# Let's get fiscal!

A Bayesian structural VAR analysis on how fiscal policy affects private consumption in Denmark and Sweden


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Master Essay II

Spring 2022

# Abstract

This thesis studies the effect on private consumption and its components by durability, following an exogenous shock to government spending, in Denmark and Sweden. In order to compare the outcomes when being at the zero lower bound (ZLB) or not, the quarterly data ranging from 1995 to 2020, is split into two sub-samples. The impulse response functions, generated by a Bayesian structural VAR (BSVAR), provides evidence towards a larger effect on private consumption in the new monetary policy regime for both countries. Conversely, the results from the higher interest rate environment suggests a crowding-out effect since consumption decreases on impact. Denmark displays a larger fiscal multiplier compared to Sweden when being in a higher interest rate environment and vice versa in the lower interest rate environment. The varying magnitude, to some extent, derives from central banks responding differently to inflationary pressure from government spending, depending on the exchange rate policy. Durable goods drive the increased consumption in a zero lower bound environment, partly explained by facilitated credit expansions. It is evident from this thesis that the state of monetary policy is pivotal for the effect on private consumption from fiscal stimulus.



**Keywords:** Fiscal policy, zero lower bound, private consumption, durable goods, non-durable goods, government spending, BSVAR.

# Contents

# 1 Introduction

During the financial crisis and the Covid-19 recession, the demand for stimulus packages increased drastically, thus, raising the question regarding the use of fiscal policy as a stabilisation tool. The aim of this thesis is to investigate how expansionary fiscal policy, more specifically government spending, affects aggregate consumption and its composition (distinguishing between durable and non-durable consumption). Furthermore, the period of analysis is split into two sub-samples where one is characterised by being in a high interest rate environment and the other in a zero lower bound (ZLB). This division is carried out since empirical evidence point to differing magnitude of the fiscal multiplier when being at the ZLB (Christiano et al., 2011; Woodford, 2011; Erceg and Lindé, 2014). The composition of private consumption further exhibits varying degrees of sensitiveness to the level of interest rates, where durable goods displays a higher level of sensitivity compared to non-durables (Mankiw, 1983). Whilst necessities constitute the largest part of non-durable goods, and are thereby not as affected by the state of the economy, the response of durable goods serves as a main economic indicator. The simulation conducted in this thesis reveals in more detail how demand changes for both goods in the different periods.

The contribution of this thesis to already existing literature is threefold. Firstly, it seeks to confirm or contradict results found in previous studies concerning the pattern of aggregate consumption following exogenous innovations to government spending, where a vast majority of empirical studies find a positive effect when using a structural vector autoregression (SVAR) (e.g., Blanchard and Perotti (2002); Fatás and Mihov (2001); Galí et al. (2007)). Secondly, the use of Danish and Swedish data adds information regarding how small, open economies reacts in contrast to large economies, as well as, comparing a fixed and flexible exchange rate regime.[1] Countries with fixed exchange rates such as Denmark should at normal times i.e., not at the ZLB, expect a larger multiplier compared to Sweden, a result validated both empirically and theoretically (Ravn and Spange, 2012). However, when being confronted by a ZLB, the fiscal multiplier is expected to be lower in an economy with a fixed exchange rate regime. This is due to long-term interest rates being unaffected in Denmark while Sweden could exhibit a decrease (Nakamura and Steinsson, 2014). Lastly, studies investigating the effect from expansionary fiscal policy when being in a low interest rate environment is sparsely and the existing literature focus mainly on aggregate consumption.[2] This thesis looks further into which components of consumer goods are affected in a ZLB environment,

[1] The majority of previous empirical evidence presented in this thesis is based on U.S data.

[2] Noteworthy as well is that the studies that are cited have focused on DSGE models whereas this thesis utilize a SVAR framework.

which to the knowledge of the authors has not previously been investigated.

The household debt ratios in Denmark and Sweden are at alarming levels, having increased from 193 to 259 and 92 to 200 percent of disposable income respectively, over the 26 years investigated.[3] Durable goods consumption has developed significantly for both countries over the period of investigation.[4] Concurrently, household debt ratios indicate that credit purchases have expanded, perhaps best explained by elevating house prices, which constitute the largest part of household indebtedness.[5] On the other hand, owning of dwellings form a large part of household wealth. Since house prices have ascended for the period of investigation, it enables further credit expansions and purchases of durable goods. This is the channel advocated for in this thesis, i.e., that the low interest rate environment has vastly facilitated lending. Thus, an expansion in government spending, ultimately leading to more money in the pocket for economic agents, would increase durable goods consumption to a larger extent compared to non-durables.

Previous literature has found durable goods to react more to changes in the interest rate compared to non-durable goods and services (Mankiw, 1983). As the interest rate has been close to zero for the 2010-2020 period investigated, the demand for durable goods is expected to be higher compared to non-durables. In periods with relatively higher interest rates such as the other period investigated (1995-2008), consumption might increase but durable goods is not expected to be the primary source. By using micro-level data, Parker et al. (2013) found that more liquidity constrained households have a larger propensity to consume following fiscal stimuli, and where the expenditures for durable goods increased the most. Noteworthy, these findings relate to the economy being in deep recession, which has been shown to affect the magnitude of the fiscal multiplier (e.g., Auerbach and Gorodnichenko (2012); Tagkalakis (2008)).

This thesis uses a Bayesian SVAR (BSVAR) where the main specification includes government spending, GDP and private consumption in the endogenous vector. A breakdown of consumption by durable and non-durable goods is studied in a second approach to see more clearly which goods are driving aggregate consumption. The identification method used is a Cholesky decomposition where government spending is ordered first, following Blanchard and Perotti (2002). The period of investigation ranges from 1995 to 2020 and is divided into two sub-samples (1995-2008 and 2010-2020), where the monetary policy regime is different.[6]

[3] See Appendix D, Figure 26.

[4] See Appendix B for the development of durable goods consumption.

[5] See Appendix D, Figure 27 for house price indices.

[6] Thus, excluding the financial crisis and the Covid-19 recession.

The results in this thesis confirms a larger fiscal multiplier when being confronted by a ZLB environment and gives further insights as to which consumption component being the driving force of the development in private consumption. Denmark and Sweden display similar effects on consumption but with different magnitude which was expected given earlier research on small, open economies with different exchange rate regimes (Nakamura and Steinsson, 2014; Ravn and Spange, 2012). Somewhat surprisingly, results from the sample outside the ZLB displayed an initial drop in consumption for both countries, opposing the majority of papers using a SVAR. On the other hand, it may be expected as central banks running a flexible exchange rate regime could respond with increased interest rates, thus counteracting the inflationary effect from the fiscal stimulus. Moreover, this outcome is in line with what Ravn and Spange (2012) finds when using an analogous approach for Denmark which includes observations almost entirely outside the new era for monetary policy. When looking into the period starting after 2010, it is evident that durable good consumption drives consumption in a low interest rate setting which is argued to be partly caused by facilitated credit expansions. The low interest rates, making loans less costly, along with household increasing their wealth through surging asset prices, are two channels through which the demand of durable goods can increase.

This thesis starts by providing some background on the development of fiscal policy and state of the Danish and Swedish economies. The following section presents previous literature on consumption and state-dependence. Thereafter, the methodological framework is addressed with a discussion regarding alternative identification strategies. Section 5 demonstrates and discusses the empirical results with focus on the impulse responses following an exogenous shock to government spending. Lastly, the authors of this thesis provide concluding remarks.

# 2 Fiscal Policy

Denmark and Sweden are seen as role models with their high living standards, less income distortions, functioning well-fare systems as well as their effective way of handling economic downturns. The two countries are similar in terms of being small, open economies and have a strong economic collaboration. Despite sharing traits, they differ in magnitude and timing of recessions, exchange rate regime and demographics to name a few. The time period of investigation includes major structural changes to the global economy, such as the digitalisation, the global financial crisis and the Covid-19 pandemic. Dealing with recessions have forced countries to alter their economic policies and Denmark and Sweden are no exceptions.

The Swedish financial crisis in the 1990s caused by a housing bubble, led to a deep economic recession in the four subsequent years. The banking crisis entailed large budget deficits as well as negative public savings, ultimately causing government debt and unemployment to rise for the remaining period of the 1990s. A new fiscal policy era had begun in 1993 where a clear inflation target of 2 percent was set and a floating exchange rate regime for the Swedish Krona. At the beginning of the crisis Sweden had a fixed exchange rate regime, however, it became too costly for the Riksbank to sustain the value of the Swedish krona and they had to let it float in the end of 1992. The banking crisis, which has been compared to the crisis in the 1930s in terms of production losses, led to the development of the still present monetary and fiscal policy framework, where one of the most crucial principle revolved around open debate and transparency regarding macroeconomic policies (Andersson et al., 2003).

Since 1982, Denmark has been running a fixed exchange rate regime. First through a pegging of the Danish krone to German D-mark, and later to the euro (Spange and Toftdahl, 2014). The decision of a fixed exchange rate regime, ultimately implies that Denmark is very limited in their monetary policy. Hence, their fiscal policy becomes all the more interesting. Having a fixed exchange rate expedites the possibility for fiscal stimulus generating real macroeconomic effects as the nominal interest rate remains unchanged. However, being a small, open economy, the result from expansionary fiscal policy could be captured more in the trade balance with larger level of imports (Ravn and Spange, 2012).

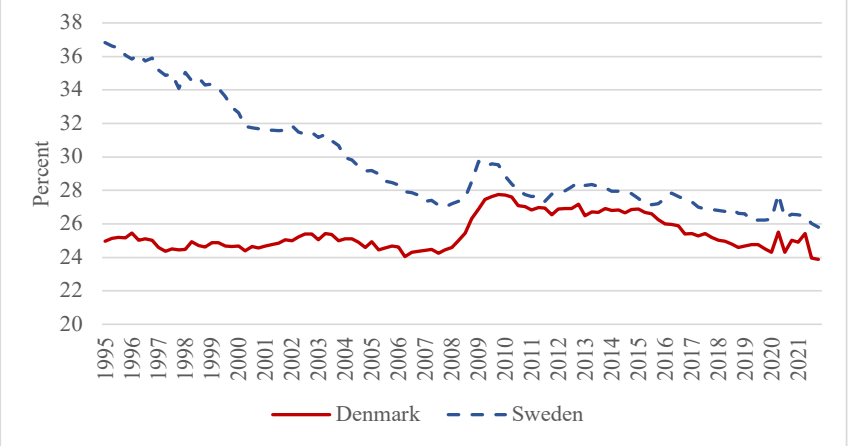
Denmark and Sweden have exceptionally high household debt to income ratios but at the same time low public debts.[7] The low sovereign debt, could be an explanation as to why Denmark succeeded to quicker turn the economy after the Covid-19 breakout compared to other European countries. Interestingly, 60 percent of the expenditures related to recovering from Covid-19 were directed towards environmental goals which could be another explana-

[7] See Figure 4 for public debt ratios and Appendix D, Figure 26 for household indebtedness.

tion for the rapid turn (OECD, 2021). An alternative explanation is that the fiscal stimulus yielded larger effects, giving support to the argument of Ravn and Spange (2012) discussed above concerning larger effects with a fixed exchange rate policy. Savings increased substantially during the pandemic but more as a response to the restrictions rather than cautious consumers. Precautionary savings rose but was still lower in comparison with the financial crisis (Andersen et al., 2021).

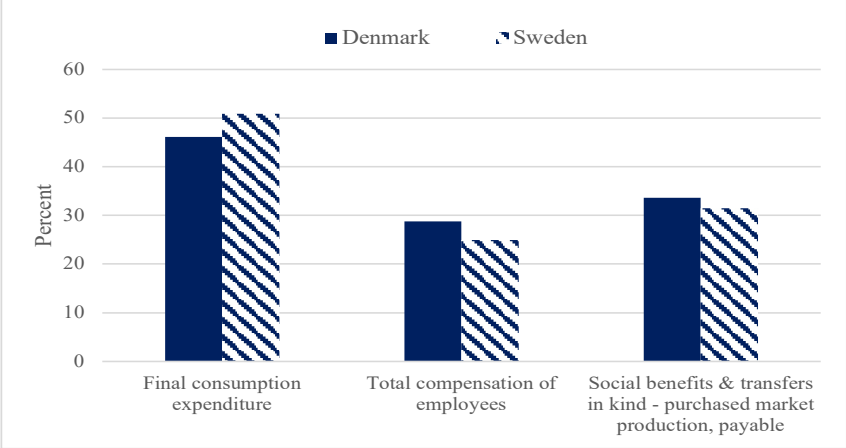
When looking at government spending as a share of GDP, displayed in Figure 1, it is apparent that the role of fiscal policy has decreased in Sweden over the years, but is still a larger component of GDP compared to Denmark. The graph further illustrates that the countries have opted contra-cyclical fiscal policy at times of deep economic downturns such as the financial crisis and the Covid-19 recession. Additionally, Figure 1 demonstrates that fiscal policy regained its role as a stabilisation tool after the financial crisis, a development mentioned in the introduction. Furthermore, Sweden and Denmark have a similar breakdown in their government spending, although Denmark spends a slightly larger part on wages and social benefits which is displayed in Figure 2. Conversely, less is spent on other consumption expenditures compared to Sweden. The composition illustrated in Figure 2, is based on 2020 data, however, as the pattern is relatively stable over time one can assume that it is neither this composition nor the different time periods investigated, that will serve as explanation to diversity in the results for both countries (see Figure 3).

**Figure 1:** Government expenditures as a share of GDP




Source: OECD

**Figure 2:** Total government expenditure by function (2020)




Source: OECD

**Figure 3:** Total government expenditure by function over time


Source: OECD

# 3 Consumption and state-dependent fiscal policy

## 3.1 Previous literature

Whilst economists agree regarding the impact on output from an increase in government spending, there is no consensus on the magnitude or direction of the impact on private consumption. Some results are in line with the neoclassical theory suggesting a decrease in consumption following expansionary fiscal policy, whereas other results are in line with Keynesian theory stating the opposite impact on consumption.

The prominent paper by Blanchard and Perotti (2002) suggested the use of a Structural VAR approach (SVAR) which until then, mainly had been used when studying monetary policy. In particular, the effects on GDP and its components following exogenous innovations to government spending and tax revenues were studied. The SVAR approach was argued to preferably be used when investigating fiscal rather than monetary policy. This is partly motivated by the lag in decision and implementation in fiscal policy enabling more exogenous shocks in comparison with monetary policy. Their result indicated an increase in private consumption following a shock to government expenditure, opposing neoclassical theory. Another study, also finding support for the Keynesian theory, investigated the effects of a fiscal policy shock on consumption and employment. Attempts to explain the results within a standard real business cycle model were conducted, but with no success since feasible assumption yielding corresponding implication could not be found (Fatás and Mihov, 2001). Galí et al. (2007) confirms the positive and persistent effect on consumption from an exogenous rise in government spending which they find is almost perfectly following the effect on disposable income.

A narrative approach or event-study approach takes the timing of events into consideration, such as, policy decisions or elections, timing of wars, details of institutional information etc. This is conducted in an attempt to mitigate the problem of fiscal foresight, i.e., economic agents anticipating the shock. A study using this approach included "war dates" in order to study the effect of changes in government spending on aggregate variables. It was found that, innovations to military build-ups caused economic growth, whilst at the same time lowering consumption and real wages, after WWII in the United States (Ramey and Shapiro, 1998). Perotti (2011) looked deeper into the components of consumption, and found a negative response for durable goods and a flat response for non-durable goods following a shock to announcements on government military spending. When estimating the VAR for the same period but using total government spending, the results are similar to earlier studies with positive and significant impact on output and consumption with durable, non-durables and

services, all showing positive responses. Interestingly, the effect on durable goods seems to be stronger compared to non-durables.

In the neoclassical view government spending is said to replace private consumption. When implementing a representative agent framework model by using real data, it is found that government spending decreases consumption (defining consumption as only non-durable and services), and the positive effect on output is argued to be evidence for agents smoothing out consumption over time. Hence, giving empirical support to neoclassical theories regarding rational expectations and government spending not having long-run real effects (Aschauer, 1985). The theory implies that consumption will not change following expansionary government spending as it will cause a rise of taxes in the future, which is also known as the Ricardian equivalence. This ultimately suggests that fiscal policy with deficit spending cannot boost the economy (Barro, 1974). On the other hand, one cannot rely on the representative agent framework in order to theoretically explain the result of increased private consumption following an exogenous innovation in government spending, something found in several studies (e.g., Blanchard and Perotti (2002); Fatás and Mihov (2001); Galí et al. (2007)).

An alternative framework, allowing for heterogeneous agents which has been used more frequently in microeconomics, might serve as an explanation to increased consumption. Incorporating rule-of-thumb consumers, i.e., consumers that each period only take current income into account, in conjunction with sticky prices, supports the effect of increased consumption following an innovation to government spending (Galí et al., 2007). Another approach makes a distinction between savers and spenders among consumers. The division allows for real effects from a tax cut in contrast to the classical Ricardian equivalence theorem. Different agents have different time horizons for consumption depending on income and initial wealth, which contradicts consumption smoothing in a representative agent framework (Mankiw, 2000).

Ravn and Spange (2012) investigated the effect of fiscal policy in Denmark after implementing the fixed exchange rate policy in 1982, using data stretching from 1982 to 2011. The method used is essentially the same as in this thesis, i.e., a structural VAR with output, consumption and government spending in the endogenous vector. Expansionary fiscal policy was found to give rise to a fiscal multiplier larger than one, resulting in a sizable effect on the real economy, but mainly in the short run. The significantly positive impact is explained by sticky prices along with the fixed exchange rate, implying that the nominal interest rate does not have time to adjust in the short run, also called the interest rate effect. Moreover, a large portion of the fiscal stimulus will be placed on imported goods due to Denmark being a small,

open economy, a phenomenon called the leakage effect. The non-persistent pattern of the multiplier is explained by prices adjusting, thus, resulting in a decrease in trade. The results suggest that the interest rate effect dominates the leakage effect for a small, open economy with a fixed exchange rate regime which is in line with economic theory. Lastly, unlike other cited papers above, consumption was found to drop on impact, which was explained to be resulting from increased private investments.

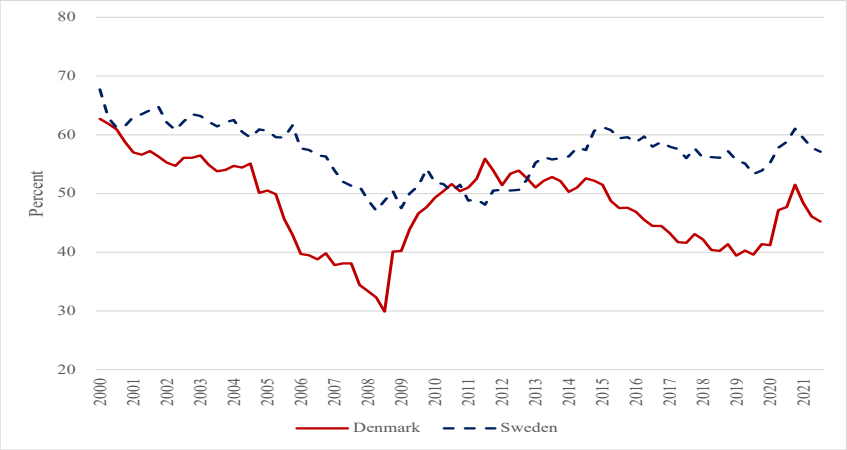
## 3.2 State-dependence

When investigating fiscal policy, researchers find that the fiscal multiplier differs a lot in magnitude depending on the period investigated. More precisely, it is the state of the economy that is determining the results. Three states that are of crucial importance and addressed in the literature are economic activity, level of sovereign debt and constraints to monetary policy in a ZLB environment. In this thesis, the ZLB environment will be the focal point as the other states discussed are either of less relevance or in need of another methodology.

If a country's economy is prosperous and in less need of stimulus, the effect of increased government spending might not be the same as if the economy is faced by a recession since agents are in different economic situations. However, the existence of literature on the state of the economy is inadequate. The lack of research is due to the main methodological frameworks used on the topic. Neither a VAR, nor a DSGE approach can fully capture the impact of economic activity in the magnitude of the fiscal multiplier (Auerbach and Gorodnichenko, 2012). Fiscal policy is found to be more efficient during recessions compared to expansions. The larger effect is explained by government spending not overtaking investments and private consumption to the extent it might do during an episode of a booming economy. An alternative explanation could be that the extra income is necessary to be consumed as economic agents have no space for saving (Auerbach and Gorodnichenko, 2012; Tagkalakis, 2008).

When discussing fiscal policy, one cannot ignore public debt. Empirical literature show that the level of public debt can affect the impact of fiscal policy. Studies have shown that at low or moderate levels of debt, government spending increase output. However, when debt is at a higher level, the effect on output becomes negative (Nickel and Tudyka, 2014; Perotti, 1999). These results indicate that decision-makers must be cautious to not accumulate too much sovereign debt to be able to stimulate the economy with fiscal policy tools. Figure 4 depicts public debt as a percentage of GDP for Sweden and Denmark for the time period 2000-2021. The Swedish public debt to GDP ratio has consistently been at a higher level, except for the couple of years after the financial crisis.

**Figure 4:** Public Debt



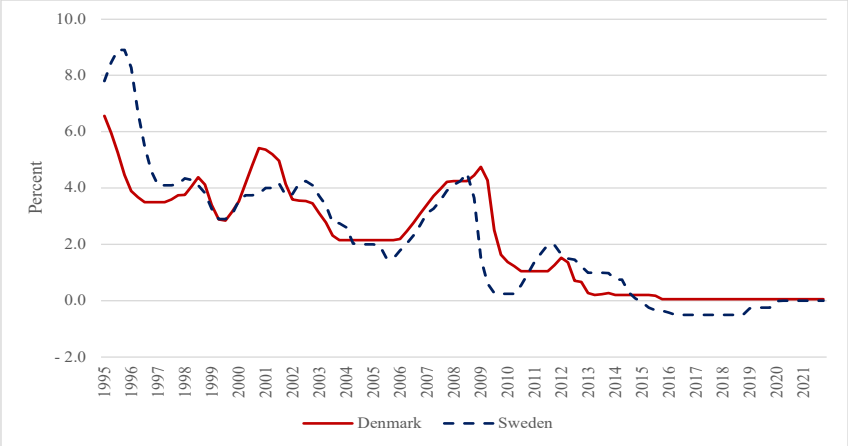

Sources: OECD

While economic activity and level of public debt are both essential for the efficiency of fiscal policy, they are arguably of less interest for this thesis. Firstly, as no deep recessions are included in the analysis and secondly, both countries have relatively low levels of sovereign debt. Thus, of much larger interest is the state of monetary policy in these countries and in particular the effect of a low interest rate environment. The economic theory regarding nominal interest rates being zero or close to zero is called the zero lower bound and refers to a liquidity trap where everyone prefers to hold their money in cash, eradicating the entire banking system (Romer, 2012). However, this has fortunately not been the case for central banks implementing these low interest rates. Instead, economists are referring to an effective lower bound which to a large extent would be determined by the cost for commercial banks transporting and storing cash in vaults (Agarwal et al., 2015).

After the financial crisis, a new era of monetary policy started where central banks went from running a corridor system to a floor system. In simple terms, the corridor system implied a close monitoring of the InterBank Overnight Rate (IBOR) by controlling the demand and supply for excess reserves (Kahn, 2010). However, when hit by the financial crisis, central banks chose to provide a large amount of liquidity as well as lowering the interest rates to such extent where the close link between excess reserves and the interest rate had disappeared. Instead, central banks went to a floor system where the demand for excess reserves had practically vanished and the target interest rate was essentially equal to the interest rate on excess reserves (IOER). A few years later, when inflation did not seem to respond and economic growth was stagnating, new unconventional methods of stimulating the economy by lowering the long-term interest rate were opted such as quantitative easing and forward

guidance. The Swedish Riksbank and the European Central Bank moved to unprecedented low policy rates, where the Riksbank set the repo rate even below zero (The Riksbank, 2015; Rostagno et al., 2019). Figure 5 demonstrates the evolution of interest rates from the first quarter of 1995 until the last quarter of 2021. Both countries reached all-time low policy rates after 2010 and although there was a slight increase, the interest rates have stayed close to zero for the remaining period.

**Figure 5:** Policy rates




Sources: Danmarks Nationalbank and the Swedish Riksbank

Although fiscal and monetary policy are disconnected in several ways, the two affect each other. The ZLB environment has been found to yield a larger fiscal multiplier (e.g., Christiano et al. (2011); Woodford (2011); Erceg and Lindé (2014)), a result on which the hypothesis of this thesis is based on, but rather looking into the composition of consumer goods by their durability. It could be argued that the larger effect on the fiscal multiplier is due to monetary policy being limited. Fiscal policy could be favoured by the ZLB as monetary policy is not expected to respond to higher consumer prices. Instead, a decrease of the real interest rate is more plausible, enhancing the fiscal multiplier (Woodford, 2011).

Looking further into the composition of consumer goods, previous literature has found durable goods to react more to changes in the interest rate compared to non-durable goods and services (Mankiw, 1983). Since the interest rate has been close to zero for the 2010-2020 period investigated, the demand for durable goods is expected to be higher compared to non-durables. In periods with relatively higher interest rates such as the other period investigated (1995-2008), consumption might increase but durable goods is not expected to be the driving force. Instead, consumption could react negatively through the crowding-out effect, as central banks at normal times may increase the policy rate. Furthermore, as mentioned

earlier, countries with fixed exchange rates such as Denmark should at normal times i.e., not at the ZLB, expect a larger multiplier compared to Sweden, a result backed up both empirically and theoretically (Ravn and Spange, 2012). However, when being confronted by a zero lower bound, the fiscal multiplier is expected to be lower in an economy with a fixed exchange rate regime. This is due to long-term interest rates being unaffected in Denmark while Sweden could exhibit a decrease (Nakamura and Steinsson, 2014).

# 4 Methodology

## 4.1 Model

For a substantial amount of time, economists were trying to claim exogenous relationships between macroeconomic variables, thus, leaning more towards traditional regression analysis as well as eyeball econometrics and claiming causalities. Although some of the claims were perhaps not too far from the truth at the time, the economic playground has changed fundamentally. Today, there are few, if any economists who would claim exogenous relationships given the large interdependence between countries and markets. Vector autoregressions (VARs), which are multivariate regression models, aim to acknowledge the endogeneity between variables. Compared to Dynamic Stochastic General Equilibrium models (DSGE models), which are commonly used when studying macroeconomics, VARs are more data driven and less theoretically founded. This is a clear advantage with the methodology if one wants to claim causalities, advocated by Sims (1980). The general model, VAR(p) can be expressed in companion form:

$$\begin{bmatrix} x_t \\ x_{t-1} \\ x_{t-2} \\ \vdots \\ x_{t-p} \\ x_{t-p+1} \end{bmatrix} = \begin{bmatrix} A_1 & A_2 & A_3 & \dots & A_{p-1} & A_p \\ I & 0 & 0 & \dots & 0 & 0 \\ 0 & I & 0 & \dots & 0 & 0 \\ 0 & 0 & I & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & I & 0 \end{bmatrix} \begin{bmatrix} x_{t-1} \\ x_{t-2} \\ x_{t-3} \\ \vdots \\ x_{t-p-1} \\ x_{t-p} \end{bmatrix} + \begin{bmatrix} \epsilon_t \\ 0 \\ 0 \\ \vdots \\ 0 \\ 0 \end{bmatrix} \tag{1}$$

or in more compact form:

$$y_t = By_{t-1} + \epsilon_t. \tag{2}$$

In this compact form, $y_t$ is of dimension $(p\,n \times 1)$, B of dimension $(p\,n \times p\,n)$ and $\epsilon$ of dimension $(p\,n \times 1)$. The model that will be of main interest in this thesis is a Structural VAR(1) with three endogenous variables, Output $(Y)$, Consumption $(C)$ and Government Spending $(G)$. It can be expressed in the following matrix:

$$A \begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = B \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} u_{G,t} \\ u_{Y,t} \\ u_{C,t} \end{bmatrix} \qquad u_t \sim VWN(0, I). \tag{3}$$

Where $A$ is the structural matrix, determining the contemporaneous relationships among the variables and allowing for correlation between the error terms. The latter statement is

apparent when writing the model in reduced form:

$$\begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = A^{-1}B \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + A^{-1} \begin{bmatrix} u_{G,t} \\ u_{Y,t} \\ u_{C,t} \end{bmatrix} \tag{4}$$

or equivalently:

$$\begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = D \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{G,t} \\ \epsilon_{Y,t} \\ \epsilon_{C,t} \end{bmatrix} \qquad \epsilon_t \sim VWN(0, \Omega). \tag{5}$$

The covariance matrix of the vector white noise $\Omega$ (given by $A^{-1}A^{-1\prime}$) is no longer assumed to be of identity form, but instead when letting the error terms correlate, it allows for an economic interpretation. The choice of having only one lag is determined by looking at AIC, BIC and HQC values as well as comparing differences in results. More importantly it is motivated by the parsimony principle, stating that less is more. When adding a lag within a VAR there is an exponential increase in the number of parameters in need of estimation and without a large number of observations this might become a problem where the model could be over-fitted. The use of a Bayesian estimation technique is mitigating the issue of many parameters being estimated, yielding more precise estimations (Nickel and Tudyka, 2014). Hence, the thesis makes use of a Bayesian structural VAR (BSVAR).

An issue often highlighted when analysing macro variables over time concerns stationarity. Sims et al. (1990), argue that non-stationarity is not of major importance when using a BSVAR, since the concern is not whether data used are non-stationary, but rather if the coefficients estimated have a non-standard distribution. Therefore, Bayesian inference need not to worry about integrated regressors since the likelihood function, in which the approach is based on, has a Gaussian shape regardless of the existence of non-stationarity. Furthermore, even though the variables are integrated of order 1, running a VAR in first differences when cointegration exists, leads to a misspecified model. Their suggestion is thereby to run a VAR in levels as it leads to consistent estimates and removes any misspecifications, however, impulse responses should not be investigated too far in horizon.

In this thesis, two specifications are made, the first one is described above where the shocking variable government spending is ordered first, followed by output and consumption. The second specification, splits consumption into two parts, durable and non-durable goods and as in the first case, they are both ordered last in the vector. When altering the order of the variables, the results did not differ significantly. As another robustness check, the financial crisis and the pandemic were included to see if the results changed, since differences were

observed in the response of the variables, these data points were excluded. Lastly, investment, tax revenue and trade balance were included in the model to investigate if the pattern of our main variables of interest changed and whether their responses could potentially explain the movement of consumption and GDP. [8]

## 4.2 Cholesky Decomposition

When using a SVAR, restrictions are needed in order to estimate the parameters in the reduced form as there are $n^2$ more parameters in the structural model compared to the reduced form. In fact, in equation (3), a restriction in form of the assumption of $u_t \sim VWN(0, I)$, i.e., imposing an identity matrix to the covariance matrix (generally denoted $\Sigma$), has already been done.[9] As the matrix $B$ is supposed to capture the dynamics, it is preferable to not put any restrictions on this but rather on the contemporaneous effects in $A$. The solution suggested by Sims (1980) is to enforce a lower triangular matrix on $A$, which imposes a Cholesky decomposition on the error terms.[10] The neat solution, however, gives rise to one problem concerning the ordering of the variables. The ordering and inclusion of variables is a user-specific choice and there exists different strategies and intuition regarding which variables to include in the vector of endogenous variables and of what order. Government spending is ordered first in the lower triangular matrix $A$, giving a contemporaneous effect on all other variables included, following Blanchard and Perotti (2002). Ordering the policy variable first differs from most literature on monetary policy. The policy variable is usually put between the slow- and fast-moving variables. This is because the policy rate follows the Taylor rule, making it endogenous to GDP and its components. When instead looking at government spending as the fiscal policy instrument, being a component of GDP, it is more reasonable to assume a contemporaneous effect on all variables in the vector.

When imposing the ordering in the structural model this gives the following shape:

$$\begin{bmatrix} p_1 & 0 & 0 \\ q_1 & q_2 & 0 \\ r_1 & r_2 & r_3 \end{bmatrix} \begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = B \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} u_{G,t} \\ u_{Y,t} \\ u_{C,t} \end{bmatrix} \tag{6}$$

and in the reduced form:

$$\begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = \begin{bmatrix} p_1 & 0 & 0 \\ q_1 & q_2 & 0 \\ r_1 & r_2 & r_3 \end{bmatrix}^{-1} B \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} p_1 & 0 & 0 \\ q_1 & q_2 & 0 \\ r_1 & r_2 & r_3 \end{bmatrix}^{-1} \begin{bmatrix} u_{G,t} \\ u_{Y,t} \\ u_{C,t} \end{bmatrix} \tag{7}$$

[8] See Appendix C.

[9] This counts for $n(n+1)/2$ restrictions, thus leaving $n(n-1)/2$ to be imposed.

[10] In this way, exactly $n(n-1)/2$ restrictions are made and the parameters can be estimated accordingly.

or equivalently:

$$\begin{bmatrix} G_t \\ Y_t \\ C_t \end{bmatrix} = D \begin{bmatrix} G_{t-1} \\ Y_{t-1} \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{G,t} \\ \epsilon_{Y,t} \\ \epsilon_{C,t} \end{bmatrix} \qquad \epsilon_t \sim VWN(0, \Omega). \tag{8}$$

Note that equation (8) is the same expression as in (5) but with a clearer definition of the structure on $A$ with $A^{-1}$ now being the Cholesky factor of $\Omega$. At this stage, concerns may arise regarding endogeneity, where the error terms are correlated with the variables. However, the two assumptions of a diagonal covariance matrix of $u_t$ in the structural form model and a lower triangular shape of $A$ erase a possible simultaneity bias. After validating the choice of identification scheme, impulse response functions (IRFs) can be calculated. IRFs, computed by a 1 percent increase in $\epsilon_G$, are the outputs generated by the multivariate system and serve as the tool for analysing exogenous shocks. They are meant to capture both the contemporaneous and dynamic effects on the endogenous variables.

## 4.3 Alternative identification schemes

Another way of identifying policy shocks is by imposing sign restrictions on the impulse responses, an identification procedure developed by Uhlig (2005) and later applied to fiscal policy by Mountford and Uhlig (2009). Sign restrictions are meant to prevent unreasonable responses on impact for the variables by determining their direction by economic intuition. The conventional wisdom existing for monetary policy shocks, does not exist in neither the theoretical nor empirical literature for a fiscal policy shock, who are unable to take a stance regarding the direction of the impact. One can also identify the fiscal policy shock by imposing long-run restrictions, something achieved by Blanchard and Quah (1988), which is another more theoretical approach. In this thesis, only a short-run assumption is made by using a Cholesky decomposition, in order for the approach to be less theoretical and rely more on data.

The narrative approach is one of the other main identification schemes first introduced by Ramey and Shapiro (1998), who conducted it for studying the effects of large unexpected government defence spending. Romer and Romer (2010), also make use of a narrative approach by collecting data of official fiscal policy announcements. However, according to Auerbach and Gorodnichenko (2012), the narrative approach imposes more constraints since the effects measured stem from a specific set of shocks, yielding a more qualitative evaluation, while policymakers are more interested in the quantitative assessment of the effects. Furthermore, as stated by Bénétrix and Lane (2010), most of the papers conducting a narrative approach

focuses on the U.S. case and it may be that this approach is not as useful when applied on other countries. Another way of claiming that the shocks calculated are indeed exogenous and not predicted by economic agents, is to follow the dynamics of public debt (e.g., Favero and Giavazzi (2007); Chung and Leeper (2007)). Chung and Leeper (2007), tackles the issue of fiscal solvency not being considered in a VAR, by introducing a debt-stabilizing condition into the VAR. The authors conclude that, at long horizons, fiscal solvency has significant quantitatively impacts, while in the short run the responses are not as affected. Since this thesis will look at the short-run impacts, it will not consider the debt dynamics implications of a fiscal policy shock.

A non-fundamental representation of a time series arises when one structural shock represents a combination of news about the past and future, resulting in the SVAR approach not being able to correctly identify the responses following a shock. Conversely, studies have found no significant difference when taking anticipation into account while using a SVAR approach (e.g., Beaudry et al. (2015); Mertens and Ravn (2010)). Furthermore, Perotti (2011) argues that using quarterly data further alleviates this issue. A narrative approach, or other ways to take fiscal foresight into account will not be conducted, although one should be aware of the potential effects anticipation can have when analysing the results.

## 4.4 Data

Quarterly national accounts data collected from the OECD database, spanning the period 1995:Q1 to 2020:Q1, constitutes the data set for the analysis. The data set is divided into two sub-samples for both countries. The first period ranges from 1995:Q1 to 2008:Q3, thus, omitting data points affected by the financial crisis. The second period consist of data from 2010:Q1 until 2020:Q1, excluding observations during the Covid-19 recession.[11] The included variables in the models (although not all being presented in the main results) are: general government final consumption, gross domestic product (GDP), private final consumption expenditure, gross fixed capital formation (GFCF), taxes less subsidies on production and imports, trade balance, durable and non-durable goods consumption.[12] Further information on the variables and data sources are provided in Appendix A and B.

The main specification in this thesis includes the variables government spending, output and consumption, following Ravn and Spange (2012). Furthermore, the composition of consumer

[11] As a reminder, results were altered when including the financial crisis and the Covid-19 recession, which is why they are excluded.

[12] All variables are transformed by using natural logarithms, which is the standard approach when doing a SVAR in levels.

goods is analysed by their durability. Final goods can be separated into durable and non-durable goods, with the difference being the period of time a good is useful for. A consumer good being useful for more than three years is defined as a durable good, e.g., a car, refrigerator, furniture etc. If the lifetime of a consumer good falls below three years, it is called a non-durable good, examples of the short-lived goods include regular household necessities such as groceries, clothing and gasoline. Studying the components of consumption has been conducted before, but with slightly different approaches and time periods (e.g., Perotti (2011); Ramey (2011)). This analysis is important in order to see how the consumption pattern is affected as well as to investigate more specifically which components are driving the aggregated consumption.

The reasoning behind adding investment (GFCF), trade balance and tax revenue is partly for checking the robustness of the results but also for investigating their dynamic responses. Investments are crucial for understanding the GDP development and due to the negative relationship with the interest rate, different outcomes are expected in the the two periods. Trade balance could capture a possible leakage effect, a typical trait for small, open economies, whereas tax revenues serves solely as a robustness check.

# 5 Empirical results: presentation and discussion

The results will focus on the impulse responses of GDP and private consumption following a 1 percent exogenous increase to government spending. Further, private consumption is divided into durable and non-durable goods. The response on consumption and its components are of main interest, GDP is included as it captures a lot of the variation and is needed in order to confirm earlier results. As a reminder, the hypothesis of this thesis is that the effect from government spending on private consumption will differ depending on the interest rate environment. Initially, the outcomes from the higher interest rate environment (1995-2008) are presented starting with aggregate consumption, and later the breakdown to durable and non-durable goods. The results from the ZLB period (2010-2020) follow an equivalent structure. The impulse responses are presented in graphs with their median response and a corresponding 68 percent credible set.[13] Moreover, the impulse responses are illustrated for a horizon of 20 quarters, however, the first couple of quarters are of main interest.[14] The MATLAB toolbox created by Canova and Ferroni, along with a guide are used in order to estimate the BSVAR (Canova and Ferroni, 2021).[15]

## 5.1 High interest rate environment

### Aggregate consumption Denmark: results and discussion

Figure 6 illustrates the impulses response functions (IRFs) following a shock to Government spending in Denmark for the period before the ZLB. The persistent shock to the fiscal policy variable leads to an initial decrease in consumption of approximately 0.5 percent on impact. The median response becomes positive after eight quarters but the response become insignificant after a couple of quarters. GDP shows a positive effect of 0.25 percent on impact and stays persistently positive although not significant after two years. The Forecast Error Variance Decomposition (FEVD) in Table 1 serves as an additional tool to illustrate the fitted VAR. It indicates how much the shock is contributing to the change in other variables. Table 1 suggests that the shock to government spending is only explaining a small part of movements in consumption and at a decreasing rate. The importance of the shock explaining GDP is small but increase after a year.

The result of decreased consumption is somewhat surprising given the majority of empiri-

[13] The 68 percent credible set corresponds to a 1 standard deviation from the mean of a normal distribution.

[14] As mentioned in Section 4, impulse responses should not be investigated too far in horizon due to the non-stationary of the variables. Moreover, focus is on the short-run effect when using a Cholesky decomposition.

[15] Empirical Macro Toolbox, URL: https://github.com/naffe15/BVAR

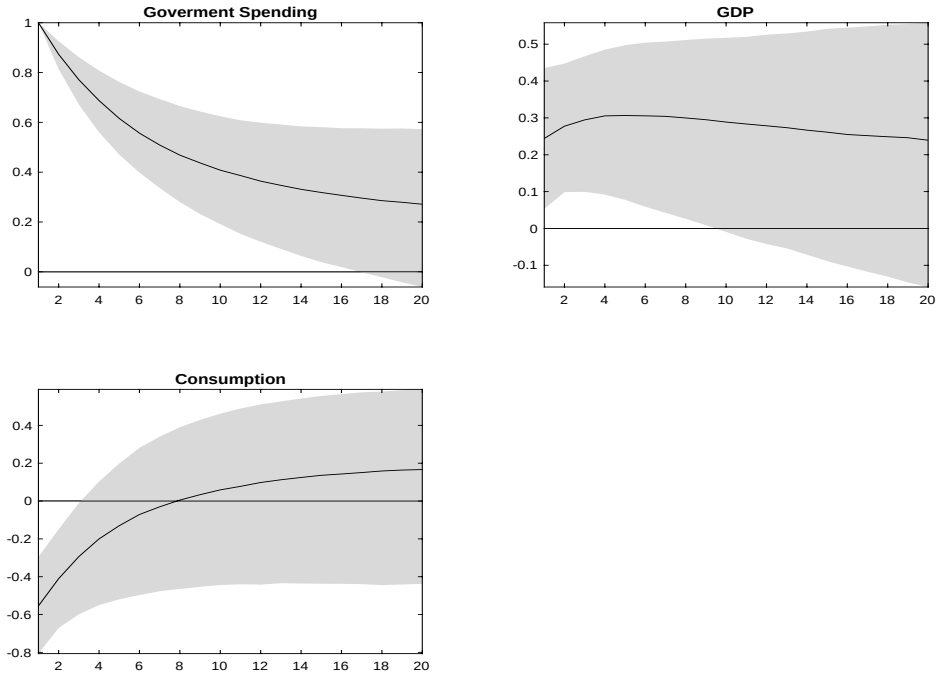
cal findings using a SVAR approach. However, this is partly in line with earlier studies on Danish data finding that consumption decreases on impact following an exogenous shock to government spending, explaining their result by private investments increasing and driving GDP (Ravn and Spange, 2012).[16] Conversely to their finding, investment responds negatively on impact when included in the SVAR indicating that government spending crowd out both components.[17] Despite the negative effect on both investment and consumption, GDP responding positively could be derived from the boom in trade balance of 6.5 percent on impact.[18] The economic intuition stems from an inflationary effect from government spending, causing central banks to raise the policy rate. This entails a decrease in both private consumption and investments, whilst the exchange rate remains unchanged and thus, the decrease in demand domestically is compensated by exports. The result implies that economic agents are behaving in a Ricardian way when interest rates are at higher level, i.e., increased savings as government spending is expected to be financed by a rise of taxes in the future.

[16] On the other hand, the paper by Ravn and Spange (2012) includes a longer time period and another method of dealing with periods of recessions.

[17] See Appendix C, Figure 14.

[18] See Appendix C, Figure 15.

**Figure 6:** IRF Denmark aggregate consumption outside ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 1:** FEVD Denmark outside ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | C |
|---|---|---|---|
| **1** | 92.74 | 5.81 | 4.61 |
| **2** | 74.12 | 8.06 | 2.74 |
| **3** | 56.28 | 8.47 | 2.09 |
| **4** | 43.04 | 8.05 | 1.90 |

Note: G refers to government spending and C stand for consumption.

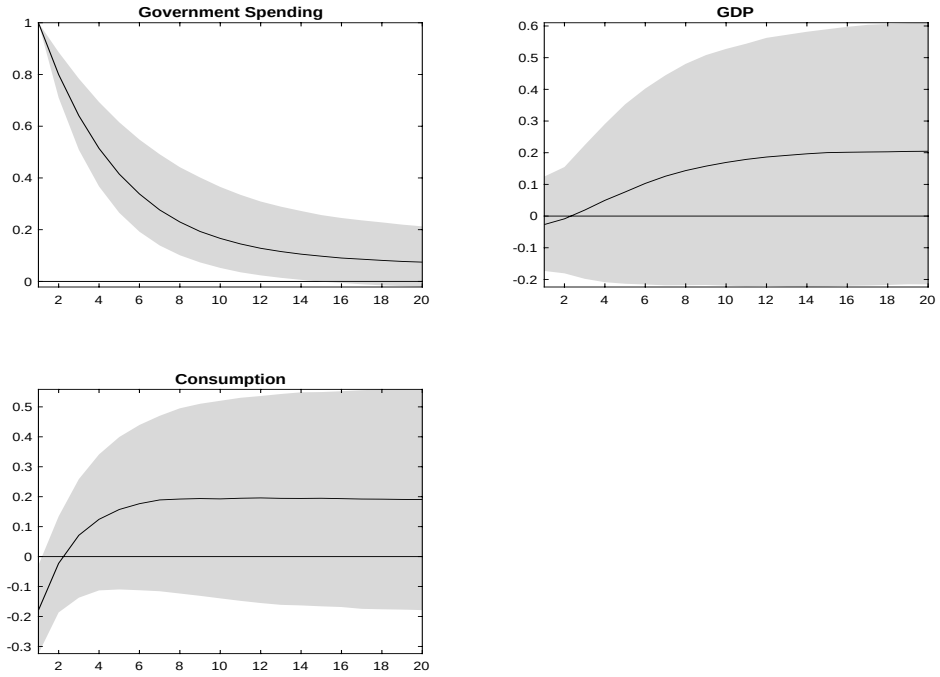
**Aggregate consumption Sweden: results and discussion**

Figure 7 depicts the responses on GDP and consumption, before the ZLB environment prevailed. The 1 percent shock to government spending shows a similar pattern as in the Danish case above, persistent but with a diminishing rate. Consumption and GDP have both slightly negative and insignificant responses on impact i.e., a drop of 0.2 percent and close to zero respectively, although with a median response becoming positive fairly quickly. In Table 2, the small effect from a shock to government spending on GDP and consumption is shown through the FEVD, never reaching a percentage explained above 5 percent for either case.

Trade balance decreases with a considerable amount, around 6 percent on impact.[19] Since consumption and GDP do not respond, the increased government spending seems to fall on imported goods, known as the leakage effect. Furthermore, when including investments in the SVAR, the argument is strengthened since the feedback is insignificant.[20] A leakage effect is more probable to occur in a small, open economy where demand for foreign goods and services is higher (Ravn and Spange, 2012). Compared to Denmark, who opt a fixed exchange rate regime, there is no opposing force as the interest rate effect in the Swedish case. The flexible exchange rate regime allows the nominal interest rate to rise in the short run.

[19] See Appendix C, Figure 18.
[20] See Appendix C, Figure 17.

**Figure 7:** IRF Sweden aggregate consumption outside ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 2:** FEVD Sweden outside ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | C |
|---|---|---|---|
| **1** | 98.88 | 0.08 | 1.44 |
| **2** | 95.06 | 0.74 | 2.83 |
| **3** | 90.14 | 1.64 | 3.73 |
| **4** | 85.28 | 2.41 | 4.23 |

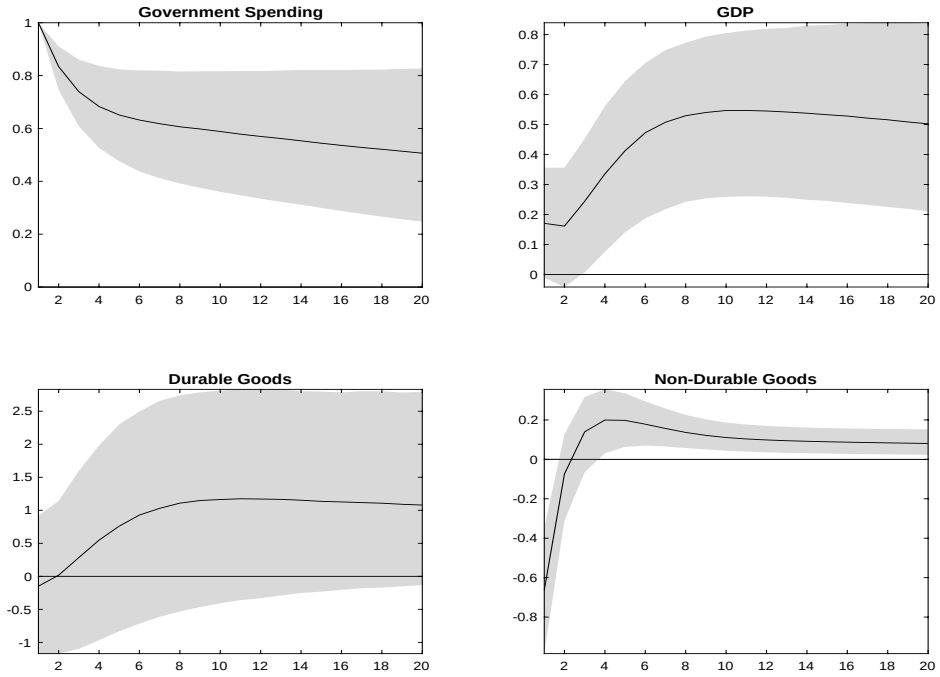
Note: G refers to government spending and C stand for consumption.

**Durable and non-durable consumption Denmark: results and discussion**

When looking further into the components of consumption, i.e., a division into durable and non-durable goods, Denmark exhibits a very persistent shock to government spending (see Figure 8). Durable goods have a median response close to zero on impact but becomes positive after two quarters, the credible set is on the other hand indicating an insignificant effect. Non-durable goods consumption falls by approximately 0.6 percent on impact but quickly turns positive after a year, where it remains for the entire horizon. However, after the shock, both types of goods follow a similar pattern as overall consumption. The pattern of both goods is confirmed when looking at Table 3, the FEVD indicate that an unexpected increase in government spending could somewhat explain future consumption of non-durable goods but less for durable.

The results are not surprising since the demand for durable goods is not expected to be stimulated in a higher interest rate environment (Mankiw, 1983). This is due to the cost of borrowing increasing in interest rate, which is required to a larger extent for the consumption of durable goods. The initial response for non-durable goods is in line with the findings by Aschauer (1985) addressed in Section 3.1, stating that when defining consumption as only non-durable goods and services, government spending will decrease consumption, in accordance with neoclassical theory. A further explanation of the small effect on consumption could perhaps be emanating from that Denmark during this period decreased their public debt by a large portion (see Figure 4). This indicates a non-expansionary policy where stimulus has been absent through this channel.

**Figure 8:** IRF Denmark durable and non-durable consumption outside ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 3:** FEVD Denmark outside ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | DUR | NDUR |
|---|---|---|---|---|
| **1** | 82.81 | 3.60 | 0.18 | 7.30 |
| **2** | 67.52 | 11.37 | 1.16 | 9.00 |
| **3** | 60.29 | 17.27 | 2.17 | 9.62 |
| **4** | 55.86 | 20.70 | 3.01 | 10.00 |

Note: G refers to government spending while DUR and NDUR stand for durable and non-durable goods respectively.

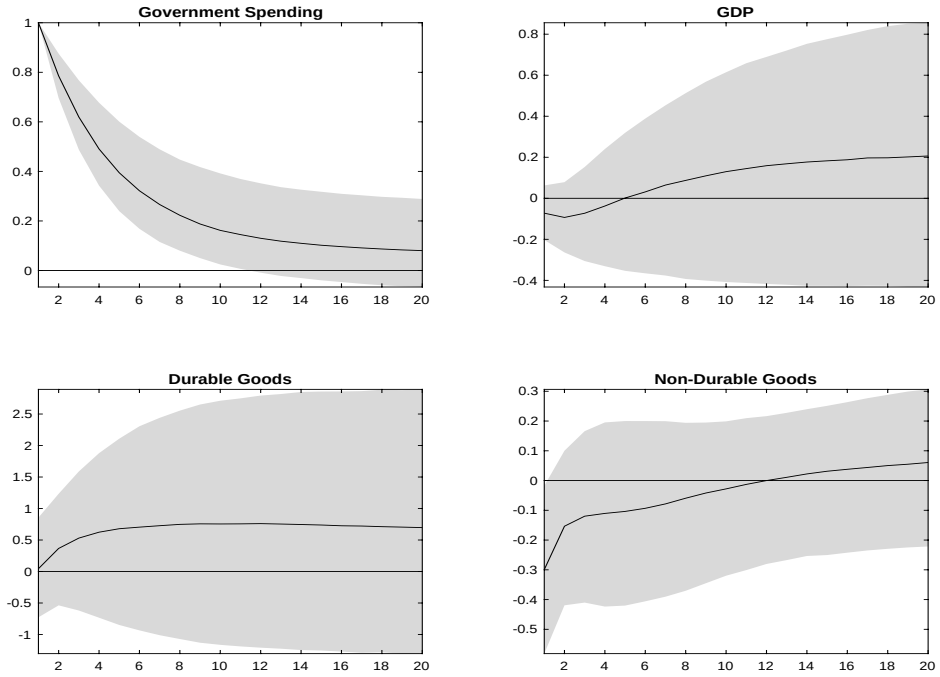
**Durable and non-durable consumption Sweden: results and discussion**

Figure 9 shows the results for Sweden before the ZLB environment with the analysis including the two components for consumption. Durable goods have a zero response on impact following an identical shock as before, with a median response becoming slightly positive along with persistence, but the estimated responses are never significant. The last statement also holds for non-durable goods, however, the initial response is a drop by 0.3 percent, although the median response turns positive after approximately three years. Table 4, stresses the insignificant outcomes described earlier, where the shock to government spending is only explaining a small fraction of the variation to both durable and non-durable goods.

As in the Danish case, non-durable goods seem to be the driving negative force for the negative impact on aggregate consumption. As displayed in Figure 1, government expenditures as a share of GDP decreases during this period implying a diminishing importance for this fiscal policy tool, whilst monetary policy still was effective. Another possible explanation for the muted responses could be derived from the change in household consumption pattern. Household indebtedness increased in Sweden by 77 percentage points as a share of net disposable income, a signal of positive expectations in the economy.[21] A flourishing economy may have mitigated the effects of fiscal policy as discussed in section 3.2, i.e., fiscal stimulus is less effective during times of high economic activity. Concurrently with this period, the repo rate dropped from 8 to 2 percent (see Figure 5), indicating that monetary policy stimulated the economy to a larger extent, as well as, contributing to a change in consumption pattern and household indebtedness.

[21] See Appendix D, Figure 26.

**Figure 9:** IRF Sweden durable and non-durable consumption outside ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 4:** FEVD Sweden outside ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | DUR | NDUR |
|---|---|---|---|---|
| **1** | 96.96 | 0.43 | 0.67 | 1.87 |
| **2** | 87.02 | 0.29 | 1.43 | 1.97 |
| **3** | 76.31 | 0.63 | 1.91 | 1.81 |
| **4** | 67.59 | 1.04 | 2.21 | 1.65 |

Note: G refers to government spending while DUR and NDUR stand for durable and non-durable goods respectively.

## 5.2 Low interest rate environment

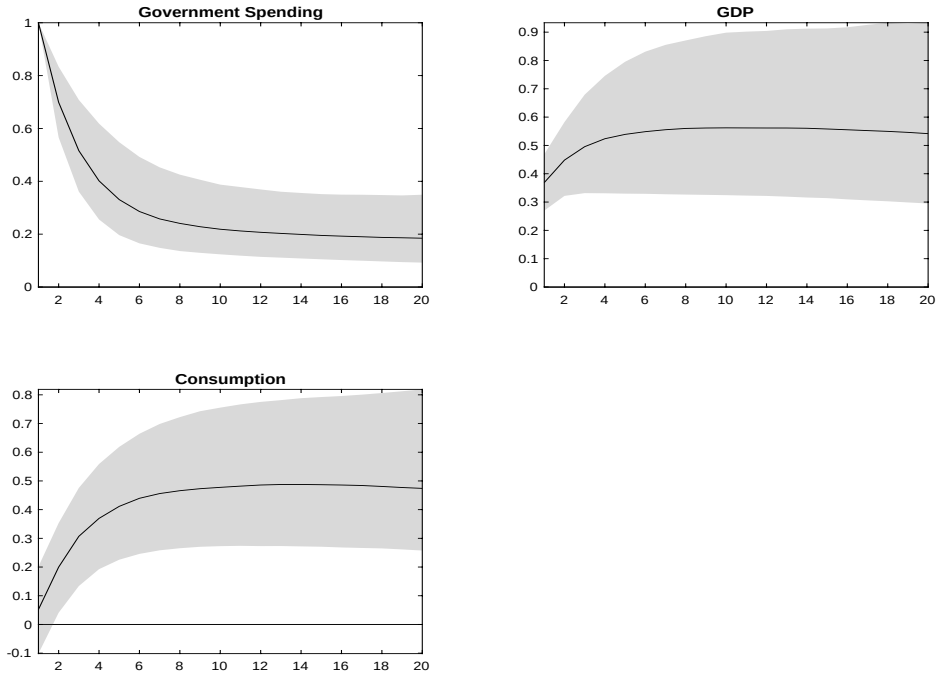
### Aggregate consumption Denmark: results and discussion

When being in a ZLB environment, a positive response of consumption is observed following the persistent shock to government spending. On impact, the response to consumption seems to be dampened but becomes significantly positive and reaches a peak at approximately 0.4 percent after a year, where it remains with persistence for the entire horizon (see Figure 10). The response of GDP is positive on impact with a magnitude of around 0.4 percent, peaking after one year at 0.5 percent where it stays persistently. The FEVD demonstrated in Table 5 is clearly different compared to the earlier time period. Firstly, the shock seems to be very persistent as a vast majority of movements in government spending is explained by the 1 percent innovation. Secondly, the degree of importance for both consumption and GDP is much greater and increase over the years. Particularly for consumption, the FEVD illustrates the delayed response.

This higher effect for GDP and consumption is in line with earlier empirical results, finding the fiscal multiplier to be larger in a low interest rate environment. As discussed in Section 3.2, this is due to inflationary pressure resulting from government spending not affecting the nominal interest rate in a ZLB environment (Christiano et al., 2011; Woodford, 2011). It is not surprising that there is a lag in the response of consumption given the large likelihood of implementation lags of the government spending. Investments increase on impact with a level of 0.5 percent, reaching a peak at 1.25 percent after one year, staying at that rate with persistence for the remaining time period.[22] This could serve as an explanation for a part of the development in GDP. The positive effect compared to the earlier period where investments declined, could be derived from the negative relationship between investments and interest rates.

[22] See Appendix C, Figure 20.

**Figure 10:** IRF Denmark aggregate consumption in ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 5:** FEVD Denmark in ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| **Years** | **G** | **GDP** | **C** |
|---|---|---|---|
| **1** | 94.42 | 40.11 | 13.48 |
| **2** | 90.06 | 46.33 | 29.28 |
| **3** | 86.38 | 48.85 | 36.97 |
| **4** | 83.35 | 50.12 | 41.07 |

Note: G refers to government spending and C stand for consumption.

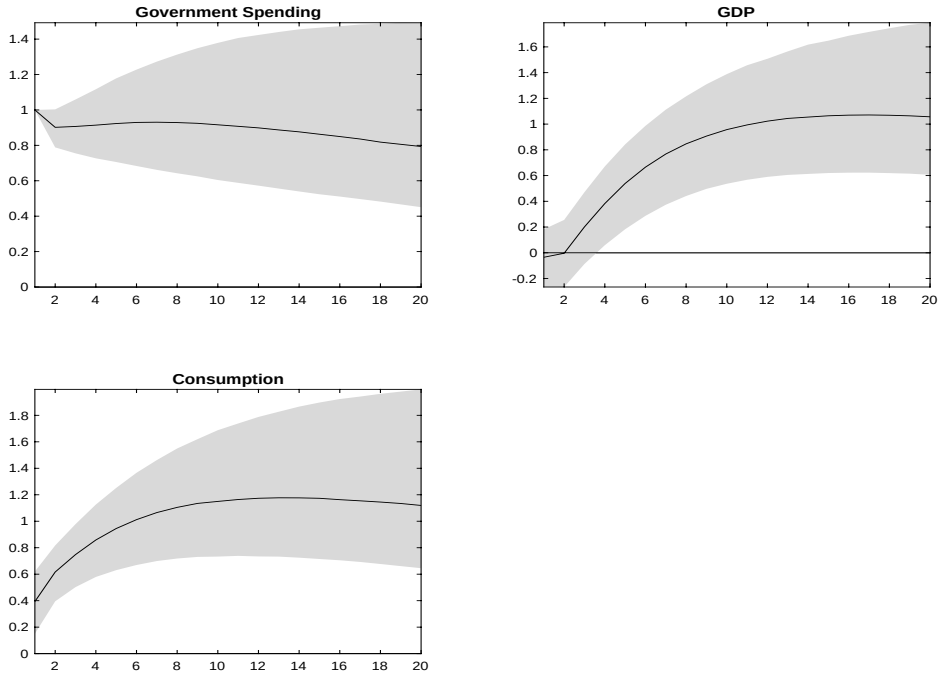
**Aggregate consumption Sweden: results and discussion**

Figure 11 depicts the IRFs for GDP and consumption after entering the ZLB environment in Sweden. The 1 percent shock to government spending has a persistent and significant effect throughout the time period of investigation. The initial effect on impact for GDP is muted but increases and stays persistently positive for the remaining horizon, peaking at 1 percent. Consumption responds with a significant positive effect on impact at 0.4 percent, and shows the same persistence and magnitude as GDP after the shock. The alternative way of presenting the estimates in Table 6, shows how the fiscal policy shock explains the variation in consumption up to 25 percent in the first year, and more than doubling in the fourth year.

The immediate positive impact of 0.4 percent on consumption in Sweden is as large as the peak in Denmark for the same variable. This larger effect on consumption displayed, confirms that a fixed exchange rate regime inhibits fiscal policy in a ZLB environment, due to real interest rates not reacting (Nakamura and Steinsson, 2014). Sweden on the other hand, could experience a drop in real interest rates, promoting investments and aggregate consumption. The trade balance displays a large decline of close to 20 percent on impact, explaining the lagged response of GDP.[23] The persistent increase in investment and consumption along with diminishing leakage effect enables a larger multiplier after a year compared to Denmark.[24]

[23] See Appendix C, Figure 24.
[24] See Appendix C, Figure 23.

**Figure 11:** IRF Sweden aggregate consumption in ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 6:** FEVD Sweden in ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| **Years** | **G** | **GDP** | **C** |
|---|---|---|---|
| **1** | 81.39 | 2.40 | 25.18 |
| **2** | 79.47 | 17.16 | 43.80 |
| **3** | 79.47 | 32.74 | 54.55 |
| **4** | 79.64 | 43.56 | 60.66 |

Note: G refers to government spending and C stand for consumption.

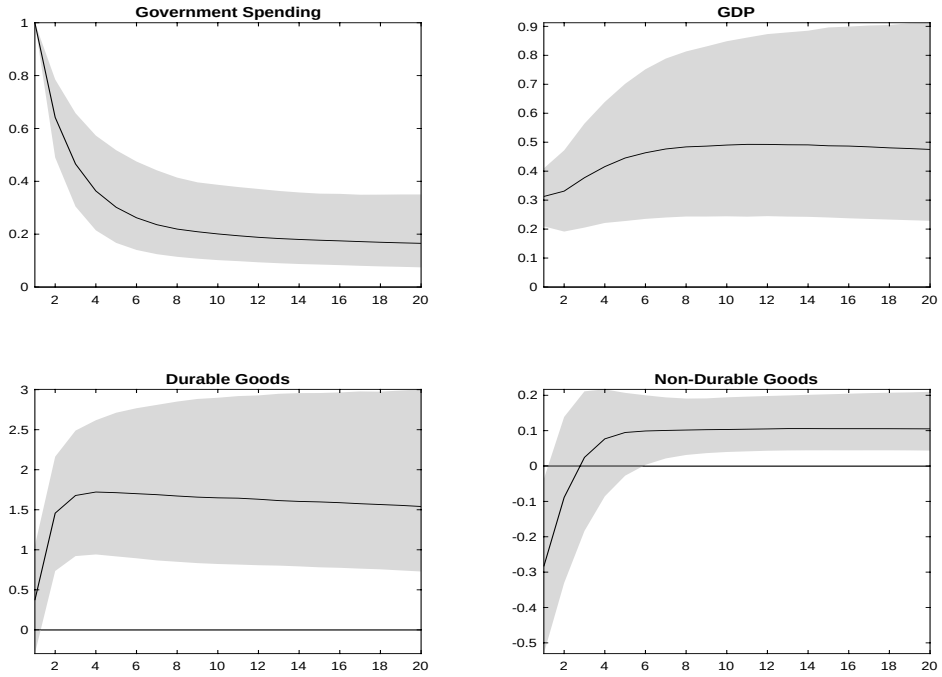
### Durable and non-durable consumption Denmark: results and discussion

When being confronted by the ZLB environment, drastically different results emerge for the division of consumer goods following a shock to government spending. Durable goods are responding positively on impact at a level of 0.5 percent, peaking at a rate of 1.5 percent where it stays persistently over the succeeding quarters (see Figure 12). Table 7 further confirms a larger effect from the government spending shock on durable goods consumption with a considerable increase in percentage of volatility explained. Non-durable goods respond in a similar way as the earlier period, declining with 0.3 percent on impact, with the FEVD indicating a smaller effect from the fiscal policy shock.

The larger effect on durable goods could be derived from a closer relationship with the interest rate, i.e., numerous goods classified as durable are financed using credits (Mankiw, 1983). The low interest rates decrease the cost of borrowing, possibly inflicting the surge in house prices.[25] The increase in wealth following the rise in house prices allow for further credit expansions, which is one important channel explaining the larger demand for durable goods.

[25] See Appendix D, Figure 26 and 27.

**Figure 12:** IRF Denmark durable and non-durable consumption in ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 7:** FEVD Denmark in ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | DUR | NDUR |
|---|---|---|---|---|
| **1** | 92.23 | 25.99 | 20.98 | 3.40 |
| **2** | 86.09 | 33.23 | 30.52 | 4.99 |
| **3** | 81.35 | 36.69 | 34.26 | 6.56 |
| **4** | 77.57 | 38.50 | 36.31 | 7.98 |

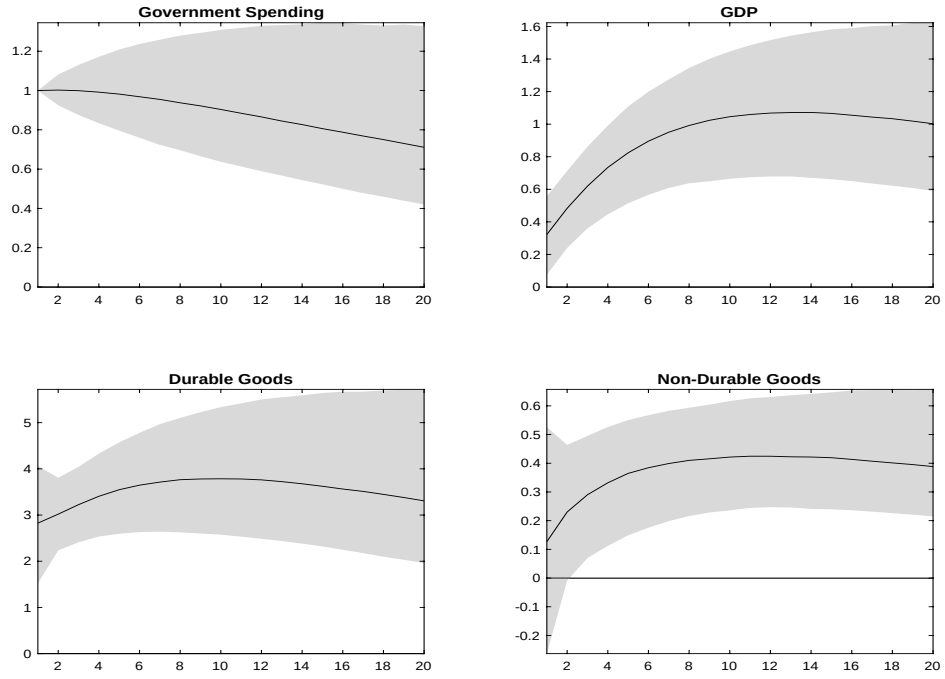
Note: G refers to government spending while DUR and NDUR stand for durable and non-durable goods respectively.

**Durable and non-durable consumption Sweden: results and discussion**

In Figure 13, the IRFs are presented for Sweden in a ZLB environment, where durable and non-durable goods display a positive response on impact with persistence. However, the effect on durable goods is almost 3 percent on impact compared to non-durables with an insignificant impact of 0.15 percent. Table 8, enhances what was previously mentioned, the shock is contributing mostly to the variation in durable goods, with an increasing rate and more than doubling after four years. The argument put forward in the Danish case concerning credit expansions being the driving force is applicable for Sweden as well.

The result for non-durable goods is somewhat more surprising if comparing with Denmark where consumption of non-durable goods was seemingly unaffected by the division of time periods. The Keynesian effect from fiscal expansions on non-durable goods could partly be explained by a larger multiplier compared to Denmark. Another explanation could be deriving from a rise in disposable income whose effect from an innovation to government spending has been found to be closely related to consumption of non-durable goods (Galí et al., 2007). However, most non-durable goods are necessities, thus not being as related to the business cycle compared to durable goods, it could rather be emanating from an increase in population demanding more non-durable goods during this period. In summary, it is evident that durable goods are causing the majority of the positive effect on aggregate consumption. The results for both Denmark and Sweden are in line with the hypothesis of this thesis i.e., the effect of government spending on the consumption pattern is different depending on the interest rate environment.

**Figure 13:** IRF Sweden durable and non-durable consumption in ZLB




Note: the black lines are the median responses to an exogenous, 1 percent innovation to government spending. The grey band is a 68 percent credible set. The vertical axis is expressing percentages and the horizontal axis displays the number of quarters.

**Table 8:** FEVD Sweden in ZLB, percentage of 1/2/3/4 years ahead volatility explained by a Government Spending shock

| Years | G | GDP | DUR | NDUR |
|---|---|---|---|---|
| **1** | 91.32 | 15.72 | 29.98 | 3.26 |
| **2** | 88.96 | 34.06 | 47.20 | 9.98 |
| **3** | 88.08 | 48.07 | 57.21 | 17.09 |
| **4** | 87.56 | 56.79 | 62.96 | 23.13 |

Note: G refers to government spending while DUR and NDUR stand for durable and non-durable goods respectively.

# 6 Conclusion

This thesis finds evidence that the response on private consumption is highly dependent on the period of investigation, following a government spending shock. When being in a higher interest rate environment, the response of private consumption supported neoclassical theory. This result was somewhat surprising given that a majority of empirical findings, using a SVAR, have found the opposite effect (e.g., Blanchard and Perotti (2002); Fatás and Mihov (2001); Galí et al. (2007)). However, when looking at the period with a new monetary policy regime, the households responded with an increased demand, in line with Keynesian effects and theories allowing for heterogeneous agents. The response of consumption and a larger fiscal multiplier are in line with earlier evidence, however the magnitudes were substantially lower compared to what Christiano et al. (2011); Woodford (2011); Erceg and Lindé (2014) have found. When solely focusing on the fiscal multiplier, Denmark experienced a larger multiplier in the first period compared to Sweden whilst the opposite was found in the second period. This result was expected given earlier empirical evidence showing how an exchange rate regime affects the multiplier.

Looking further into the components of private consumption, non-durable goods responded with a drop on impact whilst the response for durable goods was muted for both countries in the first period. Conversely, in the ZLB environment, durable goods exhibited a larger response compared to non-durables. This was explained by credit expansions being facilitated by the lower interest rate and possibly an increase in wealth due to elevated house prices in the two countries.

The policy implication from this thesis is that government spending can be used more effectively in a ZLB compared to when interest rates are at higher levels. Durable goods were causing the surge in aggregate consumption in the period of low interest rates. This might lead to increase household indebtedness since durable goods were proven to have a more sensitive relationship to the interest rate compared to non-durable goods. Both countries are experiencing alarmingly high household indebtedness levels, forcing decision-makers to be cautious when deciding on the fiscal policy measures in a ZLB environment. Since government spending seems to crowd out both investment and private consumption in a period of higher interest rates, policymakers should not expect a large effect from fiscal stimulus if the countries were to re-enter a period of contractionary monetary policy. As this thesis gives insight only on aggregate levels, further studies could involve looking at which income quintiles reap the benefits of increased government spending.

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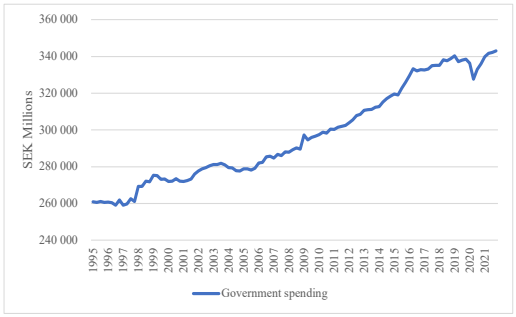
# Appendix A: Data sources

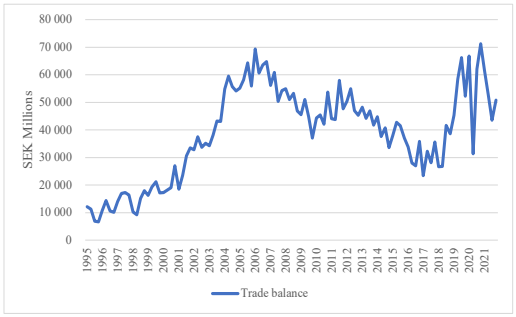
**Table 9:** Summary of variables, description and data source for both countries

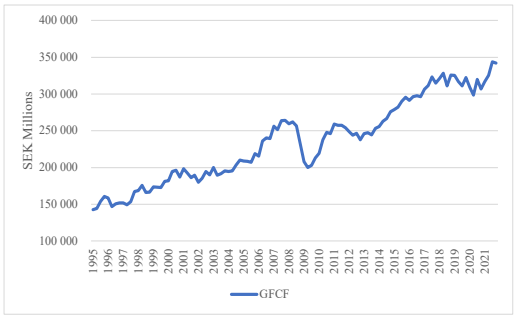
| Variable | Description | Data source |
|---|---|---|
| Government spending | General government final consumption expenditure, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| GDP | Gross domestic product, expenditure approach, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Consumption | Private final consumption expenditure, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Investment | Gross fixed capital formation, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Trade balance | Difference between exports and imports, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Tax revenue | Taxes less subsidies on production and imports, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Public debt | Sovereign debt in relation to GDP. | OECD |
| Policy rate | Short-term interest rates set by the central bank. | The Swedish Riksbank, Danmarks Nationalbank |
| Durable and non-durable good consumption | Private final consumption expenditure by durability, constant prices, national reference year, national currency, millions, seasonally adjusted. | OECD |
| Government spending by function | General government final consumption expenditure, functionality breakdown, current prices, millions. | OECD |
| Household debt | Household debt in relation to net disposable income. | OECD |
| House prices | Real house price index, 2015 reference year, seasonally adjusted. | OECD |

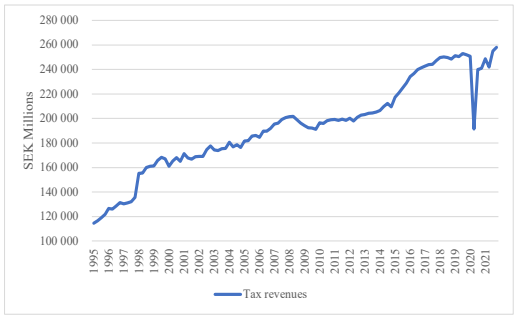
# Appendix B: Variable overview

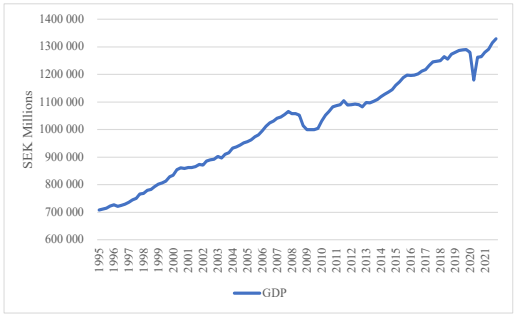
## Sweden

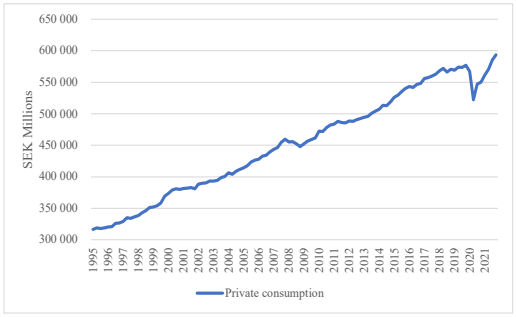


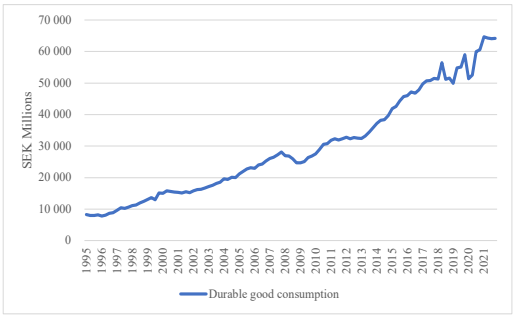



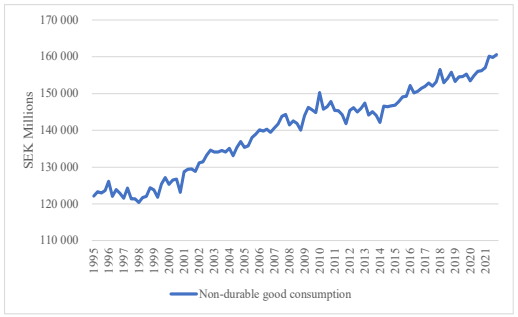



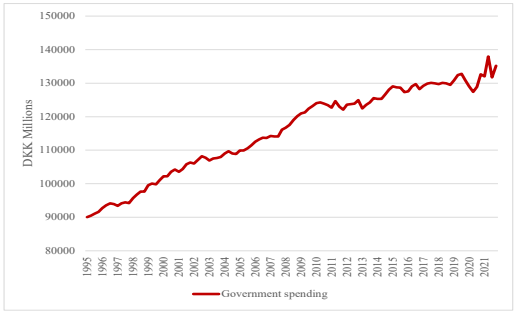



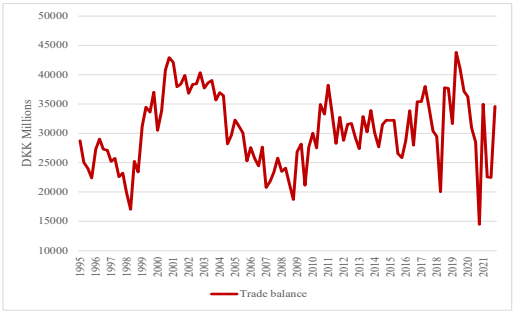



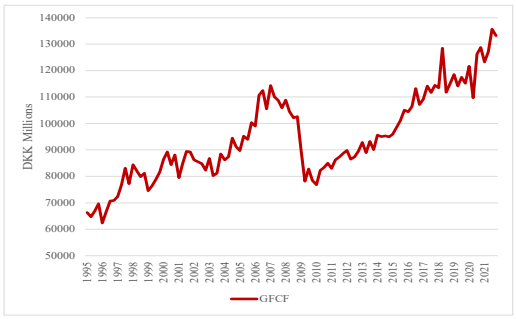



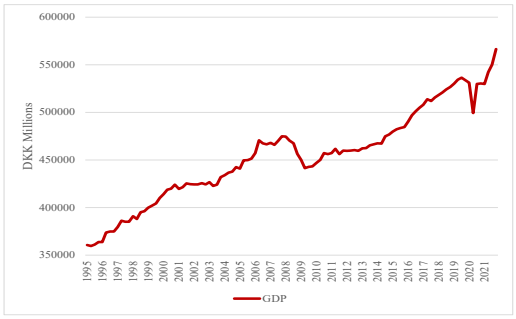
# Denmark

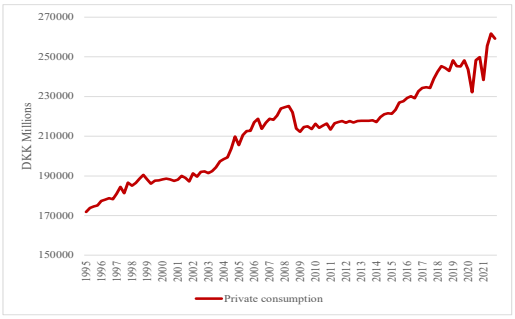

DKK Millions
Government spending

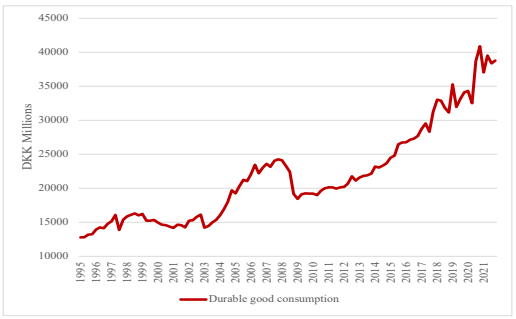

DKK Millions
Trade balance

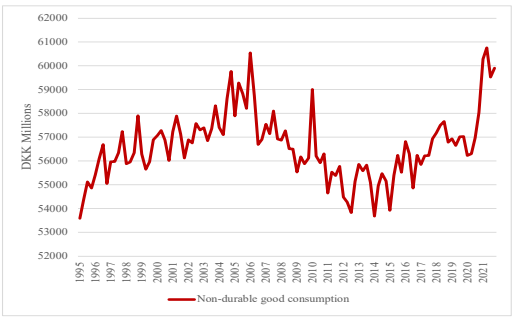

DKK Millions
GFCF


DKK Millions
Tax revenues


DKK Millions
GDP


DKK Millions
Private consumption


DKK Millions
Durable good consumption


DKK Millions
Non-durable good consumption

# Appendix C: Additional IRFs

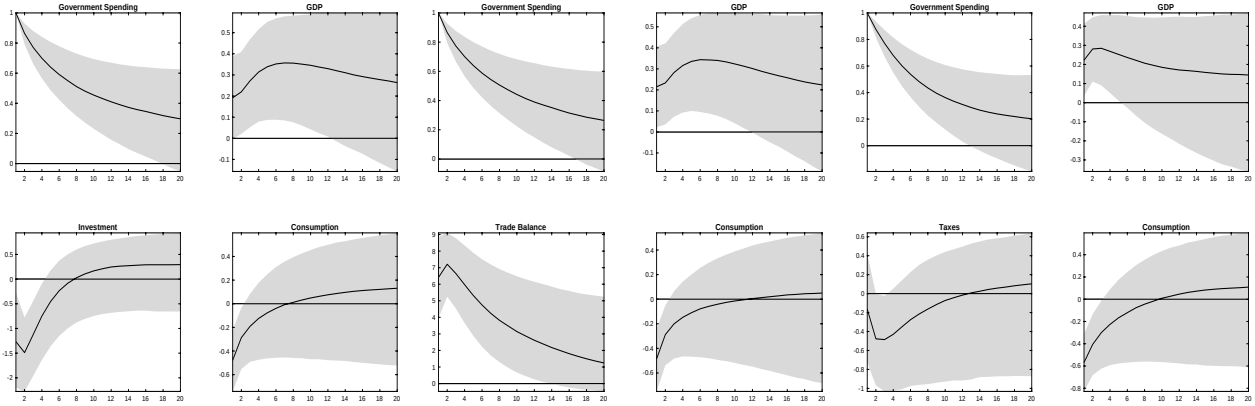



Figure 14: IRF Denmark 95:Q1-08:Q3 investment included




Figure 15: IRF Denmark 95:Q1-08:Q3 trade balance included




Figure 16: IRF Denmark 95:Q1-08:Q3 taxes included

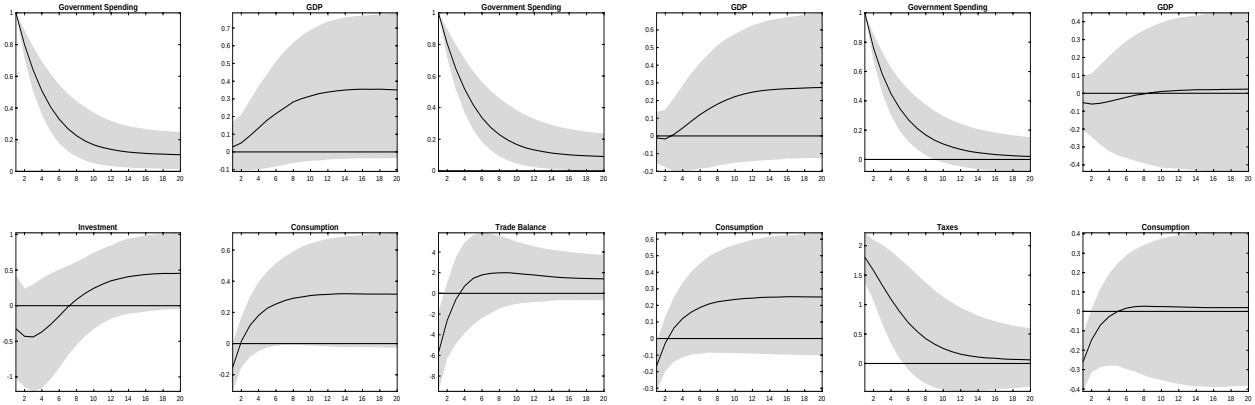



Figure 17: IRF Sweden 95:Q1-08:Q3 investment included




Figure 18: IRF Sweden 95:Q1-08:Q3 trade balance included




Figure 19: IRF Sweden 95:Q1-08:Q3 taxes included

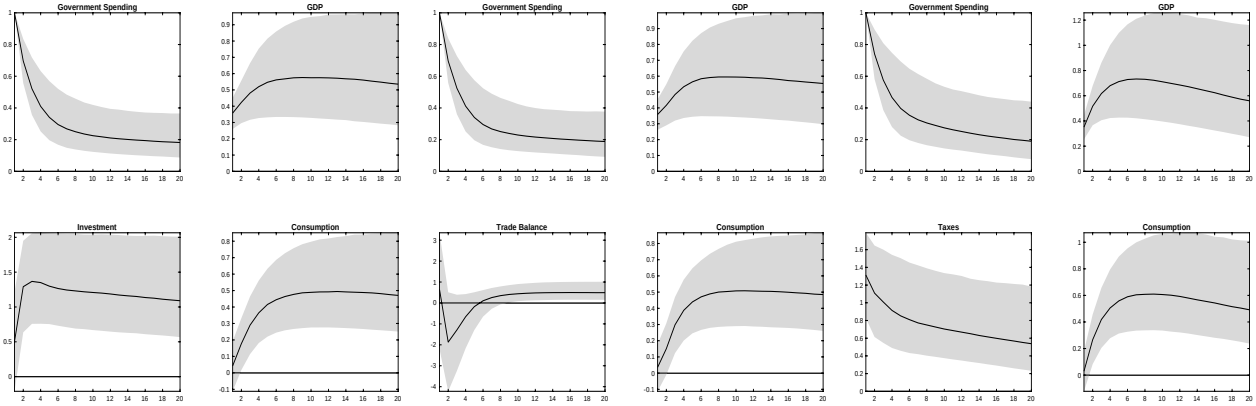



Figure 20: IRF Denmark 10:Q1-20:Q1 investment included




Figure 21: IRF Denmark 10:Q1-20:Q1 investment included




Figure 22: IRF Denmark 10:Q1-20:Q1 taxes included

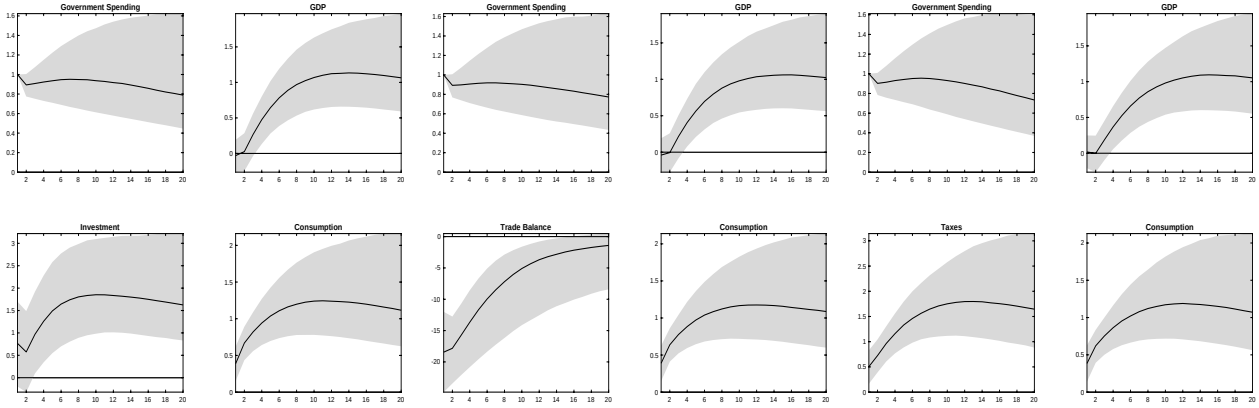



Figure 23: IRF Sweden 10:Q1-20:Q1 investment included

Figure 24: IRF Sweden 10:Q1-20:Q1 trade balance included

Figure 25: IRF Sweden 10:Q1-20:Q1 taxes included

# Appendix D: Additional figures

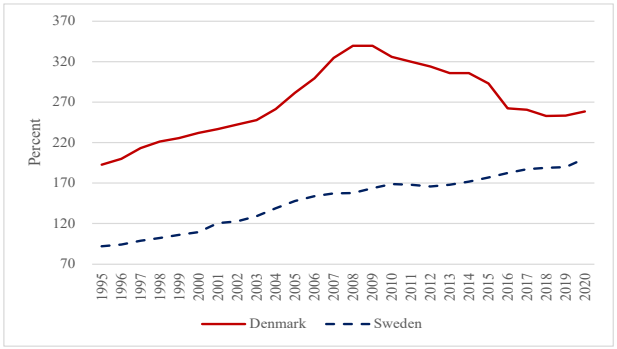



Figure 26: Household debt/net disposable income
Source: OECD

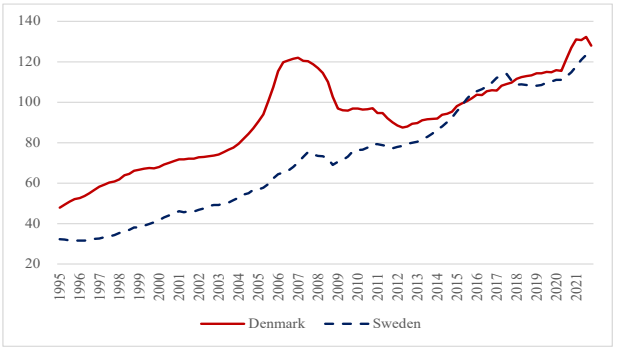



Figure 27: House price index
Source: OECD