University of Copenhagen

Department of Economics

Public Finances and Fiscal Effects - The case of Denmark

By Sebastian Honoré

Abstract

This paper investigates the size of fiscal multipliers in Denmark for high and low debt regimes. The analysis is based on new data spanning the period from 1948 to 2020. The relationship between the nominal interest rate and GDP growth rate is used to identify high and low debt periods. The relationship exploits that intertemporal budget constraints are only binding when this relationship is positive. The main findings are: First, the response of output of a government shock has increased since the adoption of a fixed exchange rate regime. Second, the output multiplier is significantly higher in low debt periods.

Total number of pages: 15

Total number of characters: 35,809

Instructor: Gabriel Züllig

1 Introduction

As the Covid-19 pandemic swept through the world in 2020, governments were forced to take rapid action. In Denmark, restrictions imposed to prevent the spread of infection forced entire sectors of the economy to shut down temporarily. Rescue packages were administered, to ailing businesses, with an intent to alleviate an increase in bankruptcies and unemployment. As a result, the central government debt rose by 13 points from 33,3 percent to 46,3 percent of GDP in 2020, a 20 year high. The sharp increase in government debt sparked a renewed public debate about the potential dangers of high government debt.

Several economists have argued that higher government debt is not necessarily a problem due to the currently low-interest rates. Rightfully so, when interest rates are lower than the growth rate of the economy, the government can pursue a permanent debt roll-over policy and remain solvent (Groth (2017)). The requirements for efficient debt roll-overs will be analyzed in section 2. Nevertheless, in a world with uncertainty and a history of interest rates significantly higher than GDP growth (see figure 1), this stance may not be viable in the long run. It may be that some of the current factors dictating the low-interest rates observed will fade over time. Alternatively, it may be that public debt spirals to a point where the interest rates exceed the economy's growth rate (Blanchard (2019)).

From the pillars of standard macro theory, it is known that individuals, firms and governments are subject to intertemporal budget constraints. The latter may have severe effects on the size of fiscal multipliers if fiscal policy is not sustainable. In this case, a government cannot pay its debt once it matures, given that it applies the current spending and tax rule in the future. In such a setting, financing government spending through new debt issuance may be received by the consumers as a sign of future tax increases. After all, the government can only stay solvent if it increases taxation or cuts back on its spending. The uncertainty induced by the risk of higher taxes may lead to an increase in savings today to ward off a higher tax bill in the future. If taxes are increased, it may have distortionary supply-side effects, which again lowers the impact on aggregate demand. In sum, this consumer response may reduce the effect of government spending and potentially render it counter-productive. To the extent that government spending is heavily financed through public debt, a key empirical question is how the effects of fiscal shocks vary with the state of public finances. The answer to this question may be of interest to policymakers in designing stabilization strategies in the future.

Despite these critical theoretical insights, there is little empirical research trying to assess how the size of fiscal multipliers varies with the state of public finances. Based on a quarterly dataset of government spending in 44 countries Ilzetzki et al. (2013) find that in countries where government debt is high, the fiscal multiplier is not statistically significant from zero on impact and negative in the long run. In their paper, a country is in a high debt regime if it exceeds 60 percent of GDP. Using quarterly data from 1983 to 2018 Honoré (2019) examines how fiscal multipliers are affected by the soundness of public finances in Denmark. The results indicate that fiscal policy remains productive even with high government debt. Though, the effect on impact is diminishing at higher debt levels. At a debt level of 40 percent of GDP, the output multiplier is 1.14 percent on impact with a peak of 1.21. Similarly, at a debt level of 50 percent of GDP, the impact multiplier of output is 0.17 percent but peaks at 1.67. In contrast, the response of private consumption is negative in high debt periods, somewhat implying Ricardian consumers.

The empirical approach of both papers could be questioned, however. They rely on linear structural vector autoregressions (SVARs), and the estimates of high debt periods in Honoré (2019) are sceptical. Mainly because debt-to-GDP ratios of 45- and 50 percent are rare in Denmark, the estimates may be spurious due to the small sample size in these periods. Furthermore, the choice of threshold for high debt periods is somewhat arbitrary, although the findings in Reinhart and Rogoff (2010) indicate that there is a negative effect when debt reaches 60 percent of GDP. The quest for a reasonable threshold is omitted in this paper by instead focusing on the relationship between the nominal interest rate and the economy's growth rate. The relationship exploits that intertemporal budget constraints are only binding when the interest rate exceeds the economy's growth rate. If they are not binding, debt levels may be high but not necessarily pose a problem in terms of fiscal effects.

The aim of this paper is twofold: to examine the effects of fiscal policy in Denmark in general and how it varies with the state of public finances. The starting point is Ravn and Spange (2012) and Honoré (2019) which estimate multipliers for government spending with identifying assumptions similar to that of Blanchard and Perotti (2002)'s seminal paper. This article provides new evidence on the stability of fiscal policy over time using a consistent quarterly dataset spanning the years 1948 to 2020. The results indicate that the fiscal multiplier is rather large in Denmark with long and persistent effects. On impact, output increases roughly 0.44 DKK when government spending is increased by 1 DKK. The multiplier peaks after four quarters at 0.75. The peak effect is somewhat smaller compared with Ravn and Spange (2012) who finds an output multiplier of 1.1 and Honoré (2019) who estimate it to be 1.36 percent. However, the lower estimated effect in this paper is likely affected by the period under consideration. Before 1983 Denmark was in a floating exchange rate regime, which should lower the effects of fiscal policy. If the period under consideration is restricted to the timing of fixed exchange rates, i.e., 1983-2020, the results are very much in line with other estimates found. On impact output increases by 1.12 with a high degree of persistence.

Building on the baseline specification, this paper extends the analysis to that of Auerbach and Gorodnichenko (2012). As such, the economy is allowed to switch between two different regimes. Namely, a regime where the nominal interest rate exceeds the growth rate of GDP and one where it does not. The former will be referred to as a high debt regime, whereas the latter is a low debt regime. The advantage of this approach is that it utilizes more information by exploiting variation in the probability of being in a particular regime so that estimation and inference for each are based on a more extensive set of observations. Allowing for non-linearities entails a more careful analysis of how public finances affect fiscal policy than what is proposed in Honoré (2019). The results indicate that fiscal policy is more effective in regimes with low debt; in response to a 1 DKK government spending shock, output increases on impact by 0.56 and 0.81 for the high and low debt regime, respectively. The cumulative two-year output multipliers are 0.5 in the high debt regime and 1.02 in the low debt regime. The five-year cumulative multipliers are 0.34 and 1.08, respectively.

The rest of the paper is structured as follows: in section 2 some theoretical considerations on the relationship between public finances and fiscal effects are explored in greater detail. The data used in this paper is described in section 3. In section 4 the SVAR and regime-switching SVAR is introduced along with the identification strategy. Section 5 presents the fiscal effects of increased government spending in the baseline specification and section 6 presents the results for different debt regimes. Alternate model specifications and the robustness of fiscal multipliers is examined in section 7. Lastly, section 8 concludes.

2 Theoretical considerations

A cornerstone in the theoretical public debt literature is that financing by debt issuance is constrained by the need to remain solvent to avoid catastrophic debt dynamics (Groth (2017)). Therefore, debt dynamics play a crucial role in determining the effects of fiscal policy. To explore this point, consider an economy with a government providing public goods and services. The government can finance its spending by levying taxes or by borrowing. For simplicity, it is assumed that there is no uncertainty and that there is only one interest rate in the economy. The implication of this is that the interest rate on government bonds is identical to that of other interest-bearing assets. The government face a dynamic government budget constraint (DGBC) defined in simple terms:

$$B_{t+1} = (1 + r_t)B_t + G_t - T_t \tag{1}$$

Where B_t is the public debt at time t, r_t is the interest rate, G_t is government spending and T_t is net tax revenue. The right-hand side of DGBC represents the government budget deficits. In reality, governments can issue new money to finance its deficit, known as seigniorage. However, for the sake of simplicity, it has been left out of the model. The law-of-motion for the debt-to-GDP ratio can be expressed as:

$$b_{t+1} \equiv \frac{B_{t+1}}{Y_{t+1}} = \frac{1+r_t}{1+g} b_t + \frac{G_t - T_t}{(1+g)Y_t} \tag{2}$$

Where g is the growth rate of the economy and assumed constant. Suppose that the government has a positive amount of debt at $t = 0$ and that it levies taxes equal to its non-interest spending. That is, taxes only covers spending and new debt is issued to cover the interest payments on debt. The assumption simplifies the law-of-motion to:

$$b_{t+1} \equiv \frac{B_{t+1}}{Y_{t+1}} = \frac{1+r_t}{1+g} b_t, \quad b_0 > 0 \tag{3}$$

Essentially, this entails that the government pursues a strategy of permanent debt roll-over, i.e., the government can issue new debt and achieve a decreasing debt-to-GDP ratio without ever having to raise taxes later. Of course, the success of this strategy hinges on whether the interest rate is higher than the growth rate of GDP or not. Three conclusions emerge from this insight:

Case 1: $r_t > g$ In this case, $b_t \rightarrow \infty$ as $t \rightarrow \infty$ due to compound interest. As such, in the long run, government debt will spiral to such heights that it will be unable to find buyers of new debt issues. The strategy of a permanent debt roll-over collapses, and fiscal policy will be unproductive. A standard OLG model most clearly captures the intuition behind this result. The young generation buys government bonds financed through part of their savings. When the government increases debt, it decreases capital and thus the wage rate of the young generation. This implies that the debt burden will become so large that the young generation will not be capable of refinancing the debt roll-over in the long run. In such a situation, state bankruptcy is looming, and nobody will buy government bonds except at a low price. This entails a higher interest rate and adds to the problem at hand. As a result, fiscal policy collapses. Either the government defaults on its debt or increases taxation, or decreases government spending (or both) until the interest rate is equal to the economy's growth rate. If seignorage were included in the model, the government would be able to cover its deficit by printing new money. The larger stock of money would give rise to inflation, and the real value of government debt would erode.

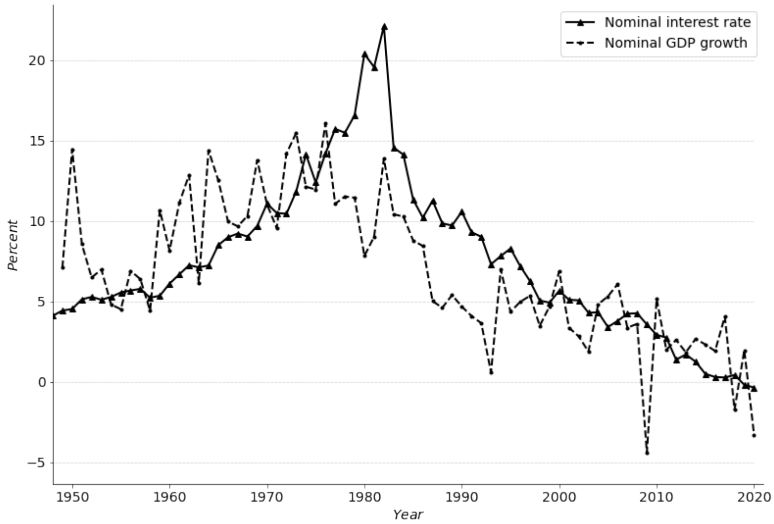
However, investors fearing this would require a risk premium on the interest rate. Again this aggravates the problem.

Case 2: $r_t = g$ in this case $b_t = b_0$ for $t \rightarrow \infty$. In this case, the government can pursue a debt roll-over strategy forever. The income and savings of the new generations follow the same growth trajectory. This implies that the young generation can cover the additional interest payments from new debt issuance. As such, the economy is dynamically efficient.

Case 3: $r_t < g$ Here $b_t \rightarrow 0$ as $t \rightarrow \infty$. As in case 2 fiscal policy is productive and the governments debt roll-over strategy is feasible. The reason is that income and savings grows more than the costs of issuing new debt.

In light of these insights, the question is which of these cases is most relevant in Denmark? Figure 1 present the nominal interest rate and nominal GDP growth from 1948 to 2020 in Denmark. On average, the interest rate has been higher over the period than the growth in the economy. The nominal interest rate has averaged 7.53 percent, while the economy's nominal growth rate has averaged 1.74 percent. As such, Denmark has a history owing to that of case 1. However, from the figure, three distinct periods emerge, which may nuance this conclusion. The first period between 1948 and 1975 has seen growth rates of the economy exceeding the interest rate as described in case 3. Secondly, from 1975 to 2000, the interest rate was dominating the relationship. The relationship narrows from 2000 until the current date, but the interest rate averaged 2.64 percent while nominal GDP growth averaged 0.68 percent. In sum, if the future will be like the past, debt roll-overs do not appear feasible in Denmark. In other words, higher debt may imply a lower effect of fiscal policy. Nevertheless, it should be noted that if the current situation with a sub-zero interest rate catches on in the future, debt roll-overs may be feasible. Hence, an increase in public debt does not come with a fiscal cost.

Figure 1: Nominal interest rate and GDP growth in Denmark



Source: Abildgren (2017) database

3 Data

The dataset includes quarterly national accounts data spanning the period from 1948Q2 to 2020Q4. Specifically, the paper considers government spending, private consumption and GDP. All variables are in real terms and transformed to logarithms. The measure of government spending does not include unemployment transfers, as these are administered through taxes. In section 6 the relationship between the nominal interest rate and nominal GDP growth is included. The nominal interest rate is the yield on maturity on 10-year central government bonds denominated in DKK. The data have been obtained from the Abildgren (2017) database.

4 Econometric specification

In this section, the baseline linear SVAR model and regime-switching SVAR model is described. First, the baseline model is described and later extended to that of Auerbach and Gorodnichenko (2012).

4.1 Baseline model

The baseline reduced-form VAR model of interest in this paper is similar to that of Ravn and Spange (2012) and Honoré (2019). Both are modified versions of Blanchard and Perotti (2002) model. The model in this paper includes three endogenous regressors. Namely, log government spending (G_T), log private spending (C_t) and log domestic GDP (Y_T), all in real terms. As such, it differs from that of Blanchard and Perotti (2002) by not including taxes and from Ravn and Spange (2012) and Honoré (2019) by not including foreign trade-weighted GDP. Taxes are not included in the model because changes in taxation may not arise as a result of policy changes but rather as a result of, for example, automatic stabilizers in the economy. The reduced-form model with lags p can be expressed as:

$$X_t = \theta D_t + \sum_{i=1}^{p} A_i X_{t-i} + \eta_t, \quad i \in (1, p) \tag{4}$$

Where $X_t = [G_t C_t Y_t]'$ is the vector of endogenous regressors. This ordering of the regressors ensure that private consumption and output have no contemporaneous effect on government spending. D_t is a vector including a constant, ν, and a linear trend τ. A_i is a matrix of autoregressive slope parameters. Finally, $\eta_t = [\epsilon_t^G \epsilon_t^C \epsilon_t^Y]$ is a vector of reduced form residuals with $E[\eta_t] = 0$ and variance-covariance matrix $E[\eta_t \eta_t'] = \Omega_\eta$.

In the reduced-form model presented in Eq. 4 the residuals are correlated. This means that the residuals do not have a clear economic interpretation and can be thought of as linear combinations of underlying structural shocks. To get a clear economic interpretation, a structural model can be defined as:

$$AX_t = A\theta D_t + \sum_{i=1}^{p} AA_i X_{t-i} + B\xi_t, \quad i \in (1, p) \tag{5}$$

The model defined above is known as the general AB-model (see, e.g. Amisano and Giannini (2012)). The 3x3 matrix A is invertible and non-singular, reflecting the instantaneous relations among the regressors. In other words, the regressors are allowed to affect each other immediately, which implies that they can be interpreted in terms of elasticities. Similarly, matrix B has the same properties as A but captures the effect of structural shocks on any of the regressors. ξ_t is the vector of serially uncorrelated structural shocks with $E[\xi_t] = 0$ and variance-covariance matrix restricted such that $E[\xi_t \xi_t'] = \Omega_\xi = I$, where I is the identity matrix. The orthogonal restriction implies that the number of structural shocks and regressors are equal. Furthermore, because all covariances equal zero, the shocks are serially uncorrelated by construction, and their variances equal one. The restriction will become useful in the identification strategy outlined below.

4.2 Identification strategy

The structural model presented in Eq. 5 does not identify the causal response of government spending on any of the regressors. As such, restrictions rooted in economic theory have to be imposed on the model. The identification strategy follows the approach initially suggested by Sims (1980) and implements elements from that of Blanchard and Perotti (2002). The former depends on a recursive structure to identify structural shocks, whereas the latter relies on a non-recursive identification. Specifically, the assumptions of Blanchard and Perotti (2002) are used in the identification strategy. That is, policymakers operate with a lag of one quarter before realizing a shock has hit the economy and adjust the fiscal policy at hand. The implication of this is that government spending is fixed between quarters, and any change will be directly attributable to the economy's automatic stabilizers.

The reduced-form VAR model and the structural VAR model relate in the following way:

$$\begin{aligned} A^{-1}AX_t &= A^{-1}A\theta D_t + \sum_{i=1}^{p} A^{-1}AA_i X_{t-i} + A^{-1}B\xi_t \\ \Leftrightarrow X_t &= \theta D_t + \sum_{i=1}^{p} A_i X_{t-i} + \eta_t \end{aligned} \tag{6}$$

Such that $\eta_t = A^{-1}B\xi_t$. To achieve identification a minimum of $K^2 + \frac{K(k+1)}{2} = 3^2 + \frac{3(3+1)}{2} = 15$ restrictions on the matrices A and B combined has to be imposed. Either the A or the B matrix can be restricted to the identity matrix. However, as discussed by Amisano and Giannini (2012) because the B matrix captures the structural shocks rooted in economic theory, the A matrix is typically restricted. Thus, the relationship between the reduced-form residuals and structural errors is:

$$\Omega_\eta \equiv E[\eta_t \eta_t'] = \underbrace{A^{-1}}_{\equiv I} B \underbrace{\Omega_\xi}_{\equiv I} B' \underbrace{A^{-1\prime}}_{\equiv I} = B'B \tag{7}$$

Restricting the 3x3 A matrix is not sufficient to achieve identification. Before finding the suitable restrictions first note that the relationship between the residuals can be expressed as:

$$\begin{bmatrix} \epsilon_t^G \\ \epsilon_t^C \\ \epsilon_t^Y \end{bmatrix} = \begin{bmatrix} 1 & b_{12} & b_{13} \\ b_{21} & 1 & b_{23} \\ b_{31} & b_{32} & 1 \end{bmatrix} * \begin{bmatrix} e_t^G \\ e_t^C \\ e_t^Y \end{bmatrix} \tag{8}$$

For ease of exposition the relationship can be expressed in a system of equations as:

$$\begin{aligned} \epsilon_t^G &= b_{12} e_t^C + b_{13} e_t^Y + e_t^G \\ \epsilon_t^C &= b_{21} e_t^G + b_{23} e_t^Y + e_t^C \\ \epsilon_t^Y &= b_{31} e_t^G + b_{32} e_t^C + e_t^Y \end{aligned} \tag{9}$$

The first equation states that unexpected changes in government spending within a quarter, ϵ_t^G, can be caused by one of three factors: The response to unforeseen movements in private consumption, captured by $b_{12}e_t^C$, the response to shocks in GDP, captured by $b_{13}e_t^Y$, and structural shocks to government spending captured by e_t^G. It is assumed that changes in private consumption do not cause automatic changes in government spending on top of an effect through output, i.e. $b_{12} = 0$.

The parameter b_{13} captures the automatic effects of GDP changes on government spending within a quarter. Denmark has a large public sector and a well-developed social security system. Hence, the automatic stabilizers in the economy are very sensitive to changes in GDP. However, transfers are embodied within taxes and do not affect government spending. As such, the sign of b_{13} is likely to be zero (see e.g. Blanchard and Perotti (2002), Ravn and Spange (2012), Honoré (2019), Ravn et al. (2012). However, Caldara and Kamps (2012) argues that the most reasonable assumption is a positive b_{13} because government consumption tends to be pro-cyclical. A solution to this would be to calibrate the parameter. In their paper Bergman and Hutchison (2010) sets the parameter to -0.2, which does not seem valid in this setting. In the absence of valid extraneous information, it is assumed that $b_{13} = 0$, although this is arguably a strong assumption.

Having imposed these two restrictions, only one more is needed to achieve identification. The second equation states that unexpected changes in private consumption within a quarter, ϵ_t^C, is affected by a response to shocks in government spending, captured by $b_{21}e_t^G$, shocks to GDP, captured by $b_{23}e_t^Y$ and structural shocks to private consumption captured by e_t^C. The last restriction requires a decision of whether output or private consumption is determined first. It is assumed that private consumption affects output within a quarter, but not the other way around. That is, $b_{23} = 0$. In section 7 the robustness of this assumption will be examined.

The identification scheme proposed above yields a lower triangular matrix equivalent to Cholesky decomposition, which can be expressed as:

$$\begin{bmatrix} \epsilon_t^G \\ \epsilon_t^C \\ \epsilon_t^Y \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ b_{21} & 1 & 0 \\ b_{31} & b_{32} & 1 \end{bmatrix} * \begin{bmatrix} e_t^G \\ e_t^C \\ e_t^Y \end{bmatrix} \tag{10}$$

4.3 Regime-switching model

To allow for non-linear government responses across low and high debt regimes, the baseline model is extended to a regime-switching model where transition across regimes are smooth as in Auerbach and Gorodnichenko (2012). The model presented in Eq. 4 can now be expressed as:

$$X_t = \theta D_t + F(s_{t-1}) \sum_{i=1}^{p} {}_{r<g} A_i X_{t-i} + (1 - F(s_{t-1})) \sum_{i=1}^{p} {}_{r>g} A_i X_{t-i} + \eta_t \tag{11}$$

The variables are defined as previously, but the variance-covariance matrix needs to be extended to reflect the regime switching behavior. Hence, $E[\eta_t \eta_t'] = \Omega_\eta = (1 - F(s_{t-1})\Omega_{r<g} + F(s_{t-1})\Omega_{r>g}$. Essentially, (11) is a weighted sum of two linear models: the first being one with a low debt regime and the second, with a probability of $F(s_t)$, a high debt regime. Because both are linear, the identification strategy is equivalent to that of section 4.2. s, denotes the transition variable. Following Auerbach and Gorodnichenko (2012), Bachmann and Sims (2012) and Berger and Vavra (2014) a seven-quarter moving average of the nominal interest-growth relationship is employed. The logistic function F transforms the state variable into a continuous variable such that $s \in (0, 1)$. Formally:

$$F(s_t) = \frac{e^{-\gamma \hat{s_t}}}{1 + e^{-\gamma \hat{s_t}}}, \quad \gamma > 0, \quad \hat{s_t} = \frac{s - \mu}{\sigma_s} \tag{12}$$

The smoothing parameter values γ and μ are not given *a priori* and need to be calibrated outside the model. The smoothness parameter γ is calibrated by referring to the number of periods where the growth rate has been dominant, roughly 18 percent of the time in the sample. Then, high debt are defined as periods where $F(s_t) \geq 0.82$ and γ is calibrated such that $Pr(F(s_t) \geq 0.82) \approx 0.18$. This entails that $\gamma = 10$. For a graphical presentation of the transition variable, see figure 4. The estimation procedure follows that of Auerbach and Gorodnichenko (2012), which rely on the assumption that regimes do not change within five years, the estimation time for impulse-response functions in this paper.

4.4 Model checking

A suitable number of lags has to be chosen for the endogenous variables. Both the Akaike- and Bayesian information criteria are minimized at a lag length of 2. See table 2. The number of lags is equivalent to that used in Ravn et al. (2012) and Honoré (2019). In section 7 the robustness of this specification will be checked. To ensure a stable system in the model, i.e. the impulse-response functions approach zero for $t \to \infty$, stationarity of the variables is required. Both the Augmented Dickey-fuller and Kwiatkowski test indicate that the endogenous variables show signs of unit-roots. As suggested by Sims (1980), a trend has been included in the model to combat the issue of unit root processes. Another way to deal with the problem of unit roots would be to transform the variables into log differences. However, valuable variation in the variables will be lost in this process, and this specification is therefore not chosen. Alternatively, a Vector Error Correction model that allows for cointegration among the variables could be adopted. Yet, this would have to be extended to capture the non-linear effects, which is beyond the scope of this paper.

5 Baseline results

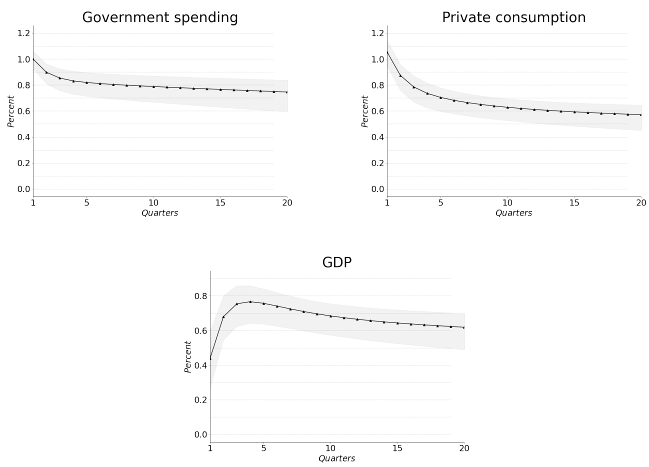
Figure 2 presents the impulse responses for government spending, private consumption and output in the baseline model. The shaded bands around the impulse response functions indicate 90 percent confidence intervals in this and all subsequent figures. Because the variables are specified in logarithms the impulse response functions have been scaled to convert percent changes into DKK changes. The impact multiplier of government spending on output is 0.4, implying that a 1 DKK increase in spending increases output by 0.4 DKK within a quarter. After one year, the output multiplier peaks at 0.75 and the effect is very persistent as it plateaus at roughly 0.65. The high persistence is not as expected from standard Keynesian models. In the open economy AS-AD model, a government spending shock increases aggregate demand and domestic inflation. The higher inflation implies a real appreciation of the exchange rate, which crowds out the effect on output through lower net exports. The slow adjustment of output is also found in Honoré (2019). Yet, the peak effect is more negligible compared with Ravn and Spange (2012) who finds an output multiplier of 1.1 DKK and Honoré (2019) who estimate it to be 1.36.

The lower estimated effect on output in this paper is affected by the period under consideration. Typically, the fiscal effects in Denmark have been examined on a sample beginning in 1983, the year where the currency was pegged against the D-mark. In a floating exchange rate regime theory predicts that the effect of fiscal policy is lower. As a theoretical example, consider the textbook Mundell-Fleming model. The model predicts that fiscal policy effectively raises output in a fixed exchange rate regime because the central bank expands the money supply to offset an appreciation of the domestic currency, which would otherwise crowd out the rise of output through net exports. In addition, the Danish economy in the 1970s until the end of the 1980s was characterized by deficits on the balance of payments, high inflation and interest rates and frequent devaluations of the Krone. These factors should reduce the size of the effects on output due to concerns over fiscal sustainability.

Furthermore, a growing public sector in this period has likely increased the size of the economy's automatic stabilizers, which in turn offsets parts of the fiscal shock and drives down output (see, e.g. Dolls et al. (2012)). If the sample is restricted to the timing of the fixed exchange rate regime, the effect on output is 1.12 on impact and with the same high persistence. The results can be reviewed in figure 5 in the appendix.

In response to a spending shock, private consumption increases by 1.06 on impact and slowly decline over five years. The impact multiplier in this paper contrasts the adverse effects on impact found in the current literature in the Danish case. Ravn and Spange (2012) find a significant negative effect of private consumption on impact, which remain low for the remainder of the period under consideration. Honoré (2019) find a negative effect on impact, but a positive and significant effect afterwards. The negative effect of a government spending shock on private consumption is predicted in standard Real Business Cycle models where consumers act in a Ricardian manner. However, the findings in this paper suggest that consumers behave contrary to this prediction as would be expected from Keynesian models.

Figure 2: Impulse responses in the linear model



6 Fiscal effects in high- and low debt regimes

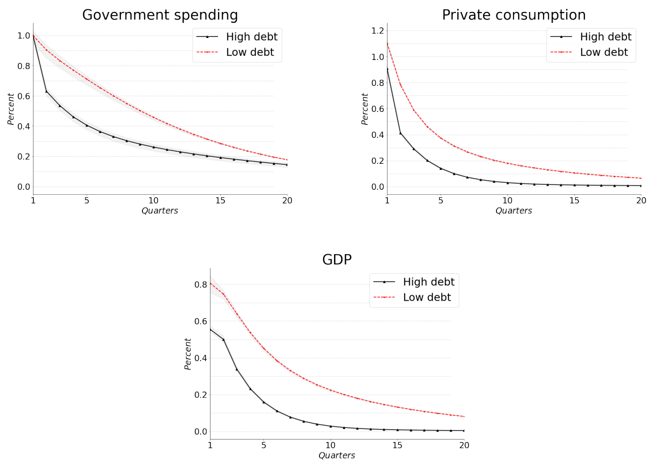
Figure 3 presents the result for the regime-switching model. Like in the linear model, the impulse responses have been scaled. The impact multiplier of output in response to a 1 DKK government spending shock is 0.56 and 0.81 for the high and low debt regime, respectively. Both impact multipliers are higher than estimated in the linear model for the entire sample and do not exhibit the same degree of persistence. The effect on output is roughly zero in the high debt regime after four years, whereas the effects in the low debt regime are more persistent as it is still 0.08 after five years. Table 7 presents the cumulative multipliers for the model presented in figure 3. The multipliers are calculated by dividing the cumulative GDP effect compared to the cumulative government spending effect. The two-year cumulative multipliers are 0.5 in the high debt regime and 1.02 in the low debt regime. The five-year multipliers are 0.34 and 1.08, respectively. This indicates that fiscal policy is more productive in periods with low debt, as expected from theory.

Given that private consumption is the single most significant component of GDP, it might explain the lower effect on output in high debt periods. On impact, private consumption increases by 0.91 and 1.09 in high and low debt regimes, respectively. While the impact multipliers are similar, the effect dies out faster in periods with high debt. After one year, the effect on private consumption is 0.20 and 0.58 in low debt periods. After two years, the effect is close to zero in the high debt regime.

7 Robustness

In this section, the robustness of the regime-switching model will be examined. Table 7 presents alternate model specifications for the output multiplier. Overall the two-year and five-year multipliers are quite robust to alternate specifications. The finding of higher fiscal effects in periods with low debts is robust across lag-lengths, ordering of the variables and transition functions. However, the impact and peak multipliers vary across specifications. With one lag, the impact multiplier is -0.24 and with three lags 0.06 for the high debt regime.

Figure 3: Impulse responses in the non-linear model



Comparably it is 0.46 and 0.36 in the low debt regime. The largest impact and peak multipliers are found in the baseline specification with two lags as previously presented.

Relaxing the third (causality) assumption from section 4.2 implies ordering GDP before private consumption. That is, GDP affects private consumption within a quarter. The impact and peak multipliers are relatively close to the baseline specification. However, the cumulative effects of output in high debt periods are higher, whereas it is smaller in low debt periods.

Calibrating the smoothing parameter in the transition function does not change much. Increasing γ such that regime switches are more sudden decreases the cumulative effects in low debt regimes but otherwise comparable to that of the baseline model. With a lower γ, the finding is equivalent.

8 Limitations and conclusion

This paper examines how fiscal effects vary with the state of public finance using a novel quarterly dataset spanning 1948 to 2020. First, a linear SVAR model is fitted to the data, including, in the following order, government spending, private consumption and output. The baseline model provides new evidence on the stability of fiscal policy over a more extended period than currently used

Table 1: Alternate model specifications, fiscal multipliers

	Impact		Two-year		Five-year		Peak	
	High	Low	High	Low	High	Low	High	Low
One lag	-0.24	0.46	0.38	1.06	0.16	1.15	0.28	0.65
Two lags	0.56	0.81	0.50	1.02	0.34	1.08	0.56	0.81
Three lags	0.06	0.36	0.41	0.92	-0.09	1.15	0.40	0.65
Ordering [G,Y,C]	0.45	0.74	0.61	0.89	0.53	0.82	0.45	0.74
$\gamma = 5$	0.16	1.07	0.48	0.87	0.49	0.93	0.43	1.07
$\gamma = 15$	0.04	1.23	0.48	0.86	0.54	0.95	0.43	1.23

in the Danish literature. In response to a government spending shock output increases by 0.44 DKK and peaks after four quarters at 0.75 DKK. Second, a non-linear STVAR model is fitted to the data, with the relationship between the nominal interest rate and GDP growth rate being the transition variable. High debt periods are defined as periods where the nominal interest rate exceeds the growth rate. The results indicate that fiscal policy remains more effective in periods with low debt. This conclusion is robust to alternate model specification; in response to a government spending shock, output increases by 0.56 in the high debt regime and 0.81 in the low debt regime. The two-year output multipliers are 0.5 and 1.02, whereas the five-year multipliers are 0.34 and 1.08.

Some limitations apply to the findings of this paper. First, the findings are an example of a stylized experiment. The results should be interpreted as an experiment where government spending is increased temporarily and unexpectedly. This is generally not how fiscal policy is carried out in reality. In fact, fiscal policy is often anticipated. Second, fiscal foresight is not accounted for in either of the models. Including such a measure would presumably lower the estimated effects because it would lead to a stronger consumption smoothing response. Third, the estimated impulse responses reflect extreme high and low debt periods. Often the economy fluctuates within these boundaries, and as a result, fiscal multipliers may be smaller in these periods.

References

Abildgren, K. (2017). A chart & data book on the monetary and financial history of denmark.

Amisano, G. and C. Giannini (2012). *Topics in structural VAR econometrics.* Springer Science & Business Media.

Auerbach, A. J. and Y. Gorodnichenko (2012). Measuring the output responses to fiscal policy. *American Economic Journal: Economic Policy 4*(2), 1–27.

Bachmann, R. and E. R. Sims (2012). Confidence and the transmission of government spending shocks. *Journal of Monetary Economics 59*(3), 235–249.

Berger, D. and J. Vavra (2014). Measuring how fiscal shocks affect durable spending in recessions and expansions. *American Economic Review 104*(5), 112–15.

Bergman, U. M. and M. M. Hutchison (2010). Expansionary fiscal contractions: Re-evaluating the danish case. *International Economic Journal 24*(1), 71–93.

Blanchard, O. (2019). Public debt and low interest rates. *American Economic Review 109*(4), 1197–1229.

Blanchard, O. and R. Perotti (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *the Quarterly Journal of economics 117*(4), 1329–1368.

Caldara, D. and C. Kamps (2012). The analytics of svars: a unified framework to measure fiscal multipliers.

Dolls, M., C. Fuest, and A. Peichl (2012). Automatic stabilizers and economic crisis: Us vs. europe. *Journal of Public Economics 96*(3-4), 279–294.

Groth, C. (2017). Lecture notes in macroeconomics. Technical report, mimeo, available at: http://www. econ. ku. dk/okocg/VM/VM-general/Material ....

Honoré, S. (2019). The fiscal effects in denmark - a structural vector auto regressive analysis.

Ilzetzki, E., E. G. Mendoza, and C. A. Végh (2013). How big (small?) are fiscal multipliers? *Journal of monetary economics 60*(2), 239–254.

Ravn, M. O., S. Schmitt-Grohé, and M. Uribe (2012). Consumption, government spending, and the real exchange rate. *Journal of Monetary Economics 59*(3), 215–234.

Ravn, S. H. and M. Spange (2012). The effects of fiscal policy in a small open economy with a fixed exchange rate: The case of denmark. Technical report, Danmarks Nationalbank Working Papers.

Reinhart, C. M. and K. S. Rogoff (2010). Growth in a time of debt. *American economic review 100*(2), 573–78.

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: journal of the Econometric Society*, 1–48.

9 Appendix

Figure 4: Probability of being in a low debt regime

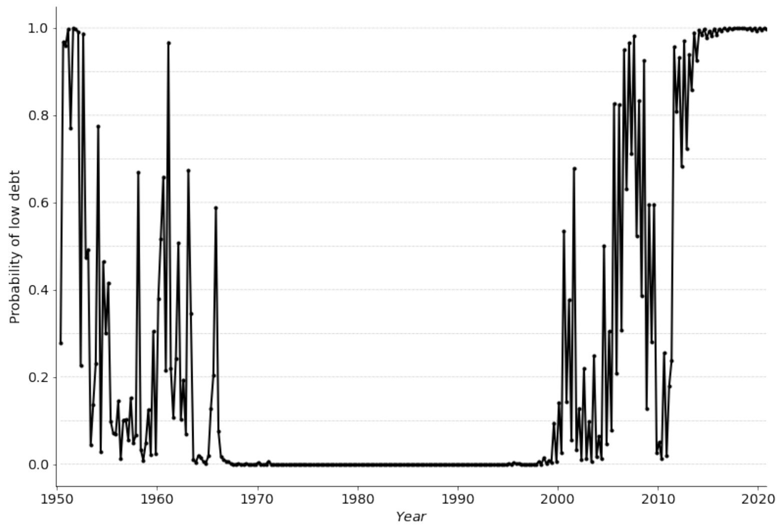


Table 2: Lag selection criteria

	$p = 1$	$p = 2$	$p = 3$	$p = 4$
AIC	2.9277	2.3409	2.7436	2.4731
BIC	2.0687	2.6108	3.1429	2.0026

Table 3: Unit root and stationarity tests

	Augmented Dickey-Fuller	Kwiatkowski
Critical value	**-1.942**	**0.146**
GDP	-3.975	6.518
Private consumption	-2.029	6.026
Government spending	-1.984	5.599

Figure 5: Linear SVAR dynamic responses, 1983-2020