Effective Consumption and Non-Keynesian Effects of Fiscal Policy

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Abstract

In this paper, we elaborate on the notion of effective consumption and its role in determining the outcome of fiscal changes. More specifically, we investigate whether government consumption, by acting either as a complement or a substitute to private consumption, can help explain the non-Keynesian effects of fiscal policy that have been previously documented. We let the periods, where government consumption has acted as a complement or a substitute to private consumption, constitute different regimes. By using econometric methodologies that allow the these regimes to be determined both exogenously and endogenously, we find that the notion of effective consumption can assist in understanding the non-Keynesian effects of fiscal policy that have been documented in Denmark, Ireland and Sweden.

JEL Classification: E21; E62;
Keywords: Private Consumption; Fiscal Policy; Government Consumption;

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1 Introduction

Recently, several studies have found that the effects of fiscal impulses on private consumption are ambiguous (see e.g. Giavazzi and Pagano, 1990, 1996; Afonso, 2001). In some cases, big fiscal contractions, brought about by government expenditure cuts, have increased private consumption (see Fels and Froehlich, 1987; Hellwig and Neumann, 1987; Giavazzi and Pagano, 1990), while in another case a severe fiscal expansion, through a debt financed cut in taxes, has failed to stimulate private consumption (see Giavazzi and Pagano, 1996). These findings stands in contrast to the Keynesian view that output is demand determined so that fiscal expansions stimulate private consumption, while fiscal contractions reduce private consumption. Instead, the non-Keynesian effects of fiscal policy have been explained by the permanent income hypothesis. Signals about permanently lowered government expenditures means that future taxes can be lowered compared to the tax level that would have prevailed if government expenditures had not been cut. These tax decreases implies that the permanent level of disposable income increases. This in turn increases private consumption and hence an expansionary fiscal contraction has occurred. The contractionary fiscal expansion phenomenon have been explained analogously. Decreases in taxes failed to stimulate private consumption since the expected permanent level of government expenditure, and hence the expected permanent level of taxes and disposable income, was kept unaffected. Although the channel of the non-Keynesian behavior has been by and large agreed upon, different suggestions regarding signals of permanence has been suggested. Giavazzi and Pagano (1996) and Afonso (2001) suggest that the overall fiscal stance that prevails when a fiscal action takes place determines the outcome. More specifically, the size and duration of fiscal policy changes are argued to signal permanence. Another position is taken by Alesina and Perotti (1995), Alesina and Perotti (1996) and Alesina and Ardanga (1998), who argue that the composition of the fiscal change is an important factor in the signalling of permanence, and hence a key determinant for the effects that will follow. However, the composition of a fiscal change doesn't only affect the signalling content of an expansion or a contraction. It can have more direct effects on the relationship between fiscal policy and private consumption.

Suppose that a private agent determines private consumption taking into account both the goods and services provided by the government and the goods and services bought privately. If this is the case, changes in public consumption will also change private consumption. Furthermore, some items of the expenditure on public goods and services may serve as substitutes for private consumption while others serve as complements. This induces an uncertainty about the way that an aggregate change in government consumption will affect private consumption. The different properties of government consumption can hence serve as a possible explanation for the unexpected effects of fiscal impulses that have been previously observed. If government consumption cuts are perceived as cuts in an item that serves as a complement to private consumption, we would expect private consumption to fall. Analogously, if government consumption is perceived as a substitute, we would expect private consumption to rise during periods where government consumption falls. By studying the behavior of private and government consumption over time, and comparing the results to the fiscal policy effects that have been previously documented

during the non-Keynesian periods, we can investigate whether the empirical evidence is consistent with such an explanation.

In this paper, we follow the line of research suggested by Barro (1981), Graham (1993), Evans and Karras (1996), Bhattacharya (1999) and Ho (2001) and investigate the notion of effective consumption. Effective consumption is defined as the sum of private and government consumption. If both of these types of consumption is entering the private agents utility function, which undoubtedly is reasonable, changes in government consumption affect the decision made about private consumption. More specifically, if the random walk hypothesis of Hall (1978) applies to effective consumption, every change in government consumption will change private consumption. The intuition behind this result is that the private agent want to keep marginal utility of effective consumption constant and hence balances every change in government consumption by a change in private consumption. The items of government consumption that can be regarded as complements to private consumption will change private consumption in the same direction as government consumption. The items of government consumption that serves as substitutes changes private consumption in the opposite direction of government consumption. However, since we are not in a position to observe disaggregated government consumption, we can only observe an aggregate change and then study if the marginal effect of government consumption on private consumption is consistent with a substitution or a complementary effect.

We investigate the substitution and complementary property in the context of the non-Keynesian effects of fiscal policy. From the previous research on non-Keynesian effects, we know several periods during which fiscal measures have coincided with non-Keynesian response in private consumption. Since we a priori know the periods where non-Keynesian effects have occurred, we can investigate the properties of government consumption during these specific periods and study if the results lend support to or refute the role of effective consumption as explanation to the non-Keynesian effects. The precise methodology to investigate this issue can take at least two forms.

Since we can define the periods during which fiscal policy has had extraordinary effects a priori, we can exogenously define the periods that we are interested in and study if the predictions of the effective consumption hypothesis are supported by the empirical data for the different periods. Alternatively, we can let the data decide the extent to which government consumption acts as a complement and as a substitute and then compare the data-decided periods during which government consumption act as a substitute and a complement to the previously identified periods with non-Keynesian fiscal contraction. In this way we study whether the substitutability of public consumption can explain the expansionary effects that fiscal policy has had on private consumption. In the same way we can study the expansionary fiscal periods that have caused private consumption contractions.

To investigate the effective consumption hypothesis by using the exogenously determined regimes, we utilize an extended version of the consumption function predicted by the effective consumption theory. By including dummy variables in this consumption function, the properties of government consumption can be investigated. When we investigate the endogenously determined regimes, we use the Markov-switching regression methodology. In this way we get a picture of the different regimes that are predicted by

the empirical evidence. We can then compare the relation between government consumption and private consumption during the different regimes and then study the different time periods during which the different regimes have occurred and compare the results to the regimes that have been previously documented in the literature.

The main results in this paper indicate that the non-Keynesian fiscal policy experiences in Denmark, Ireland and Sweden can be understood by considering the effective consumption hypothesis. During the non-Keynesian fiscal contractions in Denmark and Ireland, government consumption has acted as a substitute to private consumption during periods where government consumption has decreased and as a complement during periods when government consumption has increased. For Sweden, where a non-Keynesian fiscal expansion has been previously documented, the opposite applies. Private consumption and government consumption have been complements during periods where government consumption has decreased, while the two have been substitutes during periods where government consumption has increased. However, the effective consumption hypothesis cannot be used as an explanation for all the non-Keynesian events that are investigated in this paper. For Germany no support can be found for the view that effective consumption has contributed to the previously established non-Keynesian effect that a fiscal contraction had on private consumption. The results in the current paper highlight the importance of an eclectic view when explaining the occurrence of non-Keynesian effects of fiscal policy.

The rest of the paper is organized as follows. In Section 2 we summarize the previous findings on non-Keynesian effects of fiscal policy on private consumption. We also state during which periods government consumption should act as a complement and a substitute to private consumption in order to contribute in the explanation of the non-Keynesian effects of fiscal policy. In Section 3 we present the theoretical model. In Section 4 we specify our econometric model. In Section 5 the econometric model from the preceding section is estimated and the results are presented. Finally, Section 6 concludes.

2 Non-Keynesian effects of fiscal policy

In this section we discuss the different periods of non-Keynesian effects of fiscal policy that has been previously documented in the literature. These periods are intended to serve as benchmarks for our analysis of how government consumption is perceived by the private agents, and hence as a benchmark when judging how appropriate the effective consumption hypothesis is in explaining the non-Keynesian effects of fiscal policy. We will also discuss in detail what properties government consumption should have if the effective consumption hypothesis is to explain the non-Keynesian effects that fiscal policy have had on private consumption. The important point is the fact that government consumption can be regarded both as a complement and a substitute to private consumption, depending on which items of government consumption that are changed. If government consumption is considered to be a substitute, we should find that cuts in government consumption increases in private consumption. Furthermore, if a cut in government consumption occurs during a fiscal contraction, effective consumption motive could very well be an explanation for the non-Keynesian effects that have been documented. On the other hand, if a non-Keynesian contraction has been documented during

a period when government consumption has increased, we should not find any substitution effect between government consumption and private consumption, but instead a complementary effect, if effective consumption is to explain the non-Keynesian behavior. Analogous reasoning applies to non-Keynesian fiscal expansions.

In this paper, we discuss the non-Keynesian episodes for Denmark, Germany, Ireland and Sweden. For these countries, the non-Keynesian periods have been extensively investigated. Hence, we are provided with good benchmarks for the analysis performed in later sections.

2.1 Denmark

One of the earliest episodes of a non-Keynesian behavior in the response of private consumption to a fiscal policy change was documented by Giavazzi and Pagano (1990). The authors study the fiscal policy effects in Denmark in the beginning of the 1980s. A fiscal situation, deemed unsustainable, was reached in Denmark in the end of 1982. From the beginning of 1983, and four years on, through 1986, the full-employment primary fiscal budget balance was strengthened by about 10% points, of which 2.8% point was a fall in government consumption (see Giavazzi and Pagano, 1990). During 1983-1986 the average growth in private consumption was 3.7%, while the average growth in private consumption during the four years preceding the fiscal contraction was -0.8%.[1] Giavazzi and Pagano (1990) investigate if the substitutability between government consumption and private consumption can be used to explain the non-Keynesian response in private consumption. The changes in a few items of government consumption are studied during 1983-1984 and compared to the changes in private consumption to asses to what extent a substitution from government consumption to private consumption has occurred. The authors conclude that the boost in private consumption cannot be fully explained by substitution effects. However, there are some problems with the analysis performed.

The first problem occurs when we study the development of government consumption in Denmark during 1983-1986. Even though a large part of the budget consolidation was brought about by a decrease in government consumption as a fraction of potential GDP, government consumption was not falling. The decrease in government consumption as a part of potential GDP only implies that government consumption was not growing as fast as potential GDP. If we study the development of government consumption during 1983-1986, as plotted in Figure 1, we see that the level of government consumption even grew considerably during the period. Hence, by considering only a short period in the beginning of the consolidation, the authors neglect the possibility that government consumption can act as a complement to private consumption. The second problem with the previous study is that fact that the authors consider data only for a narrow set of classes of government consumption. Hence, important information contained in aggregate government consumption changes may be neglected.

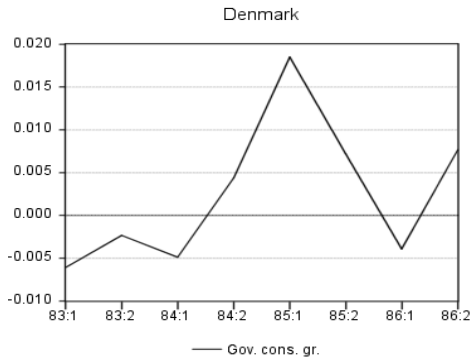
Taken together, it could very well be the case that government consumption acted as a substitute to private consumption during 1983-1984 and then acted as a complement during 1985-1986. If this was the case, it would leave room for effective consumption as

[1] The source of the data material presented is the article by Giavazzi and Pagano (1990).

an explanation for the non-Keynesian effects that have been documented following the fiscal contraction.

The main conclusion from the discussion above is that effective consumption possibly played a central role for the non-Keynesian effects that followed the Danish fiscal consolidation, and that this role has not been rigorously investigated up until now. The period during which government consumption grew has been totally neglected in previous research, this in spite of the fact that it can give valuable insights to the contribution of effective consumption motives.

Figure 1: Government consumption growth in Denmark during 1983-1986.

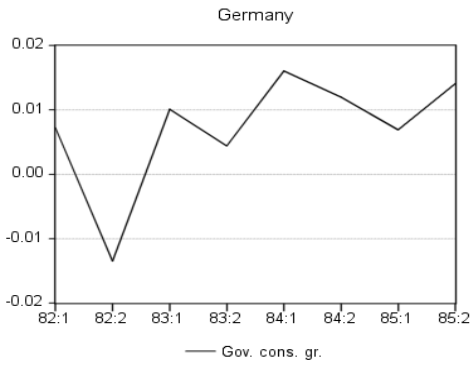


2.2 Germany

The non-Keynesian effects of fiscal policy in Germany have been documented by Fels and Froehlich (1987) and Hellwig and Neumann (1987). According to these authors, the fiscal situation in Germany was deemed unsustainable in 1981 due to a high public debt and a large budget deficit. Furthermore, the part of the government expenditure that was interest payments on the debt was also growing. Among the German experts, there was a consensus that a fiscal contraction was needed. During the period 1982-1985, the structural deficit was decreased by 50% (see Fels and Froehlich, 1987). Although the contraction relied on large expenditure cutbacks, government consumption fell only during the second half of 1982, as seen in Figure 2. The fiscal expenditure cuts that were carried out were instead achieved through large cuts in transfers (see Hellwig and Neumann, 1987).

If private consumption is determined taking into account also government consumption, the German experience should support government consumption as being a complement to private consumption, at least during 1982:1 and 1983-1985. During the second half of 1982 government consumption should be found to be a substitute to private consumption.

Figure 2: Government consumption growth in Germany during 1982-1985.



2.3 Ireland

Ireland embarked in two fiscal contraction during the 1980s.[2] The first contraction was performed 1982-1984. This contraction, however, was performed mainly using increases in taxes and other government revenue. As a consequence, many researchers argue, the effects of the contraction were not non-Keynesian. However, a second contraction was performed during the period 1987-1989. During this period, the full-employment primary deficit was cut by 7% points of GDP. The main items, through which the cut was achieved, were government consumption and government investment. During the consolidation period there was an average growth in private consumption per year of 3.6%. This implies that the cuts in government consumption expanded private consumption. It is interesting to study if this period coincides with a regime where government consumption acts as a substitute to private consumption. If this is the case, effective consumption can give insights to the non-Keynesian behavior of private consumption following fiscal policy changes.

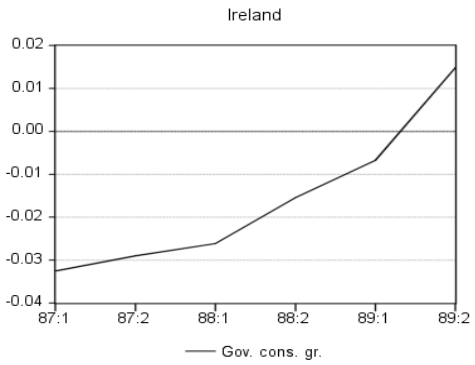
2.4 Sweden

Giavazzi and Pagano (1996) investigate how the fiscal expansion in Sweden during 1989-1994 affected private consumption. The authors note that most of the fiscal expansion occurred through debt-financed cuts in taxes. By fitting a consumption function for Sweden, the authors find that the predicted values of consumption growth was higher than the actual consumption growth during the period. The authors conclude that a downward revision of permanent income, and hence a lower private consumption through the permanent income hypothesis, is consistent with the Swedish experience during this period.

However, there is an alternative explanation of the findings of Giavazzi and Pagano (1996). In Figure 4 we depict the growth in government consumption during 1989-1994. The growth in government consumption was positive during the most of the period. A

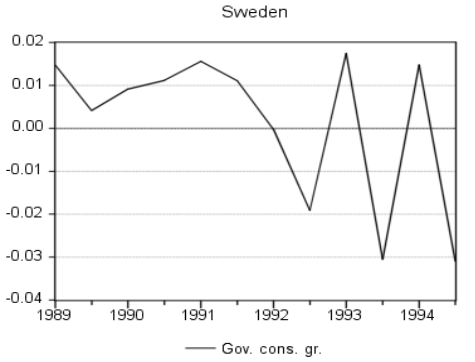
[2]Giavazzi and Pagano (1990) studies the Irish contractions. The figures presented in this subsection are gathered from this article.

Figure 3: Government consumption growth in Ireland during 1987-1989.



negative growth in government consumption was experiences only in the second halves of the last three years of the expansion. If government consumption served as a substitute during the first years of the fiscal expansion, and a complement during the end of the expansion, the non-Keynesian effects that have been observed could maybe be explained by the notion of effective consumption.

Figure 4: Government consumption growth in Sweden during 1989-1994.



2.5 Summary

From the discussion above, we can conclude that several periods of non-Keynesian fiscal policy effects have been previously documented. The periods that have been identified are summarized in Table 1. In the table we also state the properties that government consumption should have during different periods for the effective consumption hypothesis to be relevant for the non-Keynesian effects that has been documented.

During the periods where government consumption serves as a complement to private consumption we expect an increase in government consumption to increase private consumption. An similarly, we expect an increase in government consumption to decrease

Table 1: The role of government consumption for non-Keynesian effects.

Country	Period	Property[a]
Denmark	1983:1-1984:1, 1986:1	Substitute
Denmark	1984:2-1985:2, 1986:2	Complement
Germany	1982:2	Substitute
Germany	1982:1, 1983:1-1985:2	Complement
Ireland	1987:1-1989:1	Substitute
Ireland	1989:2	Complement
Sweden	1989:1-1992:1, 1993:1, 1994:1	Substitute
Sweden	1992:2, 1993:2, 1994:2	Complement

Notes: [a] Property of government consumption that gives a role for effective consumption in the occurrence of non-Keynesian effects of fiscal policy.

private consumption if government consumption serves as a substitute. This allow us to judge the signs of the regression coefficients to see whether or not the empirical evidence indicates that government consumption switched between being a substitute and a complement during the non-Keynesian periods of fiscal policy that have been observed. However, before we go on with discussing the empirical model that is intended to capture these properties of government consumption, we formalize the theoretical model of effective consumption.

3 Theoretical model

Following Evans and Karras (1996), suppose that an infinitely lived consumer optimizes life-time utility arising from the future flow of effective consumption, $\{C^*_{t+i}\}_{i=0}^{\infty}$, as in (1).

$$max \quad E_t\left[\sum_{i=0}^{\infty}\beta^i u(C^*_{t+i})\right] \tag{1}$$

In (1), $E_t[\cdot]$ denote the mathematical expectation conditional on information available at time t. The preferences of the private agent are represented by a utility function, $u(\cdot)$, that is assumed to be twice continuously differentiable with a positive first derivative and a negative second derivative. Furthermore, β denote the subjective discount factor, while C^*_t is effective consumption. Effective consumption is defined as a weighted sum of private and government consumption as in (2).

$$C^*_t = C_t + \theta G_t \tag{2}$$

The private agent is assumed to maximize utility by altering private consumption, C_t, while taking government consumption, G_t, as exogenously given. Analogously to Hall (1978), the first-order conditions for effective consumption suggests that effective consumption follows a random walk with drift as in (3).

$$C^*_t = \gamma_0 + C^*_{t-1} + \eta_t \tag{3}$$

The disturbance term, η_t, in (3) reflects news regarding the permanent level of effective consumption that can be sustained. If we rewrite the expression in (3), so that the change in private consumption is expressed as a function of the change in government consumption, we get the expression in (4).

$$\Delta C_t = \gamma_0 - \theta \Delta G_t + \eta_t \tag{4}$$

From (4) we see that the sign of θ determines how government consumption will affect private consumption. If $\theta < 0$ the marginal effect of government consumption growth on private consumption is positive, that is private and government consumption are complements.[3] The channel through which the complementary effect works can be seen by studying the utility function of the private agent in (1) and the definition of effective consumption in (2). From these expressions we see that an increase in government consumption increases marginal utility of effective consumption if $\theta < 0$. Since the first-order conditions give that the marginal utility of consumption should be smooth in optimum, the private agent responds be increasing private consumption so that the marginal utility is kept smooth.

The opposite reasoning applies when $\theta > 0$. If this is the case, we see from (4) that government consumption will be a substitute for private consumption. Hence, private consumption and government consumption will move in opposite directions.

Although intuitive, the expression in (4) hides a potentially devastating problem. When specifying an empirical model from the expression in (4), the error term, η_t, accounts for the unexpected change permanent disposable income arising from unexpected changes in either permanent gross income or permanent taxes. However, if the private agent internalize the government's budget constraint, the interpretation of the error term can be equivalently stated in terms of the permanent levels of gross income and government consumption.[4] Hence, the error term captures factors that the private agent perceive as news about the permanent level of government consumption. A positive innovation to the expected permanent level of government consumption will hence induce a negative effect on private consumption since permanent disposable income will decrease. However, when specifying an econometric model as in (4), the innovation to the expected level of government consumption will be captured by the inclusion of ΔG_t in the regression model. Hence, when estimating an econometric model from the expression in (4), the parameter estimate of θ will have a tendency to fall below the actual value of θ. The magnitude of this problem will depend on two things: the relative magnitude of expected and unexpected changes in government consumption and the degree to which innovations to government government consumption are perceived as permanent.

[3]McCulloch (1977) analyzes this type of substitution and complementary effects and discusses the use of the so called Auspitz-Lieben-Edgeworth-Patero (ALEP) and Allen-Hicks criterions for substitutes and complements. Throughout this paper, we adopt the ALEP criterion for judging whether goods are to be regarded as complements or substitutes. That is, we refer to government consumption as complements or a substitutes based on the whether it increases or decreases marginal utility of private consumption.

[4]In all real-world applications the government budget constraint is stated in terms of government revenue and government expenditure, not in terms of government taxes and government consumption. However, the main problem that we discuss in this subsection addresses the problems related to government consumption. To keep nomenclature clear, we use government consumption in the following discussion. However, it is important to note that this is done for expository reasons only.

The first factor that will determine how much the estimate of θ will be disturbed by the permanent income effect is how much of the changes in government consumption in a given period that is expected and how much that is unexpected. The reasoning behind this fact is that all changes, both expected and unexpected, change private consumption as a consequence of government consumption being a complement or a substitute. However, only unexpected changes in government consumption will have a permanent-income effect on private consumption. If a relatively large part of government consumption can be predicted, the permanent-income effect will only marginally disturb the substitution/complement effect that government consumption will have and the parameter θ can be precisely estimated.

The second factor that determines how much the estimate of θ in (4) will be disturbed by permanent-income effects is the permanence of shocks to government consumption. Private consumption will respond one-to-one with a permanent shock to government consumption. However, all shocks to government consumption doesn't affect the permanent level equally much. If government consumption is temporarily changed, the permanent level of government consumption isn't changed as much as if a permanent shock hits government consumption. Hence, if the temporary changes in government consumption are large compared to permanent changes in government consumption, the permanent-income effect should not disturb the estimate of θ in (4). The effect that a shock will have on the permanent level of government consumption can be investigated by fitting a model univariate time-series model to government consumption and trace out the long-run effect of a shock.

The two previously described factors, that determine how suitable the expression in (4) is for use in an econometric specification, amounts to an assumption on the time-series process that characterizes government consumption. If the process is well-known and exhibits quick mean reversion, we can specify an econometric model from (4) and expect to capture the parameter θ well in the estimation. The process that characterizes government consumption is well-known to the private agent if the innovation variance is small compared to the overall variance in the process. Quick mean reversion occurs if the process is mean- or trend-stationary and can be characterized by an autoregressive process with parameters that are small in absolute value. We will investigate these properties empirically in Section 5.2.

The expression in (4) is based on the assumption that there are no liquidity constraints in the economy. The absence of liquidity constraints allows the consumer to set private consumption at a level that maximizes utility and only change consumption as predicted by (4). But when liquidity constraints are present, consumption cannot reach the optimal level but can instead be changed only when income changes.

It is or course reasonable to allow for some fraction of the individuals in an economy to be liquidity constrained. Following Evans and Karras (1996), which base their work on the models by Hayashi (1982) and Campbell and Mankiw (1989), we assume that there exists two types of consumers in the economy. Besides the permanent-income individuals described in the previous subsections, we assume that some fraction of the population is liquidity constrained consumers. These liquidity constrained individuals change their consumption in response to current changes in income. Let C^1 denote the consumption of the agents that consume according to the permanent income model of

effective consumption and let the consumption of the liquidity-constrained individuals be denoted C^2. The consumption of the two types of individuals are described by (5) and (6) below.

$$\Delta C_t^1 = \gamma_0 + \gamma_1 \Delta G_t + \eta_t \tag{5}$$
$$\Delta C_t^2 = \gamma_2 \Delta Y_t \tag{6}$$

In (5), η_t denotes a random error with zero mean while Y_t in (6) denotes disposable income. Let the fraction of consumers that are liquidity constrained be ω. Total consumption, which is equal to the weighted sum of the two different types of consumption behavior, will then be given by (7) below.

$$\Delta C_t = (1-\omega)(\gamma_0 + \gamma_1 \Delta G_t + \eta_t) + \omega\gamma_2 \Delta Y_t = \beta_0 + \beta_1 \Delta G_t + \beta_2 \Delta Y_t + \varepsilon_t \tag{7}$$

The consumption function in (7) nests several testable hypotheses regarding consumption behavior. First, it is possible to test whether liquidity constraints are prevalent. If no liquidity constraints are present, γ_2, and hence β_2, will be equal to zero. Similarly, if the private agent's consumption decision is not affected by government consumption, that is if effective consumption not is an issue, γ_1 and β_1 are equal to zero. Both of these hypotheses are testable, both individually and jointly. These test will be performed when the empirical model is estimated.

It is important to note that the consumption function in (7) displays the same problem, regarding possible permanent-income effects, that was discussed above for the expression in (4). But as before, if government consumption can be reasonably well predicted and the shocks that occur doesn't have large effects on the permanent level of government consumption, we should be able to estimate β_1 without any problems.

As it stands, the consumption function in (7) does not allow for more that one effect of government consumption, i.e. government consumption must be regarded either as a complement or a substitute throughout the period covered by the sample. However, it is possible that different items of government consumption, some being complements while others being substitutes, are altered during different periods. As discussed in Section 1, this can cause aggregate government consumption to appear as being a complement during certain periods, while appearing as a substitute during other periods. In the next section, we will specify an econometric model from the consumption function in (7). The model will allow government consumption to be either a substitute or a complement depending on the time period considered.

4 Specifying the econometric model

As mentioned in Section 3, the parameter θ in the expression for total effective consumption, $C^* = C + \theta G$, determines whether government consumption is a complement or a substitute to private consumption. To be able to investigate if effective consumption is a possible explanation for the non-Keynesian periods described above, we wish to model the effects of government expenditure in a way that allows for two regimes, one where it is possible for government consumption to act as a substitute and one where it is possible

for it to act as a complement. The model that we use to investigate the properties of government consumption is presented in (8) and (9) below.

$$\Delta C_t = \beta_0 + \beta_{1,S_t}\Delta G_t + \beta_2 \Delta Y_t + \varepsilon_t \tag{8}$$

$$\varepsilon_t \sim iid\ N(0, \sigma^2_{S_t}) \tag{9}$$

The variables C_t, G_t and Y_t are defined in the previous section. The parameters β_0 and β_2 denote the intercept and slope parameter for income, respectively, and their interpretation is straightforward. However, the parameter β_{1,S_t} needs a closer explanation. The subindex S_t on the parameter is used to denote the regime that prevails in period t. Relating back to the discussion about the different properties of government consumption, the regime can for example denote whether government consumption act as a complement or a substitute. However, it is equally likely that the regime denote periods where the degree of substitutability, or complementarity, differs. The interpretation of the regime depends on the signs that the parameter takes during the different regimes. If this parameter takes different values in different regimes, we can interpret this as support for the substitute-complement dichotomy of government consumption, and consider the effective consumption hypothesis as a possible explanation of the non-Keynesian fiscal policy effects that have been previously documented. On the other hand, if the parameters during different regimes have the same sign only limited support for the effective consumption hypothesis is offered.

If we want to investigate if government consumption acted as a substitute or a complement during the non-Keynesian periods described in Section 2, we have to get an estimate of the parameter β_{1,S_t} during the different regimes. Two main choices are available to us when we are to determine what effect that is reigning during a certain period in time. We can either study the case where the regimes are determined exogenously from the previous literature as presented in Section 2. Alternatively, we can let the data decide the periods that belong to different regimes and then compare the data-determined regimes to the ones previously documented. These two choices are discussed in detail in Section 5.3 and Section 5.4 below.

5 Empirical analysis

In this section we estimate the econometric model that was specified in Section 4. We have at least two choices available when we are to estimate a model where the periods with possibly different regimes are known a priori. The first way to go about is to exogenously impose the two regimes in the econometric model and then investigate if there is any empirical support for the theorized effects during the different regimes. Another possibility is to let the regimes be determined endogenously and then compare the effects during different regimes and the timing of regimes to the previously defined periods during which non-Keynesian effects of fiscal were documented. We investigate both of these methodologies below. However, before we continue with the estimation, we present the data material used to estimate the different models.

5.1 The data

To investigate the non-Keynesian periods described in Section 2, we need data for private consumption, government consumption and income for Denmark, Germany, Ireland and Sweden. The data series used in this paper are gathered from OECD Economic Outlook No. 72. The series are semi-annual data that span 1960:1 to 2001:2. All the data series are in per capita terms, expressed in fixed prices and in natural logarithms.[5]

5.2 Investigating the assumptions

To investigate the assumption necessary to be able to estimate the regression model in (7), we study the development government consumption over time. The aim is to determine the relative importance of expected and unexpected changes in government consumption. If large fractions of the changes in government consumption is unexpected, it is less reasonable to specify a regression from the relationship in (7). However, if only a small part of the changes in government consumption is attributable to unexpected changes, there is no problem in specifying a regression model based on (7).

Suppose that we try to predict the government consumption series for the four countries using only an intercept and a time trend. Such a specification implies a simple rule for prediction and a benchmark for determining to what extent changes in government consumption are expected. In the top panel of Table 2, we give the R^2 values for the regression where an intercept and a time trend is fitted to the government consumption series.[6]

Table 2: Predictability of government consumption.

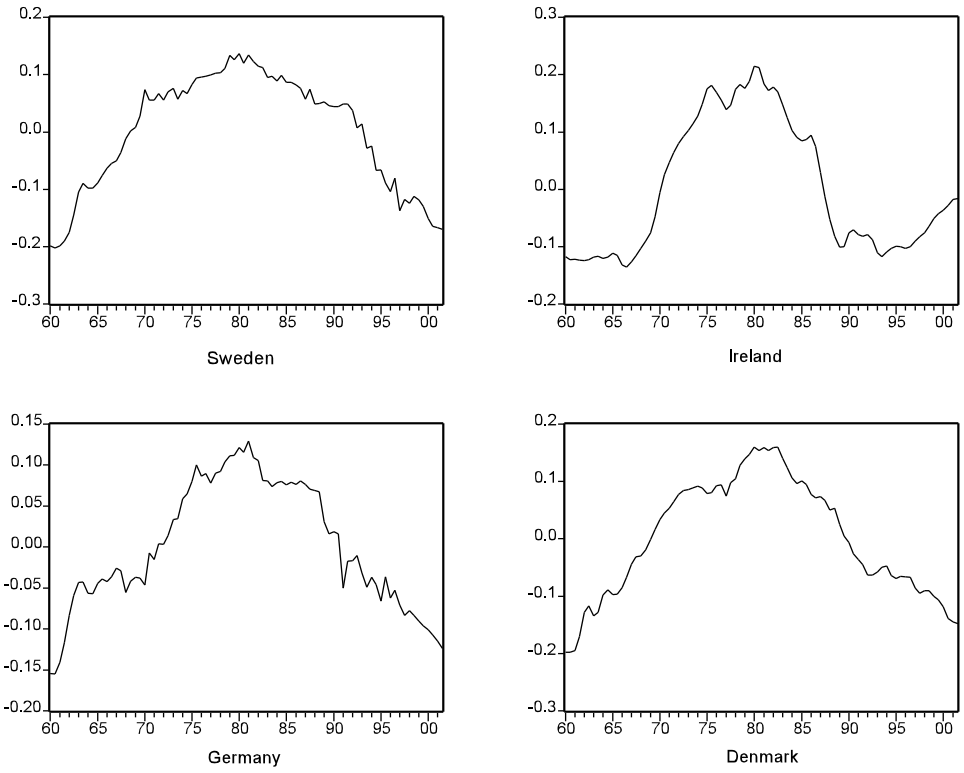
	Deterministic components only			
	Denmark	Germany	Ireland	Sweden
R^2	0.9158	0.9242	0.8866	0.8778
	Deterministic components and AR(1) term			
	Denmark	Germany	Ireland	Sweden
R^2	0.9990	0.9970	0.9978	0.9973

As seen from the top panel of Table 2, a large fraction of the government consumption series can be explained by simply predicting it by an intercept and a linear trend. However, basing predictions on deterministic components only renders a simplistic model for government consumption. If we study the residuals obtained from the detrended government consumption series, as presented in Figure 5, we see that better predictions should be obtained by allowing for an autoregressive component in the model.

[5] As disposable income was not available for all the countries on a semi-annual basis, we use GDP as a proxy for income for Denmark and Ireland. For completeness, we perform the empirical analysis using both disposable income and GDP for Germany and Sweden.

[6] Since we are to determine how well the empirically realized government consumption series fit a specific process, we use the in-sample predictions.

Figure 5: Detrended government consumption series.



From Figure 5 we also see that all of the detrended series looks stationary. Hence, including an autoregressive term in the prediction model should not affect the usefulness of the R^2 measure when assessing the predictability of government consumption. In the lower panel in Table 2 we present the R^2 measure when fitting government consumption to the deterministic components and an autoregressive term. We see that the inclusion of an first-order autoregressive term makes the regression fit even better. Only a small fraction of government consumption is attributable to unexpected shocks. The fact that only a small fraction of government consumption changes are unexpected also implies that, although possibly affecting the permanent level of government consumption to a large extent, an unexpected shock to government consumption doesn't disturb the estimate of the parameter β_{1,S_t} in (8)

The main conclusion to be drawn from the results of this section is that model specification from Section 4 is satisfactory and should be able to capture the complement/substitute effects that could exist between government consumption and private consumption. Hence, we go on by studying the empirical results obtained when estimating the specified model using regime definitions that are exogenously and endogenously determined, respectively.

5.3 Exogenously determined regimes

The first, and perhaps the simplest, way to investigate the properties of government consumption during the non-Keynesian periods is to separate out the periods of interest and construct dummy variables for these periods. The dummy variables are then interacted with government consumption growth to enable estimation of regime-dependent parameters. The construction of the dummy variables are described in (10)

$$D_t^i = \begin{cases} 1 \text{ if } \{t \in T_i^*; T_i^* \subseteq T\} \\ 0 \text{ if } \{t \notin T_i^*; T_i^* \subseteq T\} \end{cases} \tag{10}$$

In (10), T denotes the all the periods that the sample covers, while T_i^* denotes the set of periods during which non-Keynesian effects in private consumption have been documented (see Section 2 above). The subindex i on T_i^* (which is used as a superindex on D_t^i) indicates whether government consumption growth has been positive or negative, i.e. $i \in \{pos, neg\}$. The dummy variables defined in (10), D_t^i, are interacted with the variable ΔG_t in the regression model presented in (7). The obtained variables are then used to augment the consumption function to obtain the regime-dependent model in (8) in Section 4. The resulting econometric model is presented in (11) below.

$$\Delta C_t = \beta_0 + \beta_1 \Delta G_t + \beta_2 \Delta Y_t + \beta_3 D_t^{pos} \Delta G_t + \beta_4 D_t^{neg} \Delta G_t + \varepsilon_t \tag{11}$$

The parameters β_3 and β_4 should be interpreted as the change in the marginal effect of ΔG_t on ΔC_t during the non-Keynesian periods. If the different properties of government consumption are to explain the non-Keynesian effects that have been documented we would expect specific signs of the parameters β_3 and β_4. More precisely, when government consumption growth is positive, i.e. $T_i^* = T_{pos}^*$, government consumption should act as a complement to private consumption in Denmark, Ireland and Germany if effective consumption is to contribute to the occurrence of non-Keynesian fiscal periods. Hence, the sum of the parameters β_3 and β_1 should be positive for Denmark, Ireland and Germany if effective consumption should be able to contribute to the non-Keynesian behavior of fiscal policy that has been documented for these countries. On the other hand, when government consumption growth is negative we expect that government consumption and private consumption in Denmark, Germany and Ireland are substitutes. This implies that the sum of β_4 and β_1 should be negative for the three countries. For Sweden, for which a non-Keynesian fiscal expansion has been documented, we expect the sum of β_3 and β_1 to be positive and the sum of β_4 and β_1 to be negative if the effective consumption hypothesis is at work. The above discussion, about the expected signs of the parameter estimates, is summarized in Table 3.

The econometric model in (11) can easily be estimated by OLS. However, before we go on by presenting the estimation results, we note that the regression model in (11) embodies some testable hypothesis that matters both for the specification of the econometric model and for the theories regarding effective consumption and liquidity constraints.

First and foremost, we see from the regression function in (11) that is $\beta_2 = 0$ then there are no liquidity constrained individuals in the economy. Second, we note that if $\beta_1 = \beta_3 = \beta_4 = 0$ then government consumption does not enter the utility function and

Table 3: Expected signs of parameter estimates[a]

		Expected sign on parameter			
Sign on ΔG_t	Parameter	Denmark	Ireland	Germany	Sweden
Positive	$\beta_3 + \beta_1$	+	+	+	-
Negative	$\beta_4 + \beta_1$	-	-	-	+

Notes: [a]Expected signs if effective consumption is to explain non-Keynesian behavior.

hence no role is given to effective consumption. Either one, or both, of these restrictions might apply to the model in (11). To investigate this issue, and hence test the specification of the model in (11), we test these hypotheses. The test null hypotheses that we test are presented in Table 4.

Table 4: Testable hypotheses with exogenously determined regimes.

Hypothesis	Parameter restriction	Interpretation
H_0^1	$\beta_2 = 0$	No liquidity constrained individuals
H_0^2	$\beta_1 = \beta_3 = \beta_4 = 0$	No role for effective consumption
H_0^3	$\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$	H_0^1 and H_0^2 holding simultaneously

The hypotheses in Table 4 are tested by a Wald test. To this end, we estimate the model in (11), using the data material previously described. The test statistic for the null hypothesis is then obtained using the robust standard errors of White (1980).[7] The test statistics and the corresponding p-values are presented in Table 5.

Table 5: Test of restrictions, exogenous regimes.[a]

Null hypothesis	Denmark	Germany[b]		Ireland	Sweden	
	GDP	GDP	Y^d	GDP	GDP	Y^d
H_0^1	57.99	41.44	148.78	41.93	12.07	12.30
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0^2	2.20	6.49	6.23	5.57	2.01	1.99
	(0.10)	(0.00)	(0.00)	(0.00)	(0.12)	(0.12)
H_0^3	26.63	176.73	259.31	13.28	11.47	7.84
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: [a]p-values are presented within parentheses.
[b]We include a dummy variable in 1990:1 for Germany

[7]We use the robust standard errors of White (1980) since a maintained assumption is that the error variance is different across the regimes.

From Table 5 we see that we reject all the three null hypotheses for almost all of the countries. The exceptions are the hypotheses regarding effective consumption when Denmark and Sweden are considered. In these cases, the null hypothesis, that there is no role for government consumption in the private agent's utility function, cannot be rejected at the 10% significance level. However, if we study the p-values for these cases, we see that they are rather low and only marginally larger than 10%. Hence, considering the non-Keynesian periods in Section 2 and the theoretical motivation in Section 3, it seems reasonable to adopt the most general model in the consequent analysis.

The next step in the analysis is to estimate the consumption function, using the exogenously determined regimes, and study to what extent the estimation results corresponds with the prediction of the theoretical model. The estimation results are presented in Table 6.

Table 6: Estimated parameters, exogenous regimes.

	Denmark	Germany[a]		Ireland	Sweden	
	GDP	GDP	Y^d	GDP	GDP	Y^d
ΔG_t, (β_1)	0.10	0.13	0.15	-0.23	0.05	0.09
	(0.11)	(0.07)	(0.08)	(0.11)	(0.10)	(0.11)
$D^{neg}\Delta G_t$, (β_4)	-2.16	0.52	0.19	0.28	0.19	0.11
	(1.82)	(0.18)	(0.20)	(0.20)	(0.18)	(0.24)
$D^{pos}\Delta G_t$, (β_3)	0.78	-0.16	0.10	-0.52	-0.62	-0.91
	(0.35)	(0.26)	(0.32)	(0.17)	(0.47)	(0.43)
$\Delta GDP/\Delta Y^d$, (β_2)	0.71	0.62	0.64	0.72	0.42	0.44
	(0.09)	(0.10)	(0.05)	(0.11)	(0.12)	(0.13)
Constant, (β_0)	-0.0011	0.0043	0.0027	0.0039	0.0038	0.0051
	(0.0019)	(0.0016)	(0.0015)	(0.0030)	(0.0029)	(0.0026)
Dummy	-	0.0260	-0.0048	-	-	-
	-	0.0108	0.0065	-	-	-
R^2_{adj}	0.46	0.58	0.65	0.35	0.16	0.17

Notes: [a]The robust standard errors of White (1980) is presented within parentheses.
[b]We include a dummy variable for Germany 1990:1.

The first thing that we note from Table 6 is that consumption growth is sensitive to income growth for all of the countries. This corresponds well to the test results presented in Table 5. Second, when we study the effects of government consumption during periods that fall outside the non-Keynesian periods identified in Section 2, we see that government consumption acts as a complement for all countries except Ireland. For Ireland government consumption instead seems to act as a substitute for private consumption.

But now let's turn to analyzing the role of effective consumption during the periods where non-Keynesian effects of fiscal policy have been documented. In Table 1 we found the properties that government consumption should have if effective consumption was to explain the non-Keynesian effects of fiscal policy. These properties was translated

into expected parameter signs in Table 3. If we compare the expected signs in Table 3 to the estimated parameters in Table 6 and the corresponding sums in Table 7, we see that during the periods where we have observed non-Keynesian effects of fiscal policy, while government consumption was declining, we observe a stronger positive correlation between government and private consumption for all countries except Denmark. Hence, for the Germany and Ireland, government consumption remains a complement to private consumption during periods where government consumption would have to be a substitute if effective consumption were to help explain the non-Keynesian responses to fiscal policy action. But for Denmark and Sweden we get a different result. During the periods where government consumption was declining, it seems like government consumption was a substitute to private consumption in Denmark and a complement to private consumption in Sweden. Hence, the effective consumption hypothesis provides a possible explanation to the non-Keynesian behavior that have been previously established.

Table 7: Estimated parameter during different regimes.[a]

Parameter sum	Denmark	Germany[a]		Ireland	Sweden	
	GDP	GDP	Y^d	GDP	GDP	Y^d
$\beta_3 + \beta_1$	0.88	-0.03	0.25	-0.75	-0.57	-0.82
	(0.02)	(0.92)	(0.45)	(0.00)	(0.24)	(0.06)
$\beta_4 + \beta_1$	-2.07	0.65	0.34	0.04	0.24	0.20
	(0.26)	(0.00)	(0.02)	(0.72)	(0.05)	(0.29)

Notes: [a]p-values for the F-test that the sum is zero is presented within parentheses.

When we consider periods where non-Keynesian effects of fiscal policy have been documented and government consumption has been increasing, the previous results are further strengthened. From Table 6 and Table 7, we see that government consumption becomes a substitute for all countries except Denmark.[8] Hence, since government consumption has been a complement to private consumption in Denmark and a substitute to private consumption in Sweden during these periods, the effective consumption hypothesis applies also during periods where government consumption has grown. These results once again imply that the non-Keynesian effects cannot be explained by the effective consumption hypothesis for Germany and Ireland. However, for Denmark and Sweden the effective consumption hypothesis offers a possible explanation for the non-Keynesian effects that have been documented.[9]

[8]It can be noted that somewhat ambiguous results are obtained for Germany. However, the ambiguity does not alter the main conclusions drawn from the results.

[9]In the analysis of the model with exogenous regimes, we have also tried out specifications that are intended to capture effects that arise due to the dummy variable being defined from periods with non-Keynesian response in private consumption. As Göran Hjelm pointed out, the inclusion of an intercept dummy, that is constructed as the sum of the two dummies used to define the exogenous regimes, could eliminate potential problems arising from the definition of the dummy variable. The conclusions based on the estimation results from the alternative specification become dependent on the income definition when Sweden is considered, while the results become more in line with the effective consumption hypothesis for Germany. For Denmark and Ireland, the main conclusions are unaltered.

To summarize, we have established that effective consumption does not seem to contribute to the understanding of the non-Keynesian effects that fiscal policy had on private consumption in Germany and Ireland. However, for Denmark and Sweden the empirical results lend support to the hypothesis that the complement/substitution properties of government consumption can help explain the non-Keynesian effects.

One problem with exogenously determined regimes is the fact that we do not find all periods that should be classified as a regime where government consumption is either a substitute or a complement. The implication is that we may be unable to identify regimes that are in fact present. This problem could be eliminated if we were able to identify the periods that belong to a certain regime through the data material that we work with. In the next subsection, we use the Markov-switching methodology to endogenously identify the different regimes.

5.4 Endogenously determined regimes

One general problem with the use of exogenously determined regimes is the fact that we impose a regime definition on a certain period without letting the empirically realized data affect the choice of regime that is to reign in that specific period. This problem of course applies also to the analysis of Section 5.3. Even though we found some evidence that effective consumption could assist in explaining the non-Keynesian effects that have been previously documented in Denmark and Sweden, we found no such evidence for Germany and Ireland. Hence, it would be interesting to study the case where we let the regime definition, that is to be attributed to a certain period, be determined by the data material. To allow for such endogenously determined regimes, we use a Markov-switching regression methodology.

To estimate the consumption model in (8) and (9) with endogenously determined regimes, we set up the likelihood function for the regression model in (7) for two different regimes. The two different regimes are intended to capture the possible non-linearity in the relationship between government consumption and private consumption that can help explain the non-Keynesian effects that have been observed. The likelihood functions for the two regimes, denoted regime 0 and regime 1, are given by (12) and (13) below.

$$f(\Delta C_t|S_t=0)=\frac{1}{\sqrt{2\pi\sigma_0^2}}\exp\left(-\frac{[\Delta C_t-x_t\gamma^0]^2}{2\sigma_0^2}\right) \tag{12}$$

$$f(\Delta C_t|S_t=1)=\frac{1}{\sqrt{2\pi\sigma_1^2}}\exp\left(-\frac{[\Delta C_t-x_t\gamma^1]^2}{2\sigma_1^2}\right) \tag{13}$$

In (12) and (13), x_t is a 1×3 vector containing the independent variables $\{1, \Delta G_t, \Delta Y_t\}$ while $\gamma^i=\{\gamma_0,\gamma_{1,i},\gamma_2\}'$ denotes the vector of parameters corresponding to the independent variables. The superindex i on the vector γ^i is used to denote the parameter vectors of different states. As seen from (12) and (13), we only consider cases where the parameter for government consumption and the residual variance varies across regimes. We allow the latter to vary across regimes to enable specification testing in the empirical analysis.

From the likelihood functions of the different states in (12) and (13), the likelihood value for the entire sample can by obtained by summing over the weighted sum of the log

likelihood values for different states. The weights used are interpreted as probabilities of being in a certain state. To obtain an estimate of these probabilities we must assume an initial probability of being in a certain state and decide upon the transition probabilities of leaving one state for the other. Hence, the parameters to be estimated are the slope parameters of the regression function for each state, the error variance in each state and, finally, the transition probabilities. Given these parameters we can then find the probability of being in a certain state at specific point in time conditional upon the information in the sample and the maximized likelihood function. In Appendix A we describe the estimation procedure in greater detail.

The next step in the analysis will be to analyze the appropriate specification of the Markov-switching regression model. As in the previous subsection, we do this by testing various restrictions on the most general model. In the Markov-switching framework we test the different hypotheses by employing a likelihood ratio test. The hypotheses tested, which are the analogues to the ones presented in Section 5.3, are presented in Table 8.

Table 8: Testable hypotheses with endogenously determined regimes.

Hypothesis	Parameter restriction	Interpretation
H_0^1	$\gamma_2 = 0$	No liquidity constrained individuals
H_0^2	$\gamma_{1,0} = \gamma_{1,1} = 0$	No role for effective consumption
H_0^3	$\gamma_{1,0} = \gamma_{1,1} = \gamma_2 = 0$	H_0^1 and H_0^2 holding simultaneously

From Table 8 we see that is the null hypothesis H_0^2 is true then there will no Markov-switching slope parameters in the specified model. Unless some other parameter is allowed to vary across regimes, the specification under the null hypothesis would not be nested in the specification under the alternative. Hence, we let the error variance depend on the state and are as a consequence enabled to perform likelihood ratio tests to test the hypotheses in Table 8. The test statistics, together with the corresponding p-values are presented in Table 9 below.

From Table 9, we get the same principal conclusions as in the case where exogenously defined regimes were considered. With only two exceptions we reject all if the restrictions imposed on the most general model. The exception once again occurs when we test the notion of effective consumption for Sweden. When we use GDP as a proxy for income, the estimation yields a parameter vector that is situated on the boundary of the allowed parameter space.[10] Hence, the model obtained under the restrictions is deemed unreasonable and hence rejected on economical grounds. When we use disposable income in our model specification for Sweden, we cannot reject the null hypothesis that government consumption does not enter the utility function of the private agent. This undoubtedly is an argument for not including Sweden in consequent analysis. However, for completeness sake we estimate the Markov-switching regression also for Sweden, bearing in mind that we cannot reject the null hypothesis that there is no effective consumption motive at work.

[10]See Appendix A for a discussion of the allowed parameter space.

Table 9: Tests of restrictions, endogenous regimes.[a]

Null hypothesis	Denmark	Germany[b]		Ireland	Sweden	
	GDP	Y^d	GDP	GDP	Y^d	GDP
H_0^1	34.06	60.4	38.90	38.32	15.34	22.7
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
H_0^2	8.3	60.4	7.68	7.78	0.01	N.A.[c]
	(0.02)	(0.00)	(0.02)	(0.02)	(0.95)	-
H_0^3	48.1	136.5	115.03	50.56	18.02	25.38
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: [a]p-values within parentheses.
[b]We include a dummy for Germany during the period 1990:1.
[c]The model reaches the boundary of the allowed parameter space.

When we estimate the Markov-switching regression for the four countries, we get the parameter estimates presented in Table 10.

The first thing that we notice from Table 10 is that the magnitudes of the marginal propensities to consume out of income is about the same size as when exogenously determined regimes where considered. Such a stability of the estimated parameters, across different econometric methodologies, is of course a nice property.

The second thing that we note from Table 10 is that government consumption, in almost all cases, acts as a complement to private consumption. That is, we are not able to trace two distinct regimes, with government consumption acting as a complement in one regime and as a substitute in the other. The exception from this rule is Ireland, where we can observe two distinct regimes. During the regime denoted 0, we see that government consumption acts as a complement while government consumption during regime 1 acts as a substitute. With these estimated effects of government consumption, it would be interesting to study when the different regimes occur. From the previous literature, we conclude that government consumption should act as a complement to private consumption in Ireland during the second half of 1989. Hence, regime 0 should prevail in this period. During the period 1987:1-1989:1 government consumption should act as a substitute in Ireland, and hence regime 1 should prevail during this period if effective consumption is to offer an explanation for the non-Keynesian effects of fiscal policy in Ireland. The expected timing of the regimes for Ireland are summarized in Table 11.

Once the parameters of the Markov-switching model have been estimated, we can find the smoothed probabilities for being in a certain state.[11] If we plot the smoothed probabilities of being in the regime denoted 0 at a certain point in time, we can judge if the timing of this regime coincides with the periods that we are interested in. The smoothed probabilities are plotted in Figure 6.

The smoothed probabilities in Figure 6 is to be studied together with the parameter estimates in Table 10. But as we saw in Table 10, it was only for Ireland that the

[11]The smoothing filter used is described in Appendix A.

Figure 6: Smoothed probabilities

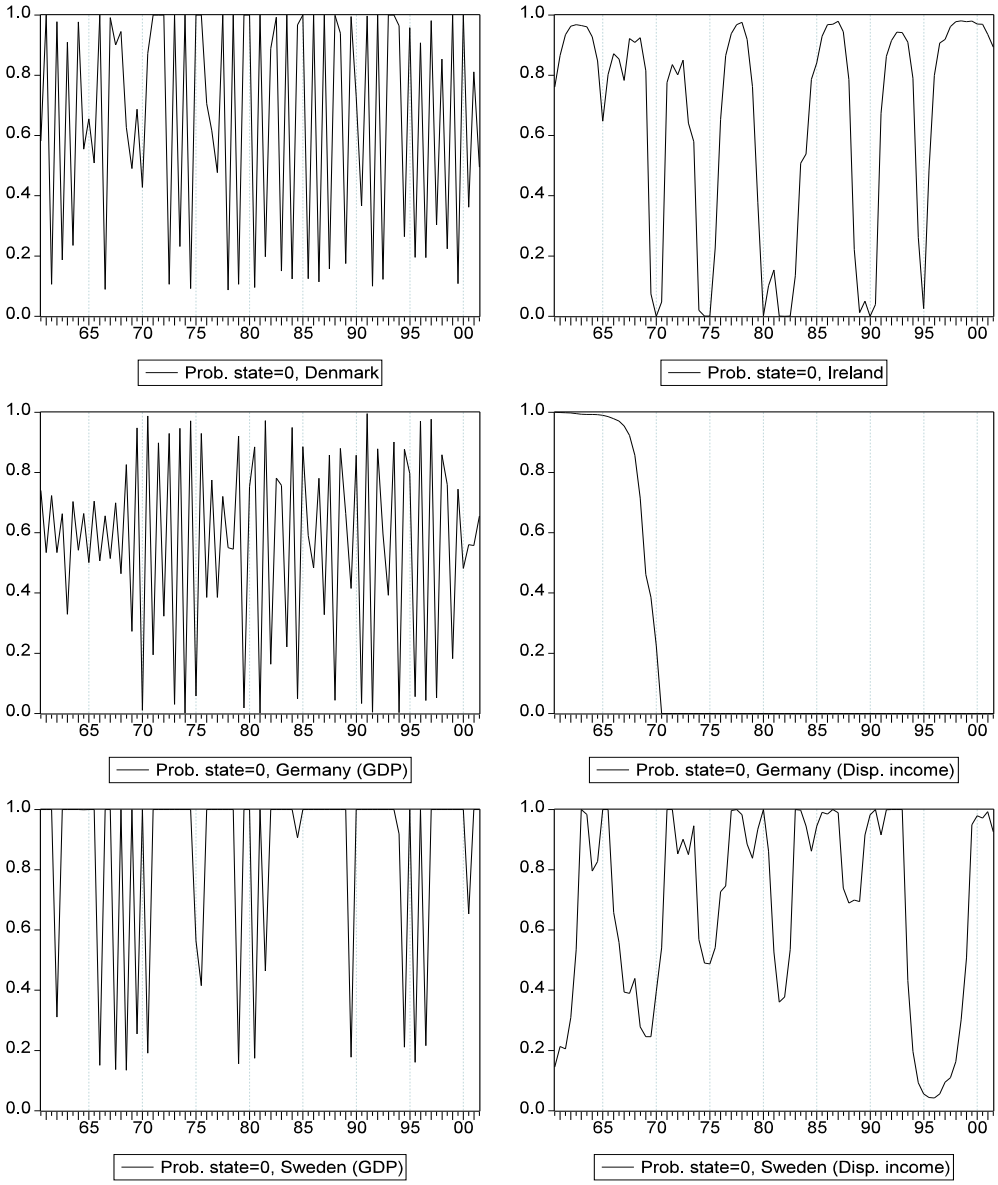


Table 10: Estimated parameters, endogenous regimes.[a,b]

	Denmark	Germany[c]		Ireland	Sweden	
	GDP	GDP	Y^d	GDP	GDP	Y^d
p_{00}	0.46	0.30	0.95	0.87	0.83	0.90
	(0.24)	(0.34)	(0.050)	(0.057)	(0.056)	(0.13)
p_{11}	0.00001	0.095	1.00	0.76	0.0088	0.76
	(0.15)	(0.48)	(0.038)	(0.084)	(0.063)	(0.12)
σ_0	-0.014	0.0053	0.0036	0.0065	-0.016	-0.018
	(0.0014)	(0.00063)	(0.00056)	(0.00096)	(0.0014)	(0.0024)
σ_1	0.0039	0.010	0.0083	0.017	-0.0006	0.0057
	(0.0016)	(0.0020)	(0.00070)	(0.0050)	(0.00018)	(0.0016)
$\Delta G_{t,0}$, $(\gamma_{1,0})$	0.059	0.28	0.11	0.15	0.14	-0.031
	(0.10)	(0.079)	(0.046)	(0.11)	(0.087)	(0.17)
$\Delta G_{t,1}$, $(\gamma_{1,1})$	0.35	-0.011	0.18	-0.51	0.20	0.014
	(0.11)	(0.073)	(0.084)	(0.11)	(0.0086)	(0.073)
$\Delta GDP_t/\Delta Y_t^d$, (γ_2)	0.70	0.60	0.68	0.59	0.24	0.47
	(0.067)	(0.11)	(0.043)	(0.072)	(0.013)	(0.088)
Constant, (γ_0)	-0.0019	0.0045	0.0021	0.0051	0.0024	0.0073
	(0.0013)	(0.0018)	(0.0011)	(0.0016)	(0.00035)	(0.0017)
Dummy	-	0.031	-0.0012	-	-	-
		(0.011)	(0.0062)			

Notes: [a]Robust standard errors of White (1982) are presented within parentheses.
[b]p_{ii} denotes transition probabilities while σ_i denotes error variances.
[c]We include a dummy for Germany during the period 1990:1.

parameter estimates for government consumption gave room for effective consumption as an explanation for non-Keynesian behavior. Hence, the analysis should be focused on Ireland.

In the top right panel of Figure 6, we see the smoothed probability of being in state 0 for Ireland. That is, the smoothed probability depicted is the probability of being in the state where government consumption acts as a complement. Once we have plotted smoothed probability for state 0 and concluded that government consumption acted as a complement during this regime, we can turn to the previous literature and ask when we expect regime 0 to reign for effective consumption to explain the non-Keynesian behavior of private consumption. But this was exactly what we specified in Table 11.

In Table 11, we saw that regime 0 was expected to occur in the second half of 1989 and that regime 1 was expected to reign during the period 1987:1-1989:1. Turning to the top right panel of Figure 6, we see that the smoothed probability of being in state 0 is drastically decreasing over the period 1987-1989. This is equivalent to saying that the probability of being in state 1 is increasing over the same period. The fact that the timing of regime 1 coincides with the prediction based on previous literature, makes the

Table 11: Expected regimes in Ireland[a]

Regime	Parameter estimate	Implied property	Expected occurrence[b]
0	0.15	Complement	1989:2
1	-0.51	Substitute	1987:1-1989:1

Notes: [a]Expected regimes if effective consumption is to explain non-Keynesian effects of fiscal policy.
[b]Period during which the regime should reign according to previous results on non-Keynesian effects.

observed non-Keynesian behavior consistent with the effective consumption hypothesis. Although some support can be found when studying regime 1, the timing of regime 0 doesn't seem to coincide with the previous prediction. However, the endogenous regime approach provides us with the possibility the effective consumption played a role for the non-Keynesian effects of fiscal policy that were observed in Ireland.

6 Conclusions

In this paper, we study the properties of government consumption. More specifically, we investigate whether government consumption acts as a substitute or a complement to private consumption during different periods. The notion that the private agent derives utility from both government and private consumption, in such a way that the marginal utility of private consumption is affected by government consumption, allows us to specify a model of effective consumption that can be utilized to test what properties government consumption has. Once the different properties of government consumption has been investigated, the effects found can be compared to the effects that would help explain previous non-Keynesian behavior of private consumption in response to fiscal policy changes. Since periods with non-Keynesian fiscal policy effects have been previously documented, we can set up an empirical model, nesting the possibility of a effective consumption motive, and study to what extent the property of government consumption as a substitute or a complement can contribute to understanding the effects that fiscal policy has on private consumption.

We study regimes that are determined both exogenously and endogenously, which allows us utilize previous knowledge about non-Keynesian periods and the information inherent in the data material in an optimal way. The main conclusions drawn from the study of government and private consumption is that effective consumption can help explain the non-Keynesian effects of fiscal policy that have been documented in Denmark, Ireland and Sweden. For Germany, no role for effective consumption can be found when studying non-Keynesian effects of fiscal policy. The results put focus on an important aspect in the analysis of fiscal policy effects. The composition of government consumption changes can be important for the outcome of the overall fiscal policy effects since government consumption can act as either a complement or a substitute to private

consumption. The results also imply that the permanent-income explanation of the non-Keynesian effects of fiscal policy should be considered together with other explanations of the phenomenon and not be regarded as the sole cause for non-Keynesian behavior in private consumption.

References

Afonso, A. (2001). Non-Keynesian Effects of Fiscal Policy in the EU-15. Working Paper 2001/07/DE, Department of Economics, Universidade Técnica de Lisboa.

Alesina, A. and Ardanga, S. (1998). Tales of Fiscal Adjustments. *Economic Policy*, 27:489–545.

Alesina, A. and Perotti, R. (1995). Fiscal Expansions and Fiscal Adjustments in OECD Countries. Working Paper 5214, NBER.

Alesina, A. and Perotti, R. (1996). Fiscal Adjustments in OECD Countries: Composition and Macroeconomic Effects. Working Paper 5730, NBER.

Barro, R. J. (1981). Output Effects of Government Purchases. *Journal of Political Economy*, 89:1086–1121.

Bhattacharya, R. (1999). Private Sector Consumption Behaviour and Non-Keynesian Effects of Fiscal Policy. Working Paper WP/99/112, IMF.

Campbell, J. Y. and Mankiw, N. G. (1989). Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence. In *NBER Macroeconomics Annual*, pages 185–216. MIT Press.

Evans, P. and Karras, G. (1996). Private and Government Consumption with Liquidity Constraints. *Journal of International Money and Finance*, 15(2):255–266.

Fels, G. and Froehlich, H.-P. (1987). Germany and the World Economy: A German View. *Economic Policy*, 4:177–206.

Giavazzi, F. and Pagano, M. (1990). Can Severe Fiscal Contractions be Expansionary? Tales of Two Small European Countries. *NBER Macroeconomics Annual*, pages 75–110.

Giavazzi, F. and Pagano, M. (1996). Non-Keynesian Effects of Fiscal Policy Changes: International Evidence and the Swedish Experience. *Swedish Economic Policy Review*, 3:67–103.

Goffe, W. L., D., F. G., and Rogers, J. (1994). Global Optimization of Statistical Functions with Simulated Annealing. *Journal of Econometrics*, 60:65–99.

Graham, F. (1993). Fiscal Policy and Aggregate Demand: Comment. *The American Economic Review*, 83:659–666.

Hall, R. E. (1978). Stochastic Implications of the Life Cycle Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*, 86:971–987.

Hayashi, F. (1982). The Permanent Income Hypothesis: Estimation and Testing by Instrumental Variables. *Journal of Political Economy*, 90(5):895–916.

Hellwig, M. and Neumann, M. (1987). Economic Policy in Germany: Was There a Turnaround? *Economic Policy*, 5:103–145.

Ho, T.-W. (2001). The Government Spending and Private Consumption: A Panel Cointegration Analysis. *International Review of Economics and Finance*, 5:95–108.

Kim, C.-J. and Nelson, C. R. (1999). *State-Space Models with Regime Switching*. MIT Press.

McCulloch, J. H. (1977). The Austrian Theory of the Marginal Use and of Ordinal Marginal Utility. *Journal of Economics*, 37(3-4):249–280.

White, H. (1980). A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity. *Econometrica*, 48:817–838.

White, H. (1982). Maximum Likelihood Estimation of Misspecified Model. *Econometrica*, 50(1):1–26.

A Estimating the Markov-switching regressions

As mentioned in Section 5.4, we find the log likelihood value for the Markov-switching model by weighting together the likelihood value for each state in each time period and then summing over the log likelihood for the different time periods. The weight used to pool the likelihood values of different states are interpreted as probabilities of being in the specific state. Using the likelihood values in (12) and (13) and the probability of being in a certain state, we can write the likelihood value for time period as in (14) below.

$$f(\Delta C_t) = f(\Delta C_t|S_t = 0) \cdot Pr(S_t = 0) + f(\Delta C_t|S_t = 1) \cdot Pr(S_t = 1) \tag{14}$$

In (14), $Pr(S_t = i)$ denotes the probability of being in state i in period t. The key issue in the estimation of the Markov-switching model is to obtain the probabilities that is to be used when weighting together the state-dependent likelihood functions. Below we describe how we estimate the parameters of the Markov-switching regressions and obtain the state probabilities.

One of the key properties of the first-order Markov-switching regressions is the fact that the probability of being in a certain state tomorrow only depends on which state we are in today. This will be an important tool that we can utilize when we derive the state probabilities.

Since we have assumed that the state switching has the Markov property, we need to find two things. First, we need an initial probability of being the different states. Second, we need to know the probabilities of leaving one state for the other. With these two pieces of information it is easy to see that we can find the probability of being in a certain state the following periods. This probability will be conditioned on the initial probability and on previous transitions.

One way to proceed when we are to find the initial probabilities is to let them depend on the transition probabilities. By doing this, we can reduce the complexity of the problem since we only have to find the transition probabilities. Following Kim and Nelson (1999), we let the initial probabilities be given by (15) and (16) below.

$$\pi_0 = \frac{1 - p_{11}}{2 - p_{00} - p_{11}} \tag{15}$$

$$\pi_1 = \frac{1 - p_{00}}{2 - p_{00} - p_{11}} \tag{16}$$

In (15), p_{00} denote the probability that the prevailing state in the next period is zero given that the prevailing state in the current period is zero. p_{11} denotes the corresponding probability for state one. The probabilities in (15) and (16) are used to initialize the recursive calculations of the probability of being in a certain state.

Once we have obtained the initial probabilities we can go on with calculating the probability of being in a certain state in the following periods. The probability of being in state j in the first period of the sample, given the initial probabilities, is given by the expression in (17) below.

$$\Pr(S_1 = j|\Psi_0) = \sum_{i=0}^{1} \Pr(S_1 = j|S_0 = i) \cdot \pi_i = \sum_{i=0}^{1} p_{ji} \cdot \pi_i \tag{17}$$

In (17), we use Ψ_{t-1} to denote the information set up until period $t-1$. This information set is crucial since the calculation of previous probabilities lead up to the probabilities that will be calculated for the next period.

Once these first probabilities are calculated, we can derive the value of the likelihood function for the first observation by using the relation in (18) below.

$$f(\Delta C_1|\Psi_0) = f(\Delta C_1|S_1 = 0) \cdot \Pr(S_1 = 0|\Psi_0) + f(\Delta C_1|S_1 = 1) \cdot \Pr(S_1 = 1|\Psi_0) \quad (18)$$

The expression in (18) uses the fact that the joint distribution of $\Delta C_1$and the state is equal to the conditional distribution of ΔC_1 *given* the state multiplied by the probability for the state.

Once we have calculated the likelihood value for the first observation we continue to the second observation. To find the likelihood value for the second observation, we would of course like to incorporate the information that is inherent in the first observation into our estimate of the probability of being in a certain state in the first period. The same principle applies to all observation throughout the sample. The general expression for the updating scheme is given in (19) and (20) below.

$$\Pr(S_t = j|\Psi_t) = \frac{f(\Delta C_t|S_t = j, \Psi_{t-1}) \cdot \Pr(S_t = j|\Psi_{t-1})}{\sum_{j=0}^{1} f(\Delta C_t|S_t = j, \Psi_{t-1}) \cdot \Pr(S_t = j|\Psi_{t-1})} \quad (19)$$

$$\Pr(S_t = j|\Psi_{t-1}) = \sum_{i=0}^{1} \Pr(S_t = j|S_{t-1} = i) \cdot \Pr(S_{t-1} = j|\Psi_{t-1}) \quad (20)$$

In the first step, (19), the probabilities for being in certain state are updated to include all the available information up until time t. This step corresponds to the step of calculating the initial probabilities in (15) and (16) above. Once we have the probabilities of being in certain state at time t, conditioned on the sample up until time t, we can calculate the probability of being in a certain state the next period, $t + 1$, given the information that is available up until time t. This is done in (20). This step corresponds to the calculation of the in (17) above. All calculations in (19) and (20) can then be performed for the entire sample, $t = 2...T$, to obtain the likelhood values for the different observations. The log likelihood value for the entire sample is then obtained through summation over the logarithms of the individual likelihood values. The log likelihood function is given by (21) below.

$$\ln L(\Delta C_t; \Theta) = \sum_{t=1}^{T} \ln \sum_{i=0}^{1} f(y_t|S_t = i, \Psi_{t-1}) \cdot \Pr(S_t = i|\Psi_{t-1}) \quad (21)$$

The distribution of ΔC_t for the different states were given in (12) and (13) above. The estimation of the Markov-switching regression chooses the components, Θ_i, of the parameter vector Θ so that the likelihood is maximized. In the most general model, with liquidity constraints and government consumption in the utility function, the parameter vector is given by $\Theta = \{p_{00}, p_{11}, \beta_0, \beta_{1,0}, \beta_{1,1}, \beta_2, \sigma_0, \sigma_1\}$, where $\beta_{1,0}$ is the coefficient for government consumption in the first regime and $\beta_{1,1}$ is the parameter for government consumption in the second regime.

Given the data, the likelihood function in (21) can be maximized with respect to the parameters of interest. A wide range of optimization procedures are available to perform this maximization. In this paper we choose to apply the Simulated Annealing (SA) procedure to maximize the likelihood function.[12] By the use of the SA procedure we are enabled to invoke restrictions on the parameter space without any difficulties. Furthermore, by using the SA algorithm we can reduce, although not eliminate, the risk of getting caught in a local maximum of the likelihood function.

The maximization of (21) is performed under a set of constraints on the parameter vector. First, we restrict the probabilities p_{00} and p_{11} to lie between zero and one. Second, we restrict the parameter values that the regression disturbance variances can take. The minimum value for the variance, in either state, is set to be 10^{-10}. This restriction is set to ensure numerical stability of the model during the estimation. The models for which the restriction binds are deemed economically unreasonable, and rejected on the same grounds. Considering the magnitude of the bound, this is a reasonable way to proceed.

In the calculations above, we have obtained the state probabilities of being in a certain state in period t conditional upon the sample information upon time t. However, at the final period of the sample, $t = T$, we have conditioned the state probability on all the information contained in the sample. By using a backward recursion, we can obtain the state probability for a certain time period conditioned on the entire sample. The backward recursions used to calculate the so called smoothed probabilities are presented in (22)-(23) below.[13]

$$Pr(S_t = j, S_{t+1} = k|\Psi_T) = \frac{Pr(S_{t+1} = k|\Psi_T) \cdot Pr(S_t = j|\Psi_t) \cdot Pr(S_{t+1} = k|S_t = j)}{Pr(S_{t+1} = k|\Psi_t)} \tag{22}$$

$$Pr(S_t = j|\Psi_T) = \sum_{k=0}^{1} Pr(S_t = j, S_{t+1} = k|\Psi_T) \tag{23}$$

As seen form (22) and (23), the smoothed probabilities can be obtained from the outputs from the estimation process and the fact that the filtered probabilities are conditioned on the entire sample for $t = T$.

[12] We use a SA procedure written by E.G. Tsionas, which is an based on the work by Goffe et al. (1994).

[13] Wee use Kim's smoothing algorithm (see Kim and Nelson, 1999).