase in government spending is announced at the same time as a detailed plan for funding the increase through lower government spending and higher taxes in the future, the fiscal multiplier under a floating exchange rate regime may have the same size as the multiplier under a fixed exchange rate regime.

rates tend to rise. They also observe an increase in private consumption under fixed exchange rates, but a decline under floating rates. Contrary to the predictions of the Mundell-Fleming model, however, they find no indications of deterioration in the current account under a floating exchange rate regime.

In a similar study based on data from 17 OECD countries for the period 1975-2008, which also includes Denmark, Corsetti et al. (2012) reach the same overall conclusion: The fiscal multiplier is higher under a fixed exchange rate regime. Corsetti et al. (2012) analyse the significance of the choice of exchange rate regime by expanding the traditional Blanchard-Perotti method with an additional regression, including a number of dummy variables. Hence, the authors assume that there is no financial crisis and that government debt does not exceed a certain limit. Under these assumptions, they find a fiscal multiplier of 0.6 under fixed exchange rates, and around zero under floating exchange rates. In both cases, a fall in private consumption is observed.

For a segment of 14 EU member states, Beetsma and Giuliadori (2011) find a multiplier of around 1.2 in the short term and up to 1.5 after one year. But as mentioned earlier, these authors also find the effect to be smaller in the most open of these economies, including Denmark. For these countries, the multiplier is just below 1. Nakamura and Steinsson (2011) study the effect of changes in military spending across states in the USA. Each state in the USA constitutes a small open economy, characterised by substantial trading with its neighbours and a fixed exchange rate. Just like Denmark. Accordingly, the effects of fiscal policy in the individual US states may, to some extent, be compared with the effects in Denmark. Based on data from the period 1966-2006, Nakamura and Steinsson find a fiscal multiplier of around 1.5.¹ This is largely in line with the findings of Ilzetzki et al. (2010). Overall, the recent empirical literature thus indicates that the impact of an unchanged nominal interest rate under a fixed exchange rate regime overshadows the leakage effect. It should be noted, however, that the group of countries with fixed exchange rates is relatively heterogeneous. Moreover, Denmark is among the "most open" countries in the group, i.e. one of the countries with a relatively large share of foreign trade.

¹ Nakamura and Steinsson take advantage of the fact that military spending in the USA can be assumed to be independent of the current economic situation in each state, and thus exogenous. Their estimated multiplier is a *relative* multiplier, i.e. it measures the activity effect in the state in question relative to other states. Consequently, it is not directly comparable with other reported multipliers.

4. ALTERNATIVE METHODS

As mentioned in section 2, Blanchard and Perotti's structural vector autoregressive model has set the standard in the literature. This model, extended to describe a small open economy, also forms the basis of the empirical analysis of fiscal policy in Denmark in section 5. However, this method, like any other, has its flaws. Therefore, a number of alternative approaches have been developed, each of which seeks to address these issues. For instance, recent studies have challenged the implicit assumption of the SVAR model that the effect of fiscal policy is always the same, cf. Box 4.1.

One of the critiques of the SVAR method is that it fails to capture so-called expectation effects. Fiscal stimulus rarely comes like a bolt from the blue. To the extent that forward-looking households and firms expect some fiscal stimulus in the future, they will incorporate this into their decision-making regarding consumption, investment, etc., already before the stimulus is implemented in practice. In other words, the fiscal stimulus has an effect already before government spending or tax revenues are changed. But the stimulus is not reflected in the national accounts figures, and thus in the SVAR method, until it is finally implemented. Consequently, there is a risk that the method will not be able to estimate the effects of fiscal policy correctly.

An alternative approach, which is better able to capture potential expectation effects, has been proposed by Ramey and Shapiro (1998) and Ramey (2011a). These authors thoroughly investigate when news magazines such as *Business Week* changed their expectations of the future course of military spending. In this way, four major expansions are identified. Subsequently, a dummy variable is created that assumes the value of 1 for the quarter in which the first mention of the expansion was recorded, and 0 in all other quarters. These expansions are the Korean War (3rd quarter 1950), the Vietnam War (1st quarter 1965), the Carter-Reagan military build-up (1st quarter 1980) and the military build-up in the wake of the September 11 attacks (3rd quarter 2001). Each of these events can arguably be assumed to be independent of the concurrent US economic situation. Therefore, they can be regarded as exogenous shocks.

As described by Ramey (2011a), the dummy variable created may then be included as an explanatory variable in a VAR model, which also comprises government spending and private consumption, GDP and possibly other variables. In this way, the effect of an increase in government spending may be estimated by observing a shock to the dummy variable. Using this method, Ramey and Shapiro (1998) and Ramey (2011a) find a

FISCAL POLICY UNDER SPECIAL CIRCUMSTANCES

Box 4.1

As described in section 3, the choice of exchange rate regime is of importance for the impact of fiscal stimulus. But this is far from the only aspect that may influence the effects of fiscal policy. A number of other parameters describing the economic environment in which a given fiscal stimulus is performed also play a role. This Box describes some of the most important aspects to be considered in an evaluation of fiscal policy.

Auerbach and Gorodnichenko (2012a) examine empirically how the effects of fiscal policy vary with the business cycle. To this end, the well-known SVAR model is expanded so that booms and recessions are modelled as two different regimes between which the economy switches. The results show that fiscal policy has substantially greater impact during a recession than during an economic boom. Specifically, the authors find that the US fiscal multiplier is between zero and 0.5 during upswings, but between 1 and 1.5 during recessions. There may be various reasons for this difference. For example, the risk that higher government demand simply replaces private demand is expected to be greater during booms, while lower capacity utilisation is a characteristic of recessions. Moreover, interest rates are typically lower during a recession, which strengthens the effect of fiscal expansion, cf. section 3. Auerbach and Gorodnichenko (2012b) also find similar results based on data from a number of OECD countries. Also based on data from various OECD countries, Tagkalakis (2008) shows that part of the explanation could be that private consumption responds differently to fiscal policy during booms and recessions. It may seem counterintuitive to consider the effect of an increase in government expenditure during a boom when fiscal policy should rather be tightened. The explanation is that in the study by Auerbach and Gorodnichenko – as well as in other VAR-based studies – the effects of fiscal policy are assumed to be symmetrical. Hence, in numerical terms, the expansionary effects of higher government spending correspond to the effects of a similar contraction in government spending. In reality, timely fiscal policy tightening during a boom may help to dampen the effects of the next recession. Such effects are not necessarily captured by the type of studies mentioned here.

A special branch of economic literature has focused on theoretical studies of fiscal policy in situations where the nominal interest rate has hit the zero lower bound, a liquidity trap. Examples include Christiano et al. (2011) and Eggertsson (2011). These studies demonstrate that the fiscal multiplier for government spending in such cases may be particularly high, between 2.0 and 2.5. The explanation is that a rise in government spending causes inflation to increase. This lowers both the short-term and the long-term real interest rates, as the nominal interest rate is assumed to remain at zero for a number of periods. Therefore, a strong effect on GDP is obtained.¹ However, Mertens and Ravn (2012b) find that the multiplier is much lower if the economy is stuck in the liquidity trap due to a self-fulfilling wave of pessimism and low consumer and business confidence. As already mentioned, these are theoretical results obtained from model simulations. Empirically examining these effects is difficult e.g. because zero interest rate periods are relatively rare. Moreover, it may be difficult to isolate the effect of the low interest rate, as these episodes tend to coincide with other extraordinary circumstances, e.g. a financial crisis. Corsetti et al. (2012) find empirical evidence that fiscal policy is significantly more efficient during financial crises.

CONTINUED

Box 4.1

Another factor that may influence the effects of fiscal policy is the level of government debt. If government debt is already high, the private sector may expect that further fiscal expansion will soon be counteracted by tightening measures to ensure fiscal sustainability. This will reduce the impact of fiscal stimulus (Sutherland, 1997). If debt is high, fiscal expansion may lead to higher interest rates if the financial markets lose confidence in the sustainability of a country's public finances. These theoretical considerations seem to be backed up by empirical findings. For instance, Ilzetzki et al. (2010) find that the effect of fiscal policy changes if government debt exceeds 60 per cent of GDP. In that case, fiscal expansion has no effect in the short term and a contractionary effect in the longer term. Similar results are presented by Corsetti et al. (2012) and Perotti (1999). These results are in line with the literature on expansionary fiscal contractions. For instance, Giavazzi and Pagano (1990) and Bergman and Hutchison (2010) stress that the substantial fiscal contraction in Denmark in 1982 was succeeded by an economic upswing. However, this fiscal contraction coincided with several other reforms, including the introduction of the fixed exchange rate policy and the suspension of an automatic wage indexation. Consequently, it may be difficult to isolate the effect of fiscal tightening, cf. Christensen and Topp (1997). In general, the literature on expansionary fiscal contractions has produced mixed results, and does not lead to clear conclusions.

¹ Note the small but significant difference between studies in which the zero lower bound on interest rates is binding and studies of a small open economy with fixed exchange rates: At the zero lower bound on interest rates, higher government spending will lower both the short-term and long-term real interest rates, as mentioned above. Therefore, the effect of fiscal expansion is very large. In a small open economy with fixed exchange rates, higher government spending will lead to a fall in the short-term real interest rate, but a rise in the long-term real interest rate, cf. Section 3. The rise in the long-term real interest rate dampens the effect of fiscal expansion, which is therefore smaller than at the zero lower bound.

fiscal multiplier of government spending of around 1 for the USA. As opposed e.g. to Blanchard and Perotti (2002), they find that an increase in government spending leads to a contraction in private consumption.

However, several problems are also associated with this method. Firstly, the results are based on relatively few events. This means that the results are highly sensitive, since they are extensively driven by a few observations, cf. Perotti (2011). Moreover, the results build on a very long data set, which is vulnerable to structural changes.¹ Finally, it may be questioned whether the economic effects of the military build-up during World War II are informative as regards the effect of fiscal stimulus today. When applied to Danish data, the additional problem arises that, in recent times, no major military build-up or other major changes in government spending have taken place that could reasonably be assumed to be exogenous to the economic situation. Against this backdrop, the method is judged not to be very relevant for Denmark.

¹ For instance, a number of authors have argued that US monetary policy changed fundamentally and permanently in the early 1980s, see e.g. Taylor (1999).

Recent studies also indicate that the differences between the findings of the popular SVAR method and the expectations-based approach are not dramatic. Perotti (2011) shows that when applied to the exact same dataset, the two methods give rise to essentially the same conclusions, especially if adjusted for a few, very influential observations. As demonstrated by Mertens and Ravn (2010a), the SVAR method yields reliable results, as long as only a limited share of the changes in fiscal policy is expected. The results from Perotti (2011) indicate that this requirement is met as far as the USA is concerned.

A different alternative to the SVAR approach has been proposed by Mountford and Uhlig (2009). This method applies *sign restrictions*. This entails e.g. that shocks to government spending are identified by assuming that they lead to positive changes in government spending for four consecutive quarters. Similar assumptions are used to identify other shocks. One of the advantages of this method is that, as opposed to the SVAR method, no assumptions are required in terms of which variables respond to each other, cf. Box 1.1. But, essentially, sign restrictions are simply based on an alternative set of assumptions that are not necessarily less problematic than the assumptions underlying the SVAR method.¹ Moreover, the conclusions of Mountford and Uhlig (2009) are not materially different from those otherwise drawn from the literature.² Therefore, the assessment is that there is no significant gain from applying this method rather than the SVAR method.

Moreover, the SVAR approach has recently been criticised for producing estimated effects of fiscal policy that are highly sensitive to the values of certain parameters, cf. Caldara and Kamps (2012). This especially applies to the automatic elasticities of government spending and tax revenues, respectively, with respect to changes in GDP. Caldara and Kamps (2012) demonstrate that even small changes in these elasticities lead to substantially different results based on US data. As described in section 5, this also applies to Danish data.

Finally, an underlying assumption of the basic SVAR model is that the effect of fiscal policy is constant. However, recent studies have shown that the effects are highly dependent on the economic climate at the time of the stimulus. In this light, Favero et al. (2011) argue that it does not make sense to refer to the fiscal multiplier as a definite, constant quantity. As described in Box 4.1, a number of recent studies examine

¹ See Fry and Pagan (2011) for a critical discussion of the application of sign restrictions. Their conclusion is that sign restrictions should mainly be used in combination with more traditional assumptions.

² The most significant difference is that Mountford and Uhlig (2009) find that tax cuts are better than government spending at stimulating the economy, as opposed e.g. to Blanchard and Perotti (2002).

this through expansions of the SVAR model, as well as through alternative approaches.

5. THE EFFECTS OF FISCAL POLICY IN DENMARK: AN EMPIRICAL STUDY

The preceding sections have examined the method behind and the findings of a number of the most important existing studies of fiscal policy. This section presents the findings of a new empirical study of the effect of fiscal policy in Denmark. The details of this study are outlined in a recent working paper, see Ravn and Spange (2012).

The method applied follows the SVAR approach (Blanchard and Perotti, 2002), modified to describe a small open economy. Therefore, the model of Box 2.1 is expanded with a variable describing economic developments abroad.¹ To this end, a weighted average of GDP in Germany and Sweden, Denmark's two most important trading partners, is used. Moreover, we attempt to correct for movements in global economic factors affecting Denmark, Germany and Sweden alike, as we include US GDP in the regression. See Box 5.1 for a description of the specification applied.

The model is estimated using data from the MONA data bank. It may be argued that the shift to the fixed exchange rate policy in 1982 represents a regime change. In our preferred specification, we therefore use data for the period 1983-2011.² Given that the model includes a trend, all variables are represented in log levels. Results achieved by using a specification in log differences are also used for a robustness analysis.

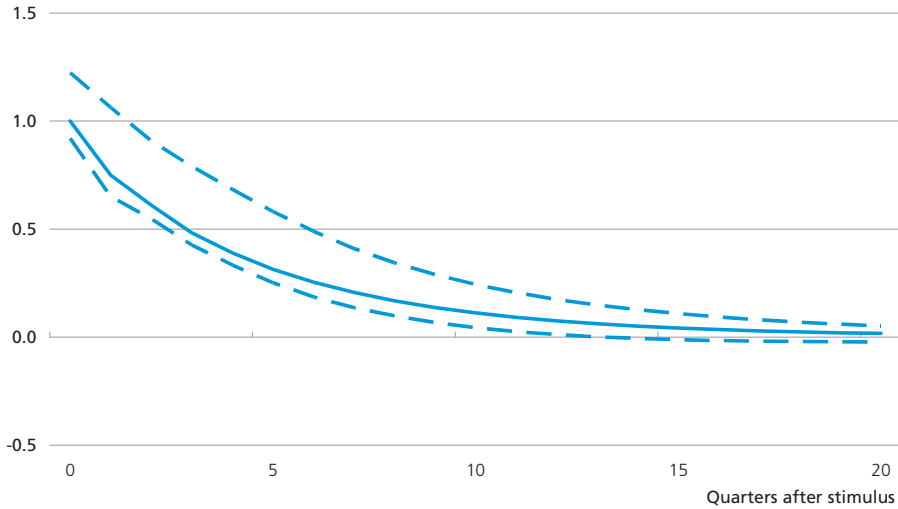
The results of the VAR model can be represented in terms of impulse response functions. An impulse response denotes the effect on the model's endogenous variables during period $t+1$, $t+2$, etc. following a single, structural shock to one of the variables in period t . Observe first the dynamic effects of a temporary increase in government spending. The design of the experiment is such that government spending is raised by kr. 1 billion during one quarter, falling back towards its initial level over a number of quarters as illustrated by Chart 5.1. It is assumed that the increase is unexpected and unannounced, e.g. in the form of an exogenous, discretionary increase in government spending. It could also reflect an unplanned increase following a slide in a component of government spending that has not been actively decided, but shows up in the data. In other words, this is a stylised experiment designed with a

¹ We also use private consumption instead of tax revenue, cf. Box 5.1.

² Since the MONA databank dates back to 1971, the period of 1971-1982 is included later as a robustness check.

COURSE OF GOVERNMENT SPENDING

Chart 5.1



Note: The full line shows the estimated effect (the response) of the increase (the impulse) in government spending, while the dashed lines indicate the 95 per cent confidence limits for the estimated effect.

EMPIRICAL MODEL OF THE EFFECT OF FISCAL POLICY IN DENMARK

Box 5.1

We construct a VAR model of the empirical effects of fiscal policy in a small open economy with a fixed exchange rate. The variables in the model are: Danish GDP (Y_t), private consumption (C_t), government purchases of goods and services (G_t), foreign trade-weighted GDP (F_t) and US GDP (Z_t). For F_t , we use a weighted average of GDP in Germany and Sweden, the weights being based on the country's share in the calculation of the effective krone rate, cf. Pedersen and Plagborg-Møller (2010). The VAR model also includes a constant, a trend (Tr_t) and a dummy (D_t) for the recent financial crisis. The latter takes on a value of one from the 4th quarter of 2008 onwards, and zero otherwise. All variables are measured in real terms.

If we collect the endogenous variables into the vector $X_t = [F_t, G_t, C_t, Y_t]'$, the specification can be written as:

$$X_t = \Psi + \Phi D_t + \Gamma Tr_t + \sum_{i=1}^p A_i X_{t-i} + \sum_{j=0}^q B_j Z_{t-j} + u_t$$

The matrices Ψ , Φ , Γ and A_i and B_j are the coefficient matrices from the regression, while the vector u_t contains the residuals. Based on various tests, the number of lags for both endogenous (p) and exogenous (q) variables are set at two. Note that US GDP (Z_t) is not included in the endogenous variables in X_t , but appears only on the right-hand side. This reflects that movements in the US economy affect the economies of Denmark, Germany and Sweden. On the other hand, it is assumed that there is no reverse impact. It is also assumed that movements in the Danish economy are affected by, but do not have an impact on, economic developments in Germany and Sweden.

CONTINUED

Box 5.1

Such assumptions are commonly used to describe a small open economy. In practice, the model thus has two exogenous blocks, one of which (the USA) impacts the other (Germany and Sweden), while the opposite is not the case. This structure is adopted from Mojon and Peersman (2003), who use a similar VAR model to study the effects of monetary policy in a number of small euro area member states.

In general, our identification strategy mirrors Blanchard and Perotti (2002) and is thus described in Box 2.1. Note that private consumption replaces tax revenues.¹ In addition, the system of equations is expanded to include an extra equation. In line with the description in Box 2.1, this equation describes how unexpected changes in foreign GDP can occur within a quarter. As a starting point, these may be due to unexpected changes in Danish GDP, in Danish private consumption or government spending, or structural shocks to foreign GDP. But as we have assumed that foreign GDP is unaffected by the Danish economy, the first three effects are zero. Consequently, we add the following equation:

$$\hat{f}_t = \hat{e}_t^f,$$

where \hat{f}_t denotes unexpected changes in foreign GDP, while (\hat{e}_t^f) denotes structural shocks to this variable.

We follow the consensus of international studies and assume that the automatic effect on government spending of a change in GDP within the same quarter is zero. As mentioned in section 2, Blanchard and Perotti's approach therefore matches the well-known, recursive VAR model (the Choleski decomposition) when taxes are excluded from the model. We retain the Blanchard-Perotti approach, however, as we later replace government spending with tax revenues. In that context, the model may be expanded to examine the economic effects of tax changes.

¹ The SVAR model is most suitable for capturing the effect of fiscal policy on the demand side of the economy. This makes the model useful for describing the effect of government spending. On the other hand, the model is less suitable for describing the effect of fiscal policy on the supply side. Since taxes extensively work through the supply side, the model provides only a partial description of the effect of tax changes. Against that backdrop, we have eliminated taxes from our preferred specification.

view to promoting comparability with similar experiments in the other studies mentioned. However, it is not similar to the way in which fiscal stimulus is often designed in practice.¹ In reality, fiscal stimulus often tends to be more persistent and, possibly, larger than the shock illustrated, and often to some extent anticipated.

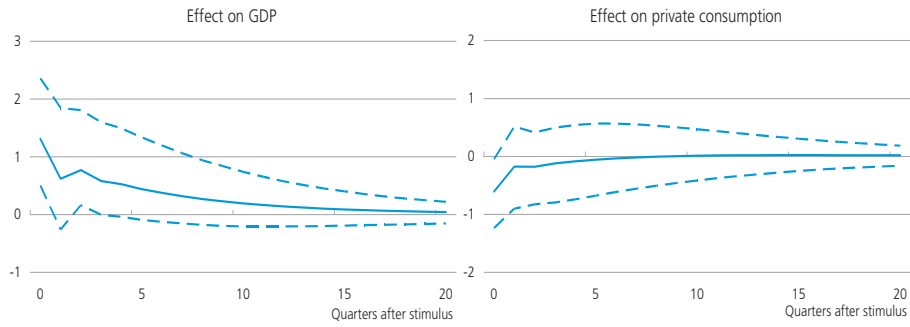
Consider next the effect of this increase on GDP and private consumption. These effects are illustrated in Chart 5.2.

The effect on GDP has been converted so that the vertical axis shows the increase in GDP in kr. billion following an increase of kr. 1 billion in government spending. The same applies to the effect on private consumption. This way, the fiscal multiplier can be observed directly from

¹ See Pedersen (2012) for a description of the theoretical effects of more realistic fiscal stimulus measures.

ESTIMATED EFFECT OF AN INCREASE IN GOVERNMENT SPENDING

Chart 5.2



the vertical axis. The unit of the horizontal axis is the number of quarters after the implementation of the stimulus.

The Chart shows that an increase in government spending leads to a rise in GDP. During the first quarter, the fiscal multiplier is greater than 1; 1.3 to be exact. In other words, the short-term effect is within the interval of 0.8-1.5 specified by Ramey (2011b) as realistic values. But the expansionary effect quickly dies out. Already in the next quarter, the multiplier is below 1. It appears from the confidence limits that the increase in government spending has no significant effect on GDP beyond the first year after the increase. The effect on GDP seems to die out as government spending returns to its initial level. This would indicate that the dynamic effects of fiscal policy are relatively small in Denmark. Hence, the results indicate that fiscal stimulus in Denmark has a faster, but also more short-lived effect than previously assumed. This is opposed to the effects in the USA, where, as already mentioned, Blanchard and Perotti (2002) have demonstrated that the effect of fiscal policy on GDP only peaks after 3-4 years. Finally, we find an immediate fall in private consumption after which the effect is close to zero. The change in private consumption is insignificant during all periods, except for the first quarter.¹ This corroborates the finding that the dynamic effects seem to be limited in Denmark. In other words, the results indicate that fiscal stimulus mainly impacts economic activity through the direct effect of higher government spending.

Chart 5.2 shows the results of our preferred specification. It is useful to examine the extent to which these results are sensitive to small changes

¹ Most existing studies of fiscal policy apply a VAR model with four lags. However, a number of tests indicate that two lags are more suitable for our data set. If, instead, the analysis is performed with four lags, interesting changes are observed in the results. The initial fall in private consumption is now quite small and is replaced by a significant increase in consumption over a number of quarters. This is reflected in a larger and especially more persistent, increase in GDP. The increase is now significant for two years rather than one. The fiscal multiplier is around 1.5 during the first quarter and subsequently rises over the next couple of quarters.

in the VAR model. Therefore, Ravn and Spange (2012) provide a detailed description of a number of robustness checks.

If the VAR model is estimated in log differences rather than log levels, a short-term, significant increase in GDP is again observed. The fiscal multiplier is now estimated to be 1.1. The effect on private consumption is insignificant.

As mentioned in section 4, Caldara and Kamps (2012) have shown US results from the SVAR approach to be very sensitive to certain of the parameters used – especially the parameter measuring the automatic change in government spending caused by a change in GDP within the same quarter. We follow the consensus among international studies and set this elasticity to zero. Giorno et al. (1995) apply an elasticity of -0.2 for Denmark. The reason is that their measure of government expenditure includes government spending and a number of unemployment-related expenses. The latter are highly dependent on GDP changes. We use only government spending, which does not include these expenses. A number of recent studies instead suggest that the parameter is positive. For instance, Lane (2003) finds a clear procyclical tendency in government spending in a series of OECD countries, including Denmark. However, this pattern has been observed based on annual data and cannot necessarily be retrieved using quarterly data as in this study.

We find that the results above are quite sensitive to the assumed elasticity of zero. If the elasticity is set at 0.1 instead of zero, the fiscal multiplier changes from 1.3 to 0.6. If the elasticity is set at -0.1, the multiplier is 1.9. In other words, the estimated multiplier is subject to substantial uncertainty. Since recent studies indicate that the elasticity is more likely to be positive than negative, the estimated multiplier of 1.3 thus represents a sort of upper bound.

Finally, we find that the same qualitative results are achieved if we expand the regression to include data for the years 1971-82. For instance, a fiscal multiplier of 1.2 is found for the entire period 1971-2011. Box 5.2 describes the development of the fiscal multiplier over time.

As mentioned earlier, Blanchard and Perotti (2002) also use the SVAR model to analyse the effects of tax changes. As mentioned in Box 5.1, we have excluded taxes from our preferred specification. But the SVAR approach still provides a useful, although not complete, description of the effects of tax policy. Therefore, we construct a specification of the model in which government spending is replaced by net tax revenues. This covers direct and indirect taxes as well as social contributions less transfers to households. The only change to the specification is that (unlike in the case of government spending), it makes no sense to assume that the elasticity of tax revenues with respect to GDP changes is

CHANGES IN THE EFFECT OF FISCAL POLICY OVER TIME

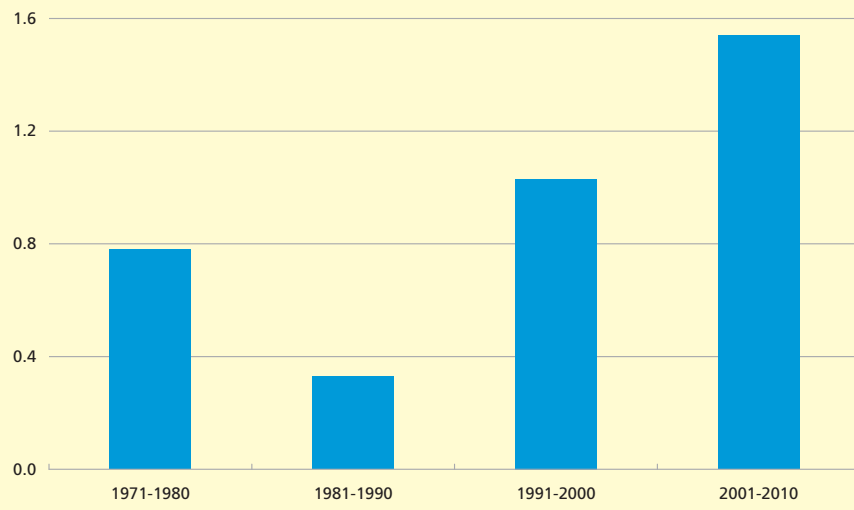
Box 5.2

So far, the analysis has been based on an assumption that all model parameters, and thus the estimated impulse responses, are constant over time. However, this need not necessarily be the case. For example, Perotti (2005) finds that the effects of fiscal policy in the USA have become less pronounced after 1980. Bilbiie et al. (2008) explain this development by two factors. Firstly, US monetary policy has become more activist, and thus less accommodative, than earlier. Secondly, financial liberalisation has given more households access to financial markets, and hence access to smooth consumption over time. Both factors point towards smaller effects of fiscal policy.¹

We examine the effect of fiscal policy in Denmark over time by estimating the fiscal multiplier of government spending for each decade in the data set. In other words, we split up the data set. With 40 observations for each decade, there should be sufficient information to obtain meaningful results, although the estimated multipliers are surrounded by very wide confidence intervals. Chart 5.3 shows the fiscal multiplier for each of the four decades for which we have data.

FISCAL MULTIPLIER IN DENMARK OVER TIME

Chart 5.3



The Chart shows that fiscal policy in Denmark has tended to become more efficient over the last two decades compared with earlier. More specifically, the fiscal multiplier was below 1 in the 1970s and 1980s, but greater than 1 during the period since 1991. It should be emphasised that great uncertainty surrounds the value of these multipliers, given that their confidence intervals are quite wide. Therefore, weight should not be attached to individual estimates, so much as to the development over time of the fiscal multiplier.

The Chart shows that the trend in Denmark during this period has been virtually opposite the trend in the USA. There are several possible reasons for this development. In the 1970s and well into the 1980s, the Danish economy was characterised by high interest rates, high and fluctuating inflation, frequent devaluations and unsound public finances. In an economic environment of this nature, there is great risk that an increase in government spending will lead to further rises in interest and inflation rates,

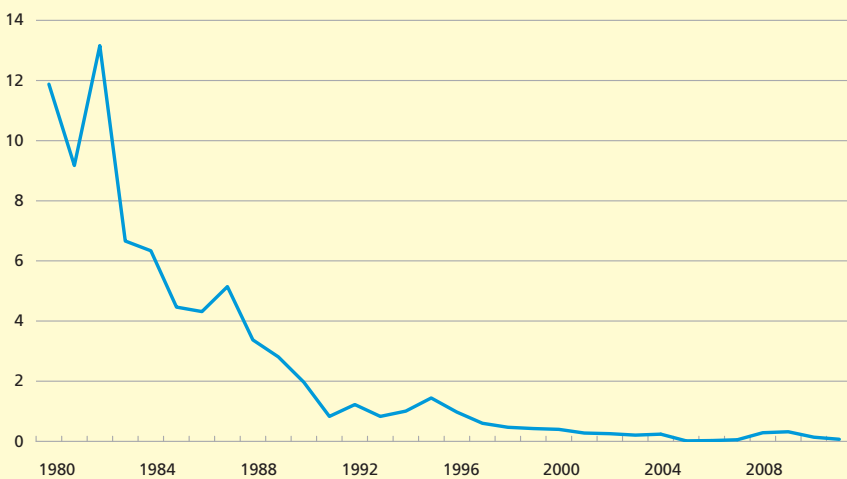
CONTINUED

Box 5.2

as well as doubt as to the sustainability of public finances. The effect on GDP, on the other hand, will be limited. In 1982, Denmark introduced the fixed exchange rate policy against the D-mark, automatic indexation of wages was suspended, and an improvement of public finances was initiated. But it takes time to build up credibility around a fixed exchange rate regime. This may be illustrated by observing the yield spread between Denmark and Germany, as shown in Chart 5.4. The Chart shows that the Danish yield spread remained at a relatively high level for a number of years after the introduction of the fixed exchange rate regime. Moreover, it takes time to build confidence that inflation will be low and stable and to reduce government debt.

YIELD SPREAD TO GERMANY, LONG-TERM GOVERNMENT BONDS

Chart 5.4

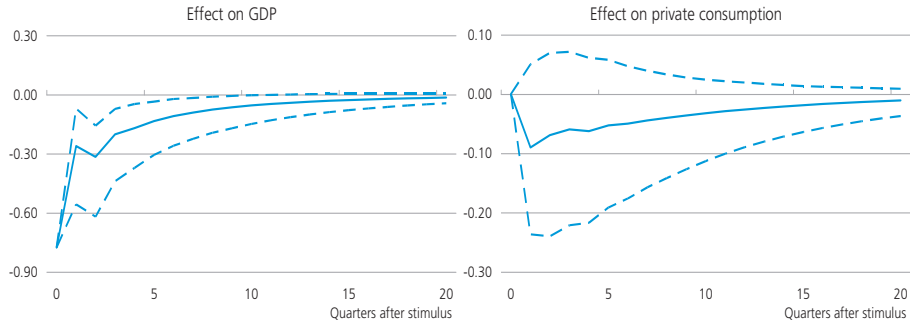


Note: The Chart indicates the difference between long-term government bond yields in Denmark and Germany (West Germany until 1989).

In this light, it is not surprising that the effect of fiscal policy in Denmark has been increasing over recent decades. As credibility around the fixed exchange rate regime has been built, underpinned by the long-term sustainability of public finances, an economic environment has been created in which short-term increases in government spending may have considerable economic effects in the very short term. As described in section 3, credibility of the fixed exchange rate regime is a key prerequisite in theoretical models if a large effect of changes in fiscal policy is to be achieved.

There is, however, no reason to expect that the effects of fiscal policy will continue to rise in the future. Firstly, the very low Danish yield spread to Germany for the past 15-20 years illustrates that very high credibility of the Danish fixed exchange rate has been achieved. Secondly, the multiplier found for the last few decades is in line with the findings of recent studies on the effects of fiscal policy in a small open economy with fixed exchange rates, cf. section 3. This indicates that the last few decades represent the "normal situation". A flexible exchange rate, high debt and high interest rates explain the relatively small effects in the 1970s and 1980s, in accordance with the theoretical and empirical explanations in section 3.

¹ A third factor pointed out both by Perotti (2005) and Bilbiie et al. (2008) is that changes in US government spending have simply been less persistent during the period after 1980.

ESTIMATED EFFECT OF AN INCREASE IN NET TAX REVENUE Chart 5.5

zero. A change in GDP automatically leads to a change in the tax base – and thus also in revenues. Ravn and Spange (2012) describe how this elasticity can be calculated.

Chart 5.5 shows impulse responses for an increase in tax revenues. The increase is designed in the same manner as the increase in government spending above. As in Chart 5.2, the vertical axis denotes the fiscal multiplier of tax changes, while the horizontal axis indicates quarters after the tax increase. An increase in taxes leads to a significant drop in GDP. The multiplier of tax changes is 0.8, and is thus lower than the multiplier of government spending of 1.3. On the other hand, the Chart illustrates that the effect on GDP is significant for about two years, and hence more persistent than for changes in government spending. Private consumption declines in response to the tax increase, but the fall is not significant. As mentioned earlier, it should be emphasised that this approach focuses on the effect of taxes on demand. Changes in, for example, income taxes also have significant supply-side effects. Recent international studies indicate that, when allowing for supply-side effects, the fiscal multiplier for tax changes is greater than for changes in government spending, cf. e.g. Alesina and Ardagna (2010) or Romer and Romer (2010).¹ Hence the results do not provide a complete picture of the effects of tax policy changes.

The empirical results of this section can be summarised as follows: With a multiplier of 1.3, changes in government spending have a relatively large effect on GDP in the short term, but the effect is very short-lived. The effect on private consumption is unclear. Finally, a tax increase will dampen economic activity. It should be emphasised that the fiscal multiplier is not constant (this also applies in Denmark), but varies

¹ Mertens and Ravn (2012) seek to bridge the gap between the different approaches. They argue that the relatively low multiplier of tax changes often found in SVAR studies is primarily due to underestimation of the elasticity of tax revenues with respect to changes in GDP.

over time (cf. Box 5.2), as well as with cyclical conditions, government finances and a series of other factors. The results above may be interpreted as a kind of average effect during "normal" times.

In general, our results comply with international empirical studies and with economic theory. As mentioned earlier, several recent studies of fiscal policy in small open economies with fixed exchange rates find a multiplier of up to 1.5.¹ As described in section 3, the relatively strong effect in a small open economy with a fixed exchange rate is also in line with both traditional and modern economic theory. Moreover, the relatively large short-term impact would indicate that the effect of a fixed exchange rate (which increases the multiplier) is stronger than the leakage effect (which lowers the multiplier).

The results indicate that the effect of fiscal policy in Denmark is more short-lived than suggested by most international studies. The reason may be that the Danish economy is very small and very open, extensively driven by external impacts.² This is corroborated by variance decompositions, cf. Ravn and Spange (2012). Part of the explanation may be that automatic stabilisers are stronger in Denmark than in most other countries. Automatic stabilisers *per se* mean that shocks to the Danish economy, including shocks caused by fiscal stimulus, are absorbed more quickly than in other countries. The short-lived effect indicated by the results above strengthens the requirements for the timing of such stimulus.

Finally, the economic literature has provided no clear-cut answer as to how private consumption responds when government spending is increased. As mentioned earlier, some studies find an increase in private consumption, others a decline. The results described above fail to provide an unambiguous answer to this question.

¹ As mentioned, the reported multiplier in Ilzetzki et al. (2010) is a cumulative multiplier. We also calculate this at 1.3 for Denmark.

² Moreover, Danish goods make up only a tiny fraction of foreign consumers' shopping basket. To the extent that fiscal expansion in Denmark gradually results in higher inflation, which is usually the case, the more expensive Danish goods will have only a negligible effect on overall foreign inflation. The increase in Danish inflation relative to abroad will therefore be fairly large, compared with the effect when a relatively large country implements fiscal expansion. This warrants that small economies will experience a fairly sharp fall in exports, which will contribute to undermining the effects of fiscal expansion after a while.

6. LITERATURE

Alesina, Alberto and Silvia Ardagna (2010), Large changes in fiscal policy: Taxes versus spending, *Tax Policy and the Macroeconomy*, Vol. 24, No. 1.

Auerbach, Alan and Yuriy Gorodnichenko (2012a), Measuring the output responses to fiscal policy, *American Economic Journal: Economic Policy*, Vol. 4, No. 2.

Auerbach, Alan and Yuriy Gorodnichenko (2012b), Fiscal multipliers in recession and expansion, in Alberto Alesina and Francesco Giavazzi (ed.), *Fiscal policy after the financial crisis*, University of Chicago Press.

Barro, Robert (2009), Voodoo multipliers, *Economists' Voice*, Vol. 6, No. 2.

Barro, Robert and Charles Redlick (2011), Macroeconomic effects from government purchases and taxes, *Quarterly Journal of Economics*, Vol. 126, No. 1.

Blanchard, Olivier and Roberto Perotti (2002), An empirical characterization of the dynamic effects of changes in government spending and taxes on output, *Quarterly Journal of Economics*, Vol. 117, No. 4.

Beetsma, Roel and Massimo Giuliodori (2011), The effects of government purchases shocks: Review and estimates for the EU, *Economic Journal*, Vol. 121, No. 550.

Bergman, Michael and Michael Hutchison (2010), Expansionary fiscal contractions: Re-evaluating the Danish case, *International Economic Journal*, Vol. 24, No. 1.

Bilbiie, Florin, André Meier and Gernot Müller (2012), What accounts for the changes in US fiscal policy transmission?, *Journal of Money, Credit and Banking*, Vol. 40, No. 7.

Blomquist, Niels, Niels Arne Dam and Morten Spange (2011), Monetary-policy strategies at the zero lower bound on interest rates, Danmarks Nationalbank, *Monetary Review*, 4th Quarter.

Born, Benjamin and Gernot Müller (2012), Government spending shocks in quarterly and annual time series, *Journal of Money, Credit and Banking*, Vol. 44, No. 2-3.

Caldara, Dario and Christophe Kamps (2008), What are the effects of fiscal policy shocks? A VAR-based comparative analysis, *ECB Working Paper Series*, No. 877.

Caldara, Dario and Christophe Kamps (2012), The analytics of SVARs: A unified framework to measure fiscal multipliers, *Finance and Economics Discussion Series*, No. 2012-20, Board of Governors of the Federal Reserve System.

Christensen, Anders Møller and Jacob Topp (1997), Monetary policy in Denmark since 1992, in *Monetary policy in the Nordic countries: experiences since 1992*, *BIS Policy Papers*, No. 2.

Christiano, Lawrence, Martin Eichenbaum and Sergio Rebelo (2011), When is the government spending multiplier large?, *Journal of Political Economy*, Vol. 119, No. 1.

Coenen, Günter, Christopher Erceg, Charles Freedman, Davide Furceri, Michael Kumhof, René Lalonde, Douglas Laxton, Jesper Lindé, Annabelle Mourougane, Dirk Muir, Susanna Mursula, Carlos de Resende, John Roberts, Werner Roeger, Stephen Snudden, Mathias Trabandt and Jan in't Veld (2012), Effects of fiscal stimulus in structural models, *American Economic Journal: Macroeconomics*, Vol. 4, No. 1.

Cogan, John, Tobias Cwik, John B. Taylor and Volker Wieland (2010), New Keynesian versus old Keynesian government spending multipliers, *Journal of Economic Dynamics and Control*, Vol. 34, No. 3.

Corsetti, Giancarlo, Keith Kuester and Gernot Müller (2011), Floats, pegs and the transmission of fiscal policy, *Federal Reserve Bank of Philadelphia Working Papers*, No. 11-9.

Corsetti, Giancarlo, Andre Meier and Gernot Müller (2012), What determines government spending multipliers?, *IMF Working Paper*, No. 12/150.

Davig, Troy, and Eric Leeper (2011), Monetary-Fiscal Interactions and Fiscal Stimulus, *European Economic Review*, Vol. 55, No. 1.

Eggertsson, Gauti (2011), What fiscal policy is effective at zero interest rates?, *NBER Macroeconomics Annual 2010*, Vol. 25.

Favero, Carlo, Francesco Giavazzi and Jacopo Peregò (2011), Country heterogeneity and the international evidence on the effects of fiscal policy, *NBER Working Papers*, No. 17272.

Fleming, Marcus (1962), Domestic financial policies under fixed and under floating exchange rates, *IMF Staff Papers*, No. 9.

Friedman, Milton (1962), *Capitalism and Freedom*, University of Chicago Press.

Fry, Renee and Adrian Pagan (2011), Sign restrictions in structural vector autoregressions: A critical review, *Journal of Economic Literature*, Vol. 49, No. 4.

Gali, Jordi, Javier Vallés and David Lopez-Salido (2007), Understanding the effects of government spending on consumption, *Journal of the European Economic Association*, Vol. 5, No. 1.

Giavazzi, Francesco and Marco Pagano (1990), Can severe fiscal contractions be expansionary? Tales of two small European countries, *NBER Macroeconomics Annual 1990*, Vol. 5.

Giorno, Claude, Pete Richardson, Deborah Roseveare and Paul van den Noord (1995), Estimating potential output, output gaps and structural budget balances, *OECD Economics Department Working Papers*, No. 152.

Hall, Robert (2009), By how much does GDP rise if the government buys more output?, *Brookings Papers on Economic Activity*, Vol. 40, No. 2.

Hebous, Shafik (2011), The effects of discretionary fiscal policy on macroeconomic aggregates: A reappraisal, *Journal of Economic Surveys*, Vol. 25, No. 4.

Ilzetzki, Ethan, Enrique Mendoza and Carlos Vegh (2010), How big (small) are fiscal multipliers?, *NBER Working Papers*, No. 16479. Updated March 2012.

Lane, Philip (2003), The cyclical behaviour of fiscal policy: Evidence from the OECD, *Journal of Public Economics*, Vol. 87, No. 12.

Leeper, Eric (2010), Monetary Science, Fiscal Alchemy, *NBER Working Papers*, No. 16510.

Mertens, Karel and Morten Ravn (2010a), Measuring the impact of fiscal policy in the face of anticipation: A structural VAR approach, *Economic Journal*, Vol. 120, No. 544.

Mertens, Karel and Morten Ravn (2010b), Fiscal policy in an expectations driven liquidity trap, CEPR Discussion Papers, No. 7931. Updated April 2012.

Mertens, Karel and Morten Ravn (2012), A reconciliation of SVAR and narrative estimates of tax multipliers, *CEPR Discussion Papers*, No. 8973.

Mojon, Benoit and Gert Peersman (2003), A VAR description of the effects of monetary policy in the individual countries of the Euro area, in Ignazio Angeloni, Anil Kashyap and Benoit Mojon (ed.), *Monetary Policy Transmission in the Euro Area*, Cambridge University Press.

Mountford, Andrew and Harald Uhlig (2009), What are the effects of fiscal policy shocks?, *Journal of Applied Econometrics*, Vol. 24, No. 6.

Mundell, Robert (1963), Capital mobility and stabilizing policy under fixed and flexible exchange rates, *Canadian Journal of Economics and Political Science*, Vol. 29, No. 4.

Nakamura, Emi and Jon Steinsson (2011), Fiscal stimulus in a monetary union: Evidence from US regions, *NBER Working Papers*, No. 17391.

Olesen, Jan Overgaard and Ann-Louise Winther (2009), Automatic stabilisers, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

Parker, Jonathan (2011), On measuring the effects of fiscal policy in recessions, *Journal of Economic Literature*, Vol. 49, No. 3.

Pedersen, Erik Haller and Mikkel Plagborg-Møller (2010), New calculation of Danmarks Nationalbank's effective krone-rate index, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

Pedersen, Jesper (2012), Fiscal policy in macroeconomic models, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter, Part 2.

Perotti, Roberto (1999), Fiscal policy in good times and bad, *Quarterly Journal of Economics*, Vol. 114, No. 4.

Perotti, Roberto (2005), Estimating the effects of fiscal policy in OECD countries, *Proceedings*, Federal Reserve Bank of San Francisco.

Perotti, Roberto (2008), In search of the transmission mechanism of fiscal policy, *NBER Macroeconomics Annual 2007*, Vol. 22.

Perotti, Roberto (2011), Expectations and fiscal policy: An empirical investigation, *IGIER Working Paper*, No. 429.

Ramey, Valerie (2011a), Identifying government spending shocks: It's all in the timing, *Quarterly Journal of Economics*, Vol. 126, No. 1.

Ramey, Valerie (2011b), Can government purchases stimulate the economy?, *Journal of Economic Literature*, Vol. 49, No. 3.

Ramey, Valerie and Matthew Shapiro (1998), Costly capital reallocation and the effects of government spending, *Carnegie-Rochester Conference Series on Public Policy*, Vol. 48, No. 1.

Ravn, Morten, Stephanie Schmitt-Grohé and Martin Uribe (2012), Consumption, government spending, and the real exchange rate, *Journal of Monetary Economics*, Vol. 59, No. 3.

Ravn, Søren Hove and Morten Spange (2012), The effects of fiscal policy in a small open economy with fixed exchange rates: The case of Denmark, *Danmarks Nationalbank Working Papers*, No. 80.

Romer, Christina and Jared Bernstein (2009), The job impact of the American recovery and reinvestment plan, unpublished manuscript, 9 January.

Romer, Christina and David Romer (2010), The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks, *American Economic Review*, Vol. 100, No. 3.

Rusnak, Marek (2011), Why do government spending multipliers differ? A meta-analysis, unpublished manuscript.

Sutherland, Alan (1997), Fiscal crises and aggregate demand: Can high public debt reverse the effects of fiscal policy?, *Journal of Public Economics*, Vol. 65, No. 2.

Tagkalakis, Athanasios (2008), The effects of fiscal policy on consumption in recessions and expansions, *Journal of Public Economics*, Vol. 92, No. 5-6.

Taylor, John B. (1999), A historical analysis of monetary policy rules, in John B. Taylor (ed.), *Monetary Policy Rules*, The University of Chicago Press.

Winther, Ann-Louise (2009), Impact of fiscal policy during the crisis, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter.