BANK OF FINLAND
DISCUSSION PAPERS

2/97

Anne Brunila

Research Department
10.2.1997

Fiscal Policy and Private Consumption - Saving Decisions: Evidence from Nine EU Countries

SUOMEN PANKIN KESKUSTELUALOITTEITA • FINLANDS BANKS DISKUSSIONUNDERLAG

Suomen Pankki
Bank of Finland
P.O.Box 160, SF-00101 HELSINKI, Finland
☎ + 358 0 1831

Anne Brunila

Research Department
10.2.1997

Fiscal Policy and Private Consumption - Saving Decisions: Evidence from Nine EU Countries

ISBN 951-686-542-9
ISSN 0785-3572

Suomen Pankin monistuskeskus
Helsinki 1997

Fiscal Policy and Private Consumption - Saving Decisions: Evidence from Nine EU Countries

Bank of Finland Discussion Papers 2/97

Anne Brunila
Research Department

Abstract

This paper considers the effects of fiscal policy on private consumption in a framework that encompasses both the conventional (Keynesian) view of fiscal policy and the Ricardian debt neutrality hypothesis. The model is built on Blanchard's stochastic model of intertemporal optimization with finitely lived consumers. As an extension to the basic framework, the model also nests various hypotheses concerning the relationship between public spending and private consumption. Empirical analyses are based on annual data from nine EU countries covering the years 1961-1994 and use the nonlinear instrumental variable GMM estimator both in country-specific and in panel estimations. The tests cannot reject the hypothesis that consumers are Ricardian except for one country. Moreover, the results suggest that in the consumers' utility functions, government consumption tends to be a complement rather than a substitute for private consumption.

Keywords: private consumption, private saving, fiscal policy, planning horizon

Tiivistelmä

Tutkimuksessa analysoidaan julkisen talouden rahoitusvaihtoehtojen - verotuksen ja velkarahoituksen - vaikutuksia yksityiseen kulutukseen ja säästämiseen. Teoreettiset tarkastelut perustuvat ajan yli optimoivan kuluttajan mallille, jossa kuluttajien suunnitteluhorisontti on äärellinen ja jossa kulutus riippuu odotetusta elinikäisestä varallisuudesta. Julkinen kulutus vaikuttaa mallissa yksityisen kulutuksen aikauraan sikäli kuin sillä on vaikutusta kotitalouksien kokemaan hyvinvointiin. Empiirinen aineisto käsittää yhdeksän EU-maata ja kattaa vuodet 1961-1994. Analyysimenetelmänä on käytetty epälineaarista instrumenttimuuttujamenetelmää (GMM). Tulokset tukevat ns. Ricardon velkaneutraliteettihypoteesia, jonka mukaan velalla rahoitettu verojen alentaminen ei lisää yksityistä kulutusta, koska kuluttajat ottavat huomioon valtion velanhoitomenojen kasvusta aiheutuvat tulevat veronkorotustarpeet ja lisäävät säästämistään. Tulosten mukaan kuluttajat kokevat julkiset menot yksityistä kulutusta täydentävinä.

Asiasanat: yksityinen kulutus, yksityinen säästäminen, finanssipolitiikka, suunnitteluhorisontti

Contents

1 Introduction

In an environment where the concern about the sustainability of fiscal policies is growing and the need for fiscal adjustment is widely recognized, it is plausible to assume that private consumers are influenced not only by current fiscal policy but also by anticipations about the future path of government budget variables. The most influential attempt to introduce rational behaviour and fiscal expectations into a forward-looking permanent income-life cycle consumption model was made by Barro (1974) in his famous paper on Ricardian equivalence. He showed that intertemporally maximizing rational consumers will not view government debt as a part of their net wealth if they accurately anticipate the future tax liability of that debt. Rational consumers would realize that the public debt created now by government borrowing must be repaid in the future by an increase in taxes. Provided that the present value of government expenditures is not affected by the choice of budget deficits and surpluses, ie by the timing of taxes, private consumption remains unchanged. Instead consumers will increase saving in order to avoid sharp decline in their future disposable income and consumption due to higher taxes. Thus, deficit financing merely generates the private saving necessary to absorb the additional government debt, leaving national saving and interest rates, investment and output unaltered.

The Ricardian and conventional views of government debt have very different policy implications. According to the conventional (Keynesian) view, that formed a consensus opinion until the 1970s, government deficits stimulate private consumption and aggregate demand in the short run, because debt is treated as net wealth to the private sector. The Ricardian equivalence proposition on the contrary states that a switch from tax financing to debt financing has no stimulating effect on the economy even in the short run and hence, the attempts to stabilize economy by fiscal means are doomed to be futile.

As in the case of budget deficits there exist different views concerning the effects of government consumption on economic activity. Under the conventional approach, changes in government consumption have no direct effect on private consumption since consumers' current disposable income remains unaltered. However, on aggregate demand they will have a one-to-one effect. Ricardian equivalence, on the other hand, suggests that government consumption has a negative but less than one-to-one impact on private consumption. This is not, however, a clear statement since Ricardian equivalence is based on the assumption of a given path of government expenditure. Ricardian way of thinking would rather suggest that consumers should expect that increases in government consumption now will be offset by cuts in the future in which case private consumption should not change at all. Only if the change in government consumption is permanent (eg the present value of government consumption changes), it would affect current private consumption, since it implies also a permanent change in taxation and hence, consumers' real wealth (see Feldstein and Elmendorf 1990).

Feldstein (1982) goes even further than the Ricardian equivalence proposition suggesting a complete ex ante crowding out of private consumption implying that current changes in government consumption must induce an equal, but opposite shift in private consumption, ie by increasing government consumption one cannot

increase aggregate demand. This extreme view leaves then no room for short run fiscal policy stabilization.

Until the 1990s the consensus opinion seems to have been that there is a degree of substitutability between public and private consumption.[1] This is, however, not very easy to justify on theoretical grounds alone. Both items are heterogeneous and although private sector may perceive some components of government consumption as close substitutes for private consumption, some might be perceived as complements, and some as unrelated.

1.1 Empirical support to various hypotheses

After Barro's (1974) Ricardian equivalence or debt neutrality proposition there has emerged a considerable amount of empirical reseach on the effects of fiscal policy on private consumption and aggregate demand. Basically, the studies testing Ricardian equivalence have been carried out in two ways: by testing whether increases in government debt are perceived as increases in household wealth and private consumption or alternatively whether larger budget deficits are associated with higher interest rates.[2] Here the focus is on the first group of studies testing the response of private consumption to government budget variables.

---

[1] The seminal contribution of the effects of government consumption on private consumption and aggregate economic activity is Bailey (1971). The impact of government consumption on private consumption depends upon whether government consumption increases or decreases the marginal utility of private consumption, ie whether government consumption is an Edgeworth complement or substitute for private consumption. Studies based on Bailey's approach, see Kormendi (1983), Barro (1981), Aschauer (1985), Leiderman and Razin (1988), Haug (1990), Karras (1994), Ni (1995), Evans and Karras (1996).

[2] Evans (1985), Plosser (1987), Barro (1989), Correia, Nunes and Stemitsiotis (1995). Barro (1989) suggests that "overall, the empirical results on interest rates support the Ricardian view. Given these findings it is remarkable that most macro economists remain confident that budget deficits raise interest rates."

The overwhelming part of these studies consider the data for only one country, usually the US.[3] The empirical evidence received is, however, highly controversial.[4] There are several reasons for mixed results: they are sensitive to the sample period, the choice and measurement of variables, and the estimation methods used.[5] Some of the major problems related to most empirical specifications of Ricardian equivalence can be characterized as follows. First, theoretical equations that are expressed in terms of expected future values, are often approximated in the empirical equations by a distributed lag on realized past values (see Haug 1990).[6] Second, most of the studies do not estimate regression equations that derive from well-specified theoretical models nesting both Ricardian equivalence and an alternative theory in which budget deficits and current taxes are not equivalent (see Evans 1988, 1993). Consequently, the results obtained are hard to interpret. Moreover, most of the literature uses nonrational expectations aggregate consumption function that is fundamentally inconsistent with the Ricardian equivalence hypothesis (see Flavin 1987). Ricardian equivalence requires intertemporal utility maximization and rational expectations that together yield an Euler equation specification.[7] Third, it is not usually established whether the underlying life cycle or permanent income model is supported by the data (the notable exception being Haug 1990, 1996). Fourth, conflicting results may result from the various measures of private consumption used in the estimations (see Graham 1992).

On the basis of his recent literature survey Seater (1993) concludes that Ricardian equivalence holds as a close approximation despite its nearly certain

---

[3] The exceptions using data from several countries include Nicoletti (1988), Haque (1988), Evans (1993) and Evans and Karras (1996).

[4] Evidence consistent with Ricardian debt neutrality or tax disconting hypothesis and rational expectations includes Seater (1982), Kormendi (1983), Aschauer (1985), Seater and Mariano (1985), Kormendi and Meguire (1986, 1990), Haque (1988), Leiderman and Razin (1988), Evans (1988), Evans and Hasan (1994), Brunila (1996). Contradictory or mixed results are found in Feldstein (1982), Blinder and Deaton (1985), Modigliani and Sterling (1986, 1990), Bernheim (1987), Feldstein and Elmendorf (1990), Haug (1990), Graham and Himarios (1991, 1996), Evans (1993), Himarios (1995), Evans and Karras (1996), Ghatak and Ghatak (1996). Evidence supporting the view that government consumption substitutes for private consumption is presented in Kormendi (1983), Aschauer (1985), Graham and Himarios (1991), Brunila (1996). The opposite result implying that government consumption complements private consumption was found in Leiderman and Razin (1988), Haug (1990), Karras (1994) and Evans and Karras (1996). In contrast to these, Modigliani and Sterling (1986, 1990), Feldstein and Elmendorf (1990) and Graham and Himarios (1991) found virtually no effect of government consumption on private consumption.

[5] For the detailed discussion on the questions concerning the estimation methods or those related to the measurement of variables, see Bernheim (1987), Leiderman and Blejer (1988), Graham (1992), Seater (1993), Himarios (1995) and Graham and Himarios (1996).

[6] Studies of Aschauer (1985), Evans (1988), Haug (1990) and Ghatak and Ghatak (1996) are exceptions.

[7] Only Aschauer (1985), Evans (1988), Haque (1988) and Leiderman and Razin (1988) follow such a procedure in the literature prior the 1990s. The more recent studies are almost invariably based on intertemporal utility maximization, eg Haug (1990, 1996), Graham and Himarios (1991, 1996), Evans (1993), Evans and Hasan (1994), Evans and Karras (1996).

invalidity as a literal description of the role of public debt in the economy. Although there appears to exist much empirical evidence suggesting the rejection of Ricardian equivalence, a large part of it fails to attend to econometric problems related to specification, simultaneity, and data stationarity, as well as to measurement of quantities involved. He holds that much of the published evidence on Ricardian equivalence, both supportive and contradictory, is therefore sufficiently flawed to be informative. He also points out that Ricardian equivalence appears true only under historical fiscal regimes. If societies change their behaviour with respect to public debt, significant effects of the debt might emerge. When considering whether Ricardian equivalence is a good approximation to reality on the basis of more recent evidence the conclusion, however, seems to be opposite to that of Seater. Recent studies avoid also many of the weaknesses cited by Seater (1993).

1.2 Purpose of the paper

The purpose of this paper is to analyze the effects of fiscal policy on private consumption in the framework of a stochastic intertemporal optimization problem where rational consumers maximize the expected value of utility, subject to the lifetime budget constraint. Individual consumers are assumed to face exogenous stochastic processes of disposable labour income and government consumption. The approach is similar to that of Aschauer (1985) in the sense that it consolidates the budget constraint of utility maximizing consumers with that of the government and allows individuals to derive utility not only from private consumption but also from public consumption. Both the substitutability and complementarity of the government and private consumption are allowed for. One can also test Feldstein's (1982) full fiscal neutrality hypothesis whereby an increase in government consumption induces a one-to-one ex ante crowding out of private consumption.

In order to be able to nest the Ricardian equivalence proposition and the conventional, non-Ricardian hypothesis Aschauer's representative agent model with an infinite horizon is modified by introducing a finite planning horizon in line with Blanchard's (1985) seminal paper. A finite planning horizon of consumers introduces a wedge between the real rate of return on assets and the rate at which consumers discount their uncertain future labour income, thus causing Ricardian equivalence to fail. Ricardian equivalence emerges then only as a special case when the discount rates on assets and labour income coincide.

The rest of the paper is organized as follows. An intertemporal model of consumption behaviour is presented in section 2. The questions concerning the empirical implementation and method of estimation are discussed in section 3. Section 4 presents the data and estimation results. Concluding remarks are drawn in section 5.

2 Private consumption behaviour and government budget constraint

The derivation of the empirical consumption function is based on a discrete-time version of Blanchard's (1985) model and the works of Hall (1978) and Aschauer (1985). It is assumed, following Blanchard, that consumers face perfect capital and insurance markets but have finite horizons because a constant fraction $(1-\gamma)$ of them dies each period. From Aschauer it is assumed that total effective consumption in period t is a linear combination of private consumption and a portion θ of government consumption. Government consumption is allowed to be either a substitute for or a complement to private consumption depending on the value of θ. Given these assumptions and the assumptions of a constant real rate of interest, quadratic preferences and lump-sum taxes and government transfer payments, the following aggregate consumption function can be derived

$$\begin{aligned} c_t^P &= \beta_0 + \beta_1 \left[(1+r)a_{t-1} + \sum_{j=0}^{\infty} \left(\frac{\gamma}{1+r} \right)^j \left(E_t h_{t+j} + \theta E_t g_{t+j} \right) \right] - \theta g_t \\ &= \beta_0 + \beta_1 E_t W_t - \theta g_t \end{aligned} \qquad (1)$$

where c_t^P is aggregate per capita real private consumption in period t, a_{t-1} represents the stock of real nonlabour assets (or debt if negative) per capita at the end of period $t-1$, r is the constant real return on these assets, γ is the constant probability of surviving from period t to $t+1$, h_t is per capita real disposable labour income defined as real per capita labour income y_t plus government transfer payments tr_t minus taxes t_t, E_t is the expectation operator conditional on information known in period t, g_t is per capita real government consumption, θ is the parameter measuring the degree of substitutability between private consumption and government consumption, β_1 is the constant propensity to consume out of total expected wealth and β_0 is a constant term.[8]

The interpretation of equation (3) is straightforward. Consumers treat the term in the brackets as the total expected wealth, $E_t W_t$, consuming the fraction β_1 of it every period. The first term in the brackets is nonlabour wealth while the second term is the expected value of human wealth.[9] When γ equals unity consumers fully recognize the future tax obligations implicit in current debt finance of a given path of future government consumption. In this case consumers have infinite horizons and the Ricardian equivalence proposition holds. With γ smaller than one, consumers behave myopically or have shorter planning horizon than the government, which leads to the break down of the Ricardian equivalence.

---

[8] Here $\beta_0 = \frac{r(\sigma - r)}{1+r}\bar{c}$, where σ is the rate of subjective time preference and $\bar{c}$ is the bliss level of consumption, and $\beta_1 = 1 - \frac{\gamma(1+\sigma)}{(1+r)^2}$. See Brunila (1996) for details.

[9] Since human wealth includes social security contributions and excludes taxes, social security wealth is treated as part of human wealth in the consumption function.

The aggregate budget constraint is given by

$$a_t=(1+r)a_{t-1}+h_t-c_t^P \tag{2}$$

Equations (1) and (2) together with the solvency condition, $E_t\lim_{j\to\infty}(1+r)^{-j}a_{t+j} = 0$, to rule out Ponzi-games (Blanchard and Fischer 1989) can be used to express the aggregate private consumption function in terms of observable variables. The solution followed here (see Brunila 1996) is to eliminate nonlabour assets and write the consumption function as

$$\begin{aligned} c_t^P=&-r\beta_0+(1+r)(1-\beta_1)c_{t-1}^P+\beta_1(1-\gamma)\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^j(E_th_{t+j}+\theta E_tg_{t+j}) \\ &-\theta g_t+(1+r)(1-\beta_1)\theta g_{t-1}+\beta_i\epsilon_t \end{aligned} \tag{3}$$

where

$$\epsilon_t=\gamma\epsilon_{Ht}+\gamma\theta\epsilon_{Gt}.$$

Error terms $\epsilon_{Ht}=(E_t-E_{t-1})\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^j h_{t+j}$ and $\epsilon_{Gt}=(E_t-E_{t-1})\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^j g_{t+j}$ reflect the revisions of expectations about the sequence of h_{t+j} and g_{t+j} that consumers make between period t−1 and t. New information at t will cause the consumer to revise previously held expectations about current and future disposable labour income and government consumption, so that the discounted present value of these expectations will itself change.

Equation (3) gives an expression for aggregate per capita private consumption in terms of lagged private consumption, current and lagged government consumption, lagged government debt, expected per capita human wealth, expected aggregate per capita wealth accruing from government consumption and revisions in expectations consumers make about human capital and government consumption when proceeding from period t−1 to period t.

Since forward looking rational consumers take into account not only the benefits to be derived from future government consumption but also the future consequences of current government debt accumulation when making their consumption and saving decisions, private and public sectors can be consolidated by substituting the government budget constraint into the aggregate per capita private consumption function (3).

In period t the government one-period budget constraint in real per capita terms is

$$t_t=g_t+tr_t-b_t+(1+r)b_{t-1} \tag{4}$$

where b_t denotes one-period real government debt. Imposing the solvency constraint $E_t\lim_{j\to\infty}(1+r)^{-j}\, b_{t+j} = 0$ on the government sector that prohibits Ponzi

games where government can run primary deficits indefinitely and accumulate an ever increasing public debt by new loans gives[10]

$$\sum_{j=0}^{\infty}(1+r)^{-j}E_t t_{t+j}=\sum_{j=0}^{\infty}(1+r)^{-j}(E_t g_{t+j}+E_t tr_{t+j})+(1+r)b_{t-1} \tag{5}$$

The government budget constraint (5) equates the present value of expected tax receipts to the initial government debt and the present value of expected government consumption plus transfer payments. This intertemporal constraint states that, for a given path of government consumption, a deficit-financed cut in current taxes leads to higher future taxes that have the same expected value as the current tax cut.

Substituting equation (5) into (3) gives

$$\begin{aligned} c_t^P=&-r\beta_0+(1+r)(1-\beta_1)c_{t-1}^P+\beta_1(1-\gamma)\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^j(E_t y_{t+j}+\theta E_t g_{t+j}) \\ &-\theta g_t+(1-\beta_1)(1+r)\theta g_{t-1}-\beta_1(1-\gamma)(1+r)b_{t-1}+\beta_1\epsilon_t+u_t \end{aligned} \tag{6}$$

where $\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^j E_t y_{t+j}$ represents the discounted value of expected future labour incomes and u_t represents transitory consumption.[11]

Equation (6) expresses aggregate private consumption per capita as a function of a constant term, expected lifetime labour income, expected government consumption as well as current and lagged government consumption, lagged private consumption purchases and government debt. It nests both Ricardian and non-Ricardian hypotheses as special cases. The key parameters are γ and θ. With γ equal to unity, forward looking rational consumers have an infinite horizon and consider today's deficit financing as tomorrow's tax liabilities. Hence, deficits have no effect on current consumption. Consumers base their consumption decisions on lifetime (permanent) income, which depends on the present value of government consumption but not on the timing of tax collections.

The parameter γ less than unity implies that, due to a shorter planning horizon, will regard their holdings of government bonds as net wealth. When this is the case, current tax cut financed by issuing new government debt will increase

---

[10] The government sector solvency constraint to be satisfied, government debt must grow at a rate below r (a necessary condition for the Ricardian equivalence to hold, see Hamilton and Flavin 1986). If the debt grows at the rate r, interest payments for b_t are financed by issuing new debt. If the debt grows at any rate above r, the limit would be infinite leading to an unsustainable situation. In theory, government debt can grow at the rate of the real interest rate in a growing economy, but for the debt-to-GDP ratio to remain finite in each period, the real growth rate of the economy must be higher than the real interest rate.

[11] Transitory consumption is defined as zero-mean shocks to the utility function and measurement errors in consumption. Flavin (1981, p. 992) justifies neglecting transitory consumption on an aggregate level. If individual realizations of transitory consumption are independently distributed across the population, aggregate transitory consumption is negligible.

expected human wealth and private consumption. This positive effect derived from an intertemporal reallocation of taxes is due to the different discount rates: if $0 < \gamma < 1$, consumers discount taxes at a rate $\gamma/(1+r)$ whereas the future interest income on government debt is discounted at the rate $1/(1+r)$. In other words one unit of taxes in period t+j has the present value $(\gamma/(1+r))^j$ which is smaller than $(1+r)^{-j}$, the present value of one unit of interest income on debt. The future tax increase is thus given a smaller weight by finite-horizon consumers than the weight attached by them to the current tax cut. In the case of extreme myopia ($\gamma=0$), consumers treat government debt fully as a net wealth.

A negative value for θ implies that an increase in government consumption raises the marginal utility of private consumption (ie the two are complements), whereas a positive θ would suggest that an increase in government consumption diminishes the marginal utility of private consumption (ie the two are substitutes).

More specifically, with γ equal to unity, θ equal to zero and δ equal to r, equation (6) reduces to the Hall (1978) specification in which current and last period's consumption differ only by the impact of news concerning permanent income.[12] The infinite horizon ($\gamma=1$) and the assumption of no population growth imply that there is no way for individuals to evade taxes by dying and/or levying taxes on other generations.

When $\gamma < 1$ and $\theta \neq 0$, expected human wealth, government consumption and government debt affect current consumption over and beyond the impact of lagged consumption. If government consumption substitutes perfectly private consumption ($\theta=1$), one has Feldstein's (1982) condition for complete ex ante crowding out and fiscal policy neutrality.

3 Empirical implementation

3.1 Derivation of the reduced form consumption function

The main problem in estimating an intertemporal consumption function with rational expectations like equation (6) is how to handle unobservable future path of labour income y_{t+j} and government consumption g_{t+j}. One solution is to follow Hayashi's procedure (1982) and to use a stochastic difference equation implied by the rational expectations assumption in expected labour income and government consumption to eliminate the unobservables from the estimation equation. The advantage of this method is that one needs not to specify the stochastic processes

[12] According to Flavin (1981) consumption would be an exact random walk only if the transitory component of income were identically equal to zero.

for labour income and government consumption.[13] Accordingly, the following difference equations are postulated

$$\begin{aligned}\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}E_{t}y_{t+j}-\frac{1+r}{\gamma}\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}E_{t-1}y_{t+j-1}&=-\frac{1+r}{\gamma}y_{t-1}+e_{Yt}\\ \sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}E_{t}g_{t+j}-\frac{1+r}{\gamma}\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}E_{t-1}g_{t+j-1}&=-\frac{1+r}{\gamma}g_{t-1}+e_{Gt}\end{aligned} \tag{7}$$

where e_{Yt} and e_{Gt} are the expectational revisions made by consumers as they proceed from period t−1 to period t. Formally,

$$e_{Yt}=\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}(E_{t}-E_{t-1})y_{t+j}$$

$$e_{Gt}=\sum_{j=0}^{\infty}\left(\frac{\gamma}{1+r}\right)^{j}(E_{t}-E_{t-1})g_{t+j}$$

These surprise terms are, by construction, orthogonal to the information set available in t−1, I_{t-1}, and thus serially uncorrelated. They may, however, be correlated with variables dated period t and contemporaneously correlated with each other.

Using equations (7) to form $c_t^P - [(1+r)/\gamma]c_{t-1}^P$ the unobservable variables can be removed from equation (6). Rearranging gives the expression for c_t^P in terms of observable variables:

$$\begin{aligned}c_{t}^{P}=\beta_{0}^{*}&+\left[(1+r)(1-\beta_{1})+\frac{1+r}{\gamma}\right]c_{t-1}^{P}-(1-\beta_{1})\frac{(1+r)^{2}}{\gamma}c_{t-2}^{P}\\ &-\beta_{1}(1-\gamma)\frac{1+r}{\gamma}y_{t-1}-\theta g_{t}+\theta\left(1-\beta_{1}\left(\frac{\gamma-1}{\theta}+1\right)+\gamma\right)\frac{1+r}{\gamma}g_{t-1}\\ &-\theta(1-\beta_{1})\frac{(1+r)^{2}}{\gamma}g_{t-2}-\beta_{1}(1-\gamma)(1+r)b_{t-1}+\beta_{1}(1-\gamma)\frac{(1+r)^{2}}{\gamma}b_{t-2}+v_{t}\end{aligned} \tag{22}$$

where

$$\beta_{0}^{*}=\frac{r(1+r-\gamma)}{\gamma}\beta_{0}$$

---

[13] Another approach to model the future path of government consumption followed by Aschauer (1985) is to use an explicit forecast equation in which present and past values of government debt and deficit are used to signal changes in government spending. This kind of formulation has the advantage that if allows to distinguish between debt as a potential component of wealth, which is the concern of Ricardian equivalence, and debt's role as a signal of future levels of government consumption.

and

$$v_t=\beta_1\epsilon_t-\frac{1+r}{\gamma}\beta_1\epsilon_{t-1}+u_t-\frac{1+r}{\gamma}u_{t-1}$$
$$+\frac{\beta_1(1-\gamma)}{\gamma}e_{Yt}+\frac{\beta_1(1-\gamma)(\theta-1)}{\gamma}e_{Gt}$$

3.2 Econometric issues

Before the model can be estimated, it is necessary to address several issues of specification that arise from the nature of aggregate time series data used in estimations. The estimation of equation (8) involves a number of problems, which risk to result in inconsistent parameter estimates. Firstly, the time aggregation imposed on consumption function by the use of annual data in the estimations and the inclusion of consumer durables in the measure of private consumption[14] introduces a first-order moving average term into the lagged consumption expenditure (see Working (1960) and Campbell and Mankiw (1990) for time aggregation and Mankiw (1982) for durability). To avoid misspecification arising from time-averaging and durability requires the use of instruments that are lagged more than one period so that there is at least two period time gap between the instruments and the variables in equation (8). There may also be white-noise errors in the levels of the consumption and income variables due to "transitory consumption" or measurement errors. White-noise errors in levels become first-order moving average errors in the specification and could be correlated with once-lagged instruments, but not with twice-lagged instruments.

Second problem pointed out by Hayashi (1982) is that although ϵ_t, e_{Yt} and e_{Gt} are orthogonal to the information set at time $t-1$, I_{t-1}, they might not be orthogonal to y_t, g_t and b_t, since these variables do not belong to I_{t-1}. To correct for this problem requires also the use of instrumental variables estimator, where at least twice-lagged variables are chosen as instruments, which by definition are orthogonal to ϵ_t, e_{Yt} and e_{Gt}.

These arguments for twice-lagging the instruments imply that the error term in equation (8) has a first-order moving average structure (MA(1)). If this is ignored and standard nonlinear least squares and instrumental variables procedures are used, the coefficient estimates remain consistent but the standard errors are inconsistent. To derive consistent standard errors in the presence of serial correlation and conditional heteroscedasticity in the error term Hansen's (1982) General Method of Moments estimator is used. The reported standard errors are thus heteroscedasticity and autocorrelation consistent standard errors (White (1980)) calculated by the Parzen kernel estimator.

Since the equation (8) is nonlinear only in its parameters, it could be estimated as an unrestricted linear model. One could then test whether the

---

[14] See Ch. 4 in Brunila (1996) and Appendix 2 for further details on the measurement of the variables.

estimated composite coefficients have the probability limits implied by the Ricardian equivalence. However, given that the model is overidentified, the underlying parameters cannot be recovered. By using a nonlinear estimator one can get direct estimates of the parameters in question that will also give a more meaningful measure of any rejection that might occur. In this paper, Hansen's (1982) GMM estimator is used, so the model adequacy is tested by Hansen's (1982) overidentifying restrictions test (J-test).[15]

In order for the GMM estimator to be asymptotically justifiable, all variables should be stationary. Nonstationarity would be a problem when estimating in levels,[16] because it can give rise to a spurious relationship among the levels of the variables (see Phillips 1986). Also the parameter estimates from a regression of one such variable on others are inconsistent and may not even be convergent. To account for the nonstationarity a possible solution would be to follow Campbell and Deaton (1989) and to divide all variables by the lagged level of income, y_{t-1} to obtain stationarity, or to estimate equation (8) in the first difference form. The problem in transforming the equation into difference form is that lagged values of Δc_t as instruments do not explain a large fraction of the variance of Δc_t, if the univariate time series process for c_t is close to a random walk.

These transformations are, however, not needed, if the nonstationary variables are cointegrated. Recent results by Sims, Stock and Watson (1990) and West (1988) show that inference and estimation may proceed in the standard way and no special steps to handle the nonstationarity is necessary, if the nonstationary regressors are cointegrated and the unconditional mean of their first differences is non-zero. The underlying theory clearly suggests that there should be a stable long run relationship among the levels of variables in equation (8), and the set of variables used in the empirical estimation should be cointegrated. The results of the unit root and cointegration tests are presented in Appendix 1.

4 Description of the data and estimation results

4.1 Data

The annual time series data are from the OECD National Accounts and the sample consists nine EU countries listed in Table 1. The criterion for including a country was the availability of at least thirty observations for the actual estimation period given that some observations are lost due to the use of lagged instruments. Detailed description of the data is given in the Appendix 2.

---

[15] The test statistic converges in distribution to χ^2_{r-q} with degrees of freedom equal to the number of moment (orthogonality) conditions minus the number of parameters to be estimated.

[16] Flavin (1981, 1985), Hayashi (1982), and others generally specify the permanent income model with variables in levels and then remove a deterministic time trend from the data to achieve stationarity of the variables. Mankiw and Shapiro (1985), however, show that such detrending can lead to spurious excess sensitivity of consumption to income innovations. On the other hand, Stock and West (1988) show that the spurious sensitivity is not due to spurious cycles but rather to the shift in the asymptotic distribution when a deterministic trend is included.

Table 1. **Countries in the sample and estimation period**

Country	Estimation period
Austria	1963-1994
Belgium	1964-1994
France	1964-1993
Germany	1963-1993
Greece	1964-1994
Italy	1964-1994
Netherlands	1965-1994
Sweden	1964-1994
UK	1963-1994

Private consumption c_t is measured by per capita total private consumption expenditures at constant prices, before-tax labour income y_t is measured by per capita wages, salaries and employers' contributions for social security and private pension including operating surplus of private unincorporated enterprises and withdrawals from private quasi-corporate enterprises for those countries where the data was available. Taxes t_t are measured by per capita household income taxes and other direct taxes. Government consumption g_t is measured by general government final consumption expenditures per capita at constant prices. Government debt b_t is measured by per capita general government debt in book value.

The instrument set consists of a constant, the second and third lag of total private consumption, before-tax labour income, government consumption, government debt and household income taxes. All instruments are measured in per capita terms. The same set of instruments were used in all estimations.[17]

The real interest rate was fixed to 3 % p.a. in the estimations. A sensitivity test regarding this assumption is reported below in the context of the panel estimation. All data not already valued at constant prices are deflated by the price deflator implied by the ratio of nominal total private consumption expenditures.

4.2 Estimation results

Deviations from Ricardian neutrality have generally been explained by different planning horizons of the government and private sector. As suggested by the theoretical framework the effects of government financing decisions on private consumption depend crucially on the estimated parameter value of γ, eg on the length of average horizon for private consumption and saving decisions, $1/(1-\gamma)$. Estimated parameter values for γ less than unity result in a finite planning horizon for the private sector and hence, in fiscal policy nonneutrality. The unrestricted

[17] Some results are to some extent sensitive to the number of lags included. In general, the higher the number of lags, the more efficient the estimates. There exist some modifications in the lag structure of some instruments across countries, for further details see Appendix 2.

version of the consumption equation is estimated first and then theory-generated restrictions on γ and θ are tested using the Wald test.[18]

Table 2 presents the estimates of β, γ and θ with their autocorrelation and heteroscedasticity consistent standard errors over the sample period given in Table 1 for the respective country. A constant term is always included as both an instrument and a regressor but is not reported in the tables. The J-statistic is a χ^2 test for the validity of the overidentification restrictions and its significance level is shown in parentheses underneath.

Overall results suggest that the unrestricted form of the model performs satisfactorily for all countries. The restricted estimates are broadly consistent with the unrestricted ones, albeit some restrictions result in economically unreasonable, but statistically insignificant, parameter estimates for France, Italy and Sweden. The estimates of γ turn out to be statistically significant and of the expected sign and magnitude for all countries, whereas the estimates of β and θ are not equally precise.

The unrestricted estimate of γ proves to be around unity for all countries. Moreover, the restriction $\gamma=1$ can be rejected by the Wald test only for one country in the sample, the one being Germany. The results give thus a strong support for the Ricardian neutrality hypothesis and infinite planning horizon as a valid approximation of the consumer behaviour in the eight EU countries in the sample. This implies that one cannot reject the hypothesis that consumers do not treat government debt as net wealth and, hence, do not change their consumption in response to perceived changes in the future path of government deficits (or the future path of taxes).

The unrestricted estimate of β, which measures the propensity to consume out of total expected wealth, is statistically significant only for Belgium, Germany, Greece and Italy. The estimated values of β prove to be, however, excessively high given an infinite planning horizon or even a planning horizon of approximately six years in the case of Germany.[19] Similar inconsistencies in the estimated parameter structure were also found in the Finnish data (Brunila 1996). Potential reasons for the surprisingly high value of β for some countries as well as the insignificance of the estimates for other countries include measurement errors in consumption and labour income, and, more importantly, the existence of liquidity constraints that decrease consumers' ability for intertemporal consumption smoothing and make consumption to be excessively sensitive to current income to conform the predictions of intertemporal optimization (see Flavin 1981). Under the restriction $\gamma=1$ the estimates of β tend to decrease slightly and become generally more efficient, eg the imposition of $\gamma=1$ results in statistically significant β's also for the Netherlands and the UK.

---

[18] The hypotheses to be tested are written as $h(b)=0$, where b is the vector of parameters of the unconstrained model and h(b) is a set of m nonlinear constraints on those parameters. Given a set of estimates b and the associated covariance estimate V(b), the constraints h(b) and their covariance matrix (all evaluated at the estimated b vector) is computed as: $V(h(b)) = (\partial h/\partial b)' V(b) (\partial h/\partial b)$. From h(b) and its variance a test statistic is formed $T = h(b) V(h(b))^{-1} (h(b))'$. This test statistic is distributed asymptotically as a χ^2 variable with degrees of freedom equal to m under the null hypothesis (when the constraints hold).

[19] The estimated value of γ .84 for Germany implies a planning horizon of roughly six years whereas the value of β around .5 implies a planning horizon of only two years.

Table 2. **GMM estimation of equation (8) for selected EU countries**[20]

	β	γ	θ	P-value	Wald-test
Austria					
Unrestricted	.331	1.048	-1.671	.937	
	(.418)	(.308)	(.991)		
Restrictions					
$\gamma = 1$	.349		-1.883	.970	.025
	(.300)		(1.055)		(0.875)
$\theta = 0$	.273	1.000		.708	2.841
	(.237)	(.105)			(0.092)
$\gamma = 1, \theta = 0$	.273			.793	2.909
	(.211)				(0.233)
Belgium					
Unrestricted	.523	.964	-.952	.677	
	(.184)	(.037)	(.772)		
Restrictions					
$\gamma = 1$	.359		-.452	.787	0.967
	(.208)		(.896)		(0.325)
$\theta = 0$	.351	.943		.846	1.518
	(.174)	(.060)			(0.218)
$\gamma = 1, \theta = 0$	.265			.886	1.715
	(.179)				(0.424)
France					
Unrestricted	.255	1.030	-4.937	.571	
	(.363)	(.249)	(1.549)		
Restrictions					
$\gamma = 1$	-.339		-5.138	.701	0.014
	(.191)		(1.406)		(0.904)
$\gamma = 1, \theta = 0$	-.198			.615	12.473
	(.135)				(0.002)
Germany					
Unrestricted	.470	.841	-2.002	.456	
	(.178)	(.043)	(.861)		
Restrictions					
$\gamma = 1$	.793		-.354	.639	13.238
	(.217)		(.811)		(0.000)
$\theta = 0$	.677	.827		.696	5.401
	(.148)	(.058)			(0.020)
$\gamma = 1, \theta = 0$	.755			.745	21.226
	(.179)				(0.000)

[20] Due to somewhat inconclusive results of the unit root tests the equation was estimated also using transformed variables suggested by Campbell and Deaton (1989). The conclusions remained roughly the same, the major differences being in the efficiency of estimates. The transformed variables tend to produce more efficient estimates than those obtained in the level form.

Table 2 (continued)

	β	γ	θ	P-value	Wald-test
Greece					
Unrestricted	.779	1.070	-3.306	.359	
	(.212)	(.035)	(.381)		
Restrictions					
$\gamma = 1$	.478		-3.780	.403	4.008
	(.228)		(.679)		(0.050)
$\theta = 0$	.036	1.027		.321	75.419
	(3.411)	(3.554)			(0.000)
$\gamma = 1, \theta = 0$	.056			.430	78.152
	(.116)				(0.000)
Italy					
Unrestricted	.560	.988	1.451	.403	
	(.146)	(.046)	(1.830)		
Restrictions					
$\gamma = 1$	.574		1.468	.493	0.065
	(.143)		(1.468)		(0.799)
$\theta = 0$	-.002	2.511		.454	0.628
	(.005)	(.880)			(0.428)
$\gamma = 1, \theta = 0$	.606			.579	1.284
	(.143)				(0.526)
Netherlands					
Unrestricted	.428	1.015	-2.695	.567	
	(.263)	(.105)	(.679)		
Restrictions					
$\gamma = 1$	.457		-2.783	.667	.021
	(.147)		(.593)		(.885)
$\theta = 0$	.404	1.000		.342	15.747
	(.156)	(.069)			(0.000)
$\gamma = 1, \theta = 0$	.405			.431	20.568
	(.095)				(0.000)
Sweden					
Unrestricted	.161	.899	4.938	.992	
	(.122)	(.155)	(1.533)		
Restrictions					
$\gamma = 1$	.105		4.128	.986	0.018
	(.092)		(1.488)		(0.893)
$\theta = 0$	.012	.876		.854	4.080
	(.227)	(.121)			(0.043)
$\gamma = 1, \theta = 1$	-.046			.977	4.114
	(.154)				(0.128)
$\gamma = 1, \theta = 0$	-.145			.911	7.209
	(.169)				(0.027)

Table 2 (continued)

	β	γ	θ	P-value	Wald-test
UK					
Unrestricted	.264	1.107	-.593	.331	
	(.368)	(.415)	(.704)		
Restrictions					
$\gamma = 1$	.387		-.682	.384	.066
	(.113)		(.568)		(0.797)
$\theta = 0$	.193	1.179		.488	.709
	(.406)	(.594)			(0.400)
$\gamma = 1, \theta = 0$	.340			.476	1.359
	(.099)				(0.507)

Notes: Heteroscedasticity and autocorrelation-consistent standard errors are in parentheses. P-value is the significance level of the validity of overidentifying restrictions (J-test). The Wald-test is for the validity of the imposed restriction with its significance level in parentheses. The instruments for the unrestricted and restricted specifications include the constant, the second and third lag of private consumption, government consumption, before-tax labour income, government debt and household income taxes. Detailed description of country-specific differences in the lagstructure of instuments is given in Appendix 2.

The parameter estimates of θ tend to vary more across countries than those of γ and β. For France, Germany, Greece and the Netherlands the unrestricted estimates of θ turn out to be negative and statistically significant implying that government consumption is complement to private consumption in these countries. Sweden, on the contrary, show a statistically significant positive value for θ indicating that government consumption and private consumption are substitutes. This same results was also found for Finland (Brunila 1996). For Austria, Belgium, Italy and the UK the estimated value of θ proves to be statistically insignificant. Moreover, the restriction θ=0, which implies that government consumption and private consumption are unrelated, cannot be rejected by the Wald test for these countries. For Italy the restriction results, however, in an unplausibly high and statistically insignificant estimate of γ as well as negative but statistically insignificant β. For France,[21] Germany, Greece, the Netherlands and Sweden, where θ was found to be statistically different from zero, the restriction θ=0 is rejected at 5 per cent significance level.

The restriction θ=1, conforming to Feldstein's complete ex ante crowding out of private consumption -hypothesis, was imposed only on Sweden, since θ proved to be postitive and statistically significant only in this country. The restriction cannot be rejected at conventional levels of significance by the Wald test. The relevant Wald test statistics is, however, not reported in Table 2 due to lack of convergence.

Finally, the joint restriction, γ=1 and θ=0, cannot be rejected at 5 per cent significance level for Austria, Belgium, Italy and the UK whereas it is strongly rejected for France, Germany, Greece, the Netherlands and Sweden. For

[21] For France the restricted equation could not be estimated due to nonconvergence of the data.

completeness also the joint restriction, $\gamma=1$ and $\theta=1$, is tested for Sweden. According to the Wald test the restriction cannot be rejected for Sweden.

The cross-country evidence on Ricardian debt neutrality and the degree of substitutability between private and government consumption is summarized in Table 3 together with some data characterizing public finances over the sample period. For each country the table reports the unrestricted estimates of γ and θ and the sample mean of the government debt to GDP ratio, the ratio of debt to household income taxes and the ratio of government consumption to GDP. The table indicates that there seems to be no clear association between the degree of Ricardian debt neutrality (or tax-discounting) and the level of debt ratio nor between the degree of substitutability and the ratio of government consumption to GDP across countries.

Table 3. **Unrestricted estimates of γ and θ and the stance of fiscal policy in selected EU countries over the sample period**

	γ	θ	b/GDP	b/t	g/GDP
Austria	1.048*	-1.671	0.40	1.89	0.16
Belgium	.964*	-.952	0.93	3.80	0.15
Finland	1.033*	2.723*	0.21	0.92	0.17
France	1.030*	-4.937*	0.35	1.64	0.17
Germany	.841*	-2.002*	0.31	1.23	0.18
Greece	1.070*	-3.306*	0.43	3.22	0.16
Italy	.988*	1.451	0.64	3.37	0.15
Netherlands	1.015*	-2.695*	0.61	2.29	0.15
Sweden	.961*	4.275*	0.46	1.56	0.24
UK	1.107*	-.593	0.74	4.78	0.20

Notes: b/GDP denotes the ratio of general government gross debt to GDP, b/t the ratio of general government gross debt to household income taxes and g/GDP denotes the ratio of general government consumption to GDP. Asterix (*) indicates the statistical significance at least at 0.05 level. Parameter estimates for Finland are from Brunila (1996).

According to the estimation results, Ricardian nonneutrality in government financing holds only for Germany, where the debt ratio is among the lowest in the group of ten EU countries. This finding is in accordance with Nicoletti's (1988) results on an international comparison of private consumption behaviour in eight OECD countries for the period 1960–1987. His study indicates that, with the exception of France and the UK, the degree of Ricardian nonneutrality tends to be associated across countries with the level and variance of the debt ratio. Ricardian nonneutrality was found only in countries where the level and variance of the public debt ratio was low whereas sizeable tax-discounting effects were detected in countries like Italy and Belgium with high levels of government debt. The results obtained in the present study indicate, however, that the association, if there is any, between the level of government debt and the degree of tax-discounting is not so straightforward as suggested by Nicoletti.

As regards θ, the findings conform to a large extent the results reported in two recent studies (Karras 1994, Evans and Karras 1996) on the degree of substitutability between private consumption and government consumption. The general conclusions in these studies indicate that government consumption and private consumption tend to be complements rather than substitutes. In this study the major exceptions from this general pattern prove to be Finland and Sweden, where private consumption and government consumption is found to be strong substitutes. This finding cannot, however, be attributed to a higher than average government consumption to GDP ratio as one could have expected, since this holds only in Sweden.

According to Evans and Karras (1996) cross-country differences in the degree of substitutability tend to be negatively related to the fraction of government spending that goes to national defence. The differences in the composition of government consumption is thus a potential source for cross-country differences in the degree of substitutability. Evans and Karras also conclude that government size has no apparent effect on the substitability between private and government consumption, whereas high quality of government services was found to make them more substitutable.

4.3 Panel estimation

Since empirical results for individual countries may suffer from various econometric shortcomings due to relatively short sample periods, the data is used as a panel for all the nine EU countries in the sample supplemented by the data from Finland.[22] Specifically, country-specific panel data provide several benefits for econometric estimation since the data contain information with regard to intercountry differences in private consumption behaviour as well as its time variation in each country. The general structure of the estimated fixed effect or within model can be written as

$$c_{it}^{P}=\alpha_0+\alpha_i+\mu'X_{it}+\varepsilon_{it}, \qquad t=1,...,T_i \quad \text{and} \quad i=1,...,N$$

where c_{it}^{P} denotes aggregate per capita private consumption in country i at time t, α_0 and α_i are parameters, X_{it} is a vector of variables including the interest rate and predetermined variables for country i at time t, and ϵ_{it} is the error term.

The estimates are obtained by allowing a fixed effect for each country, ie allowing a different intercept for each country regression. The parameter $\alpha_{1i} = \alpha_0 + \alpha_i$ is the intercept of the i^{th} country, where α_0 is the mean intercept and α_i represents the unobservable country-specific effect calculated as the difference from the mean for the i^{th} country. The hypothesis that the intercepts are equal across the countries is then tested by the Wald-test.

To obtain asymptotically efficient estimates of panel data without imposing either conditional homoscedasticity or independence over time on the disturbances

[22] Country-specific parameter estimates for Finland are reported in Brunila (1996).

of the model, the GMM estimator proposed by Hansen and Singleton (1982)[23] is used. Since the estimation period differs across countries the panel is unbalanced. The use of unbalanced panel data gives 314 observations.

The first line in Table 4 gives unrestricted panel estimates of β, γ and θ given a fixed real interest rate of 3 per cent with their autocorrelation and heteroscedasticity consistent standard errors. As shown in the table the panel estimation results confirm the conclusions made on the basis of separate country-specific estimations. The unrestricted estimate of γ proves to be around unity and is statistically significant at 1 per cent level. As expected, the restiriction $\gamma=1$ cannot be rejected by the Wald-test.

Table 4. **GMM estimation of equation (8) using a panel of 10 EU countries**

	Unrestricted estimates			Wald-test			
	γ	θ	P-value	$\gamma=1$	$\theta=0$	$\gamma=1$ $\theta=0$	Equal intercepts
r=0.03	1.043	-1.010	0.954	1.297	3.136	4.373	19.174
	(.038)	(.570)		(0.255)	(0.077)	(0.112)	(0.024)
r=0.05	1.067	-1.389	0.995	0.563	5.073	5.575	13.730
	(.089)	(.617)		(0.453)	(0.024)	(0.061)	(0.132)
Subperiod	1.058	-1.649	0.997	1.910	10.639	12.940	32.453
(obs=244)	(.042)	(.506)		(0.167)	(0.001)	(0.001)	(0.000)

Notes: Heteroscedasticity and autocorrelation-consistent standard errors are in parentheses. P-value is the significance level of the validity of overidentifying restrictions (J-test). The Wald-test is for the validity of the imposed restrictions with its significance level in parentheses. The instruments for the unrestricted and restricted specifications include a constant, the second and third lag of private consumption, government consumption, before-tax labour income, government debt, the second lag of household income taxes and nine country-dummies.

The unrestricted estimate of θ is negative and in accordance with the general tendency found in the individual country-specific estimations that private consumption and government consumption are complements rather than substitutes. The estimate is, however, somewhat imprecise and the restriction $\theta=0$ cannot be rejected at conventional levels of significance. Nevertheless, at the 10 per cent level the restriction is rejected. Finally, the joint hypothesis, $\gamma=1$ and $\theta=0$, cannot be rejected by the Wald-test.

The unobservable country-specific effects (not reported in the table) proved to be statistically significant only for Finland and Sweden. Despite the fact that the overwhelming part of these country-specific effects were statistically insignificant, the hypothesis that the intercepts are equal across the countries is rejected by the Wald-test. This result suggests that a fixed effects model should be used rather than a pooled one.

[23] See also Arellano and Bond (1991).

To check the robustness of the panel estimation results, the model is also estimated using a given real interest rate of 5 per cent and alternatively, using a subperiod that starts from 1970 instead of the total sample period starting from 1963. The second line in Table 4 gives the estimates of γ and θ under the assumption of a 5 per cent real interest rate and the third line those for the subperiod. The estimate of γ proves to be robust with respect to both changes whereas the estimate of θ proves to be somewhat sensitive to the interest rate applied as well as to the estimation period. Specifically, the absolute value and statistical significance of θ increases making the complementarity of government consumption and private consumption stronger in both cases. The rejection $\theta=0$ and the joint rejection, $\gamma=1$ and $\theta=0$, are soundly rejected by the Wald-test.

5 Conclusions

In general, the results from the country-specific as well as panel estimations with respect to Ricardian equivalence are mixed. On the one hand, the results seem to give a strong support for an infinite planning horizon for consumers and thus, for Ricardian debt neutrality. On the other hand, the high propensity to consume out of total expected wealth, found in the study, is not entirely compatible with an infinite planning horizon but in fact, itself suggests a rather short one. This inconsistency in the results may reflect the existence of liquidity constraints that prevent consumers from borrowing to smooth consumption over transitory fluctuations in income. Before the validity of the economic policy implications of the Ricardian debt neutrality could be assessed, further work on the effects of liquidity constraints is needed.

The findings also indicate that during the estimation period government consumption tends to be a complement rather than a substitute for private consumption. Strong substitutability between private consumption and government was found only in Sweden.

References

Arellano, M. - Bond, S. (1991) **Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.** Review of Economic Studies, Vol. 58.

Aschauer, D.A. (1985) **Fiscal Policy and Aggregate Demand.** American Economic Review, Vol. 75 No. 1, March.

Bailey, M.J. (1971) **National Income and the Price Level: A Study in Macroeconomic Theory.** 2nd ed. New York: McGraw-Hill.

Barro, R.J. (1974) **Are Government Bonds Net Wealth?** Journal of Political Economy, Vol. 82, November/December.

Barro, R.J. (1981) **Output Effects of Government Purchases.** Journal of Political Economy, Vol. 89 No. 6.

Barro, R.J. (1989) **The Ricardian Approach to Budget Deficits.** Journal of Economic Perspectives, Vol. 3 No. 2, Spring.

Bernheim, B.D. (1987) **Ricardian Equivalence: An Evaluation of Theory and Evidence.** NBER Working Paper No. 2330, July.

Blanchard, O.J. (1985) **Debt, Deficits, and Finite Horizons.** Journal of Political Economy, Vol. 93 No. 2.

Blanchard, O.J. - Fischer, S. (1989) **Lectures on Macroeconomics.** Cambridge, Mass.: MIT Press.

Blinder, A.S. - Deaton, A. (1985) **The Time Series Consumption Function Revisited.** The Brookings Papers on Economic Activity, No. 2.

Brunila, A. (1996) **Fiscal Policy and Private Consumption - Saving Decisions: Evidence from Finland.** Bank of Finland Discussion Papers, Research Department, No. 28.

Campbell, J.Y. - Deaton, A. (1989) **Why is Consumption so Smooth?** Review of Economic Studies, Vol. 56.

Campbell, J.Y. - Mankiw, N.G. (1990) **Permanent Income, Current Income, and Consumption.** Journal of Business & Economic Statistics, Vol. 8 No. 3, July.

Correia-Nunes, J. - Stemitsiotis, L. (1995) **Budget Deficit and Interest Rates: Is there a Link? International Evidence.** Oxford Bulletin of Economics and Statistics, Vol. 57 No. 4.

Dickey, D.A. - Fuller, W.A. (1979) **Distribution of the Estimators for Autoregressive Time Series with a Unit Root.** Journal of the American Statistical Association, June.

Evans, P. (1985) **Do Budget Deficits Raise Nominal Interest Rates? Evidence from Six Countries.** Journal of Monetary Economics, Vol. 20 No. 2.

Evans, P. (1988) **Are Consumers Ricardian? Evidence for the United States.** Journal of Political Economy, Vol. 96 No. 5.

Evans, P. (1993) **Consumers are not Ricardian: Evidence from Nineteen Countries.** Economic Inquiry, October.

Evans, P. - Hasan, I. (1994) **Are Consumers Ricardian? Evidence for Canada.** The Quarterly Review of Economics and Finance, Vol. 34 No. 1, Spring.

Evans, P. - Karras, G. (1996) **Private and Government Consumption with Liquidity Constraints.** Journal of International Money and Finance, Vol. 15 No. 2, April.

Feldstein, M. (1982) **Government Deficits and Aggregate Demand.** Journal of Monetary Economics, Vol. 9.

Feldstein, M. - Elmendorf, D.W. (1990) **Government Debt, Government Spending, and Private Sector Behavior Revisited: Comment.** American Economic Review, Vol. 73 No. 5.

Flavin, M.A. (1981) **The Adjustment of Consumption to Changing Expectations about Future Income.** Journal of Political Economy, Vol. 89 No. 5.

Flavin, M.A. (1985) **Excess Sensitivity of Consumption to Current Income: Liquidity Constraints or Myopia?** Canadian Journal of Economics, Vol. 18 No. 1, February.

Flavin, M.A. (1987) **Comment.** NBER Macroeconomics Annual, Vol. 2.

Ghatak, A. - Ghatak, S. (1996) **Budgetary Deficits and Ricardian Equivalence: The Case of India, 1950-1986.** Journal of Public Economics, Vol. 60.

Graham, F.C. (1992) **On the Importance of the Measurement of Consumption in Tests of Ricardian Equivalence.** Economics Letters, Vol. 38.

Graham, F.C. (1993) **Fiscal Policy and Aggregate Demand: Comment.** American Economic Review, Vol. 83.

Graham, F.C. - Himarios, D. (1991) **Fiscal Policy and Private Consumption: Instrumental Variables Tests of the "Consolidated Approach".** Journal of Money, Credit, and Banking, Vol. 23 No 1, February.

Graham, F.C. - Himarios, D. (1996) **Consumption, Wealth, and Finite Horizons: Tests of Ricardian Equivalence.** Economic Inquiry, July.

Hall, R.E. (1978) **Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence.** Journal of Political Economy, Vol. 86 No. 6.

Hansen, L.P. (1982) **Large Sample Properties of Generalized Methods of Moments Estimators.** Econometrica, July.

Hansen, L.P. - Singleton, K.J. (1982) **Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models.** Econometrica, Vol. 50.

Haque, N. (1988) **Fiscal Policy and Private Saving Behavior in Developing Economies.** IMF Staff Papers, Vol. 35 No. 2, June.

Haug, A.A. (1990) **Ricardian Equivalence, Rational Expectations, and the Permanent Income Hypothesis.** Journal of Money, Credit, and Banking, Vol. 22 No.3, August.

Haug, A.A. (1996) **Blanchard's Model of Consumption: An Empirical Study.** Journal of Business and Economic Statistics, Vol. 14 No. 2, April.

Hayashi, F. (1982) **The Permanent Income Hypothesis: Estimation and Testing by Instrumental Variables.** Journal of Political Economy, Vol. 90, No. 5, October.

Himarios, D. (1995) **Euler Equation Tests of Ricardian Equivalence.** Economc Letters, Vol. 48.

Johansen, S. (1988) **Statistical Analysis of Cointegrating Vectors.** Journal of Economic Dynamics and Control, Vol. 12.

Karras, G. (1994) **Government Spending and Private Consumption: Some International Evidence.** Journal of Money, Credit, and Banking, Vol. 26 No. 1, February.

Kormendi, R.C. (1983) **Government Debt, Government Spending, and Private Sector Behavior.** American Economic Review, Vol. 73 No. 5, December.

Kormendi, R.C. - Meguire, P. (1986) **Government Debt, Government Spending, and Private Sector Behavior: Reply.** American Economic Review, Vol. 76 No. 5.

Kormendi, R.C. - Meguire, P. (1990) **Government Debt, Government Spending, and Private Sector Behavior: Reply and Update.** American Economic Review, Vol. 80 No. 3.

Leiderman, L. - Blejer, M.I. (1988) **Modeling and Testing Ricardian Equivalence.** IMF Staff Papers, Vol. 35 No. 1, March.

Leiderman, L. - Razin, A. (1988) **Testing Ricardian Neutrality with an Intertemporal Stochastic Model.** Journal of Money, Credit, and Banking, Vol. 20 No. 1, February.

MacKinnon, J. (1991) **Critical values for Cointegration Tests, in Long-Run Economic Relationships: Readings in Cointegration.** Ed. by Engle, R.F. and Granger, W., Oxford University Press.

Mankiw, N.G. (1982) **Hall's Consumption Hypothesis and Durable Goods.** Journal of Monetary Economics, Vol. 10, November.

Mankiw, N.G. - Shapiro, M. (1985) **Trends, Random Walks and Tests of the Permanent Income Hypothesis.** Journal of Monetary Economics, Vol. 16, September.

Modigliani, F. - Sterling, A. (1986) **Government Debt, Government Spending and Private Sector Behavior: Comment.** American Economic Review, Vol. 76 No. 5, December.

Modigliani, F. - Sterling, A. (1990) **Government Debt, Government Spending and Private Sector Behavior: A Further Comment.** American Economic Review, Vol. 80, No. 3, June.

Ni, S. (1995) **An Empirical Analysis on the Substitutability between Private Consumption and Government Purchases.** Journal of Monetary Economics, Vol. 36.

Nicoletti, G. (1988) **Private Consumption, Inflation and the "Debt Neutrality Hypothesis": The Case of Eight OECD Countries.** OECD Working Papers, Department of Economics and Statistics, No. 50, January.

Perron, P. (1989) **Trends and Random Walks in Macroeconomic Time Series: Further Evidence From a New Approach.** Journal of Economic Dynamics and Control, Vol. 12.

Phillips, P.C.B. (1986) **Understanding Spurious Regressions in Econometrics.** Journal of Econometrics, Vol. 33.

Plosser, C.I. (1987) **Fiscal Policy and the Term Structure.** Journal of Monetary Economics, Vol. 20.

Seater, J.J. (1982) **Are Future Taxes Discounted?** Journal of Money, Credit and Banking, Vol. 14 No. 3, August.

Seater, J.J. (1993) **Ricardian Equivalence.** Journal of Economic Literature, Vol. 31, March.

Seater, J.J. - Mariano, R.S. (1985) **New Tests of the Life Cycle and Tax Discounting Hypotheses.** Journal of Monetary Economics, Vol. 15.

Sims A. - Stock, J.H. - Watson, M.W. (1990) **Inference in Linear Time Series Models with Some Unit Roots.** Econometrica, Vol. 58 No. 1.

Stock, J.H. - West, K.D. (1988) **Integrated Regressors and Tests of the Permanent Income Hypothesis.** Journal of Monetary Economics, Vol. 21, January.

West, K.D. (1988) **Asymptotic Normality When Regressors have a Unit Root.** Econometrica, Vol. 56 No. 6, November.

White, H. (1980) **A Heteroscedasticity-Consistent Covariance Matrix and a Direct Test for Heteroscedasticity.** Econometrica, Vol. 48.

Working, H. (1960) **Note on the Correlation of First Differences of Averages in a Random Chain.** Econometrica, October.

Appendix 1

Time series properties of the data

Based on the theory of cointegrated processes, recent research on consumption has been conducted in level form.[24] Augmented Dickey-Fuller (1979) tests for unit roots as well as Johansen's maximum likelihood tests for cointegration were performed to check whether estimation of equation (8) in levels is appropriate.

Table A1 presents the results of augmented Dickey-Fuller tests of the null hypothesis that each series has one unit root and of the null that its first difference has one unit root.

The test results indicate that the null hypothesis that each series in levels has one unit root cannot be rejected at the 0.05 level for any of the series tested. The null hypothesis that each first-differenced series has one unit root can be rejected for all series at the 0.05 level only for the UK. However, roughly at the 0.10 level, the null can be rejected for all series also for Austria and Sweden. The results suggest that the series b_t is integrated of order two in Belgium, Germany, Greece and the Netherlands. The I(2)ness is, however, clearly an implausible result suggesting that the real per capita government debt would be in an explosive path and consequently, leading to unsustainable government debt positions in the long term in these countries. The government debt has grown rapidly in several European countries during the 1980s and early 1990s. The growth rate of the debt has, however, started to slow down in all countries due to comprehensive measures taken in order to consolidate public finances and to fulfil the convergence criteria required for the third stage of the European Monetary and Economic Union. The combined effect of these events seems to have been that the debt series has undergone structural breaks which may cause the standard unit root test - which do not allow for the possibility of one or more structural breaks under the null and alternative hypotheses - to have low power (see Perron 1989). Moreover, these same qualifications apply to some extent to several other series in the sample, but particularly so to income series in Belgium, France and Italy with considerable breaks in the 1980s and 1990s and to government consumption series in Sweden with breaks during the 1990s. Due to these breaks the series appear to be integrated of order two instead of an economically more plausible of order one. Hence, further analyses are conducted assuming that all series are I(1) variables.

The results for cointegration are given in Table A2 for the I(1) variables and instruments used in the estimation equation (8). Tests for cointegration are based on the Johansen's (1988) maximum likelihood estimation procedure with two lags in the VAR, which produces white noise residuals.

---

[24] See eg Evans (1988), Leiderman and Razin (1988), Graham and Himarios (1991, 1996), Himarios (1995).

Table A1. **Augmented Dickey-Fuller tests for selected EU countries**

Variable	Levels ADF (1)	First differences ADF(1)
Austria	1962-1994	1963-1994
c_t	-1.893	-3.962
y_t	-1.940	-2.106
g_t	-1.045	-2.074
b_t	-1.994	-2.012
t_t	-3.007	-3.864
Belgium	1963-1994	1964-1994
c_t	-1.784	-2.963
y_t	-1.365	-1.991
g_t	-0.497	-2.266
b_t	-0.770	-1.741
t_t	-0.774	-2.227
France	1963-1993	1964-1993
c_t	-1.148	-2.892
y_t	-0.604	-1.314
g_t	-2.882	-3.941
b_t	-1.358	-2.426
t_t	-1.744	-4.063
Germany	1962-1993	1963-1993
c_t	-2.043	-4.522
y_t	-1.697	-4.234
g_t	-0.691	-2.857
b_t	-0.051(4)	-0.491
t_t	-1.599	-3.396
Greece	1962-1994	1963-1994
c_t	-0.551	-3.065
y_t	-0.675	-4.095
g_t	-0.197	-2.425
b_t	-	-1.781
t_t	-1.991	-3.658
Italy	1963-1994	1964-1994
c_t	-3.751	-3.615
y_t	-1.180	-1.694
g_t	-1.757	-2.353
b_t	-0.847	-2.191
t_t	-2.006	-1.434
Netherl.	1963-1994	1964-1994
c_t	-1.987	-2.923
y_t	-0.942	-2.737
g_t	-2.164	-2.953
b_t	-2.563	-1.667
t_t	-1.024	-3.135
Sweden	1963-1994	1964-1994
c_t	-1.650	-2.681
y_t	-0.772	-3.644
g_t	-1.963(2)	-1.644
b_t	-2.516	-2.969
t_t	-1.818	-2.563

Table A1 (continued)

Variable	Levels ADF (1)	First differences ADF(1)
UK	1962-1994	1963-1994
c_t	-2.247	-3.678
y_t	-2.762	-3.213
g_t	-1.929	-4.849
b_t	-1.833	-3.849
t_t	-2.712	-4.006

Notes: ADF(1) is the ADF statistic of order 1, if not otherwise indicated; the critical values of the ADF statistics are from MacKinnon (1991), the 0.05 critical value for the sample 1962-1993 is -3.556, for the sample 1963-1993 -2.959, for the sample 1964-1993 -2.963, for the sample 1962-1994 -3.551 and for the sample 1963-1994 -2.959. Including additional lags did not affect the results.

According to the trace test (Table A2) the hypothesis of cointegration cannot be rejected at the conventional 5 % significance level for any of the countries. The fact that the cointegration rank is as high as four or even five for Sweden, may reflect the possible I(2)ness of some of the series (see also ADF-test in Table A1).

Because of the upward trend in c_t, y_t, g_t, b_t and t_t the condition that the unconditional mean of their first-differences is non-zero is also fulfilled.

Table A2. **Johansen's maximum likelihood tests for cointegration**

	Eigenvalue	Null hypothesis [c,y,g,b,t]	Trace	0.05 critical value
Austria	0.721	r = 0	89.51	68.5
	0.538	r ≤ 1	47.37	47.2
	0.327	r ≤ 2	21.88	29.7
	0.224	r ≤ 3	8.80	15.4
	0.013	r ≤ 4	0.44	3.8
Belgium	0.694	r = 0	85.62	68.5
	0.518	r ≤ 1	47.77	47.2
	0.362	r ≤ 2	24.41	29.7
	0.256	r ≤ 3	10.01	15.4
	0.017	r ≤ 4	0.54	3.8
France	0.750	r = 0	72.32	68.5
	0.361	r ≤ 1	29.32	47.2
	0.238	r ≤ 2	15.43	29.7
	0.180	r ≤ 3	7.01	15.4
	0.030	r ≤ 4	0.94	3.8
Germany	0.621	r = 0	95.17	68.5
	0.501	r ≤ 1	43.19	47.2
	0.300	r ≤ 2	20.23	29.7
	0.172	r ≤ 3	8.47	15.4
	0.066	r ≤ 4	2.24	3.8
Greece	0.781	r = 0	105.10	68.5
	0.630	r ≤ 1	55.02	47.2
	0.312	r ≤ 2	22.20	29.7
	0.215	r ≤ 3	9.88	15.4
	0.056	r ≤ 4	1.89	3.8
Italy	0.645	r = 0	96.37	68.5
	0.541	r ≤ 1	63.23	47.2
	0.446	r ≤ 2	38.33	29.7
	0.376	r ≤ 3	19.40	15.4
	0.126	r ≤ 4	4.31	3.8
Netherlands	0.624	r = 0	69.54	68.5
	0.440	r ≤ 1	38.27	47.2
	0.287	r ≤ 2	19.72	29.7
	0.180	r ≤ 3	8.88	15.4
	0.076	r ≤ 4	2.54	3.8
Sweden	0.599	r = 0	88.18	68.5
	0.544	r ≤ 1	58.96	47.2
	0.444	r ≤ 2	33.80	29.7
	0.289	r ≤ 3	15.04	15.4
	0.120	r ≤ 4	4.10	3.8
UK	0.610	r ≥ 0	68.95	68.5
	0.380	r ≤ 1	37.84	47.2
	0.375	r ≤ 2	22.04	29.7
	0.175	r ≤ 3	6.55	15.4
	0.006	r ≤ 4	0.20	3.8

Notes: All equations are estimated assuming that the data do not contain a deterministic trend. Lag length of two was used to remove autocorrelation in the residuals. Critical values for the trace tests are obtained from Johansen (1988).

Appendix 2

Data

The data are from OECD National Accounts, Vol. II, covering the period 1960–1994 for Austria, Greece and the UK, the period 1961–1994 for Belgium, Italy, the Netherlands and Sweden, the period 1960–1993 for Germany and the period 1961–1993 for France. The data for Germany refer to West Germany until 1991 and the united Germany thereafter. All variables are in per capita terms and deflated by the implicit price deflator of which the base year for Greece is 1970, for France 1980, for Belgium and Italy 1985, and for Austria, the Netherlands, Sweden and the UK 1990. In panel estimations the base year for all countries in the sample is 1990 and the variables are expressed in US dollars.

Private consumption c_t: private final consumption expenditure.

Pre-tax labour income y_t: the sum of household sector wages, salaries and employers' social security contributions for all the countries in the sample, plus operating surplus of private unincorporated businesses for the Netherlands and the UK, plus withdrawals from quasi-corporate enterprises for Germany, plus operating surplus of private unincorporated businesses and withdrawals from quasi-corporate enterprises for Finland and Sweden.

Disposable labour income y_{dt}: the sum of pre-tax labour income and transfer payments, net taxes.

Government consumption g_t: general government final consumption expenditure.

Taxes t_t: the sum of household income taxes and other direct taxes, employees' social security contributions and fees, fines and penalties.

Government debt b_t: data are end-of-year observations of outstanding general government debt at book value. The series is extrapolated by using the data of general government net lending for the years 1961–1963 for Italy and the years 1960–1969 for Austria and the UK, and by using the data on central government debt from IMF International Financial Statistics for the years 1961–1969 for Belgium, the Netherlands and Sweden and the years 1961–1976 for France.

Price deflator: the ratio of final private consumption expenditures at current prices to the value of these expenditures at base-year prices.

Population: end-of-year total population.

Instruments

Austria, Belgium, Italy, Sweden: a constant, the second and third lag of private consumption, pre-tax labour income, government consumption, government debt and household income taxes.

France: a constant, the second through fourth lag of private consumption and pre-tax labour income, the second and third lag of government consumption and government debt and the second lag of household income taxes.

Germany: a constant, the second and third lag of private consumption, pre-tax labour income, government consumption, government debt and the second lag of household income taxes.

Greece: a constant, the second through fourth lag of private consumption, the second lag of pre-tax labour income, government consumption and household income taxes, and the second and third lag of government debt.

The Netherlands: a constant, the second through fourth lag of private consumption, the second and third lag of pre-tax labour income, government consumption, government debt and housheld income taxes.

The UK: a constant, the second and third lag of private consumption, government consumption, government debt and household income taxes, and the second lag of pre-tax labour income.

BANK OF FINLAND DISCUSSION PAPERS

ISSN 0785-3572

1/97 Peter Nyberg **Macroenomic Aspects of Systemic Bank Restructuring**. 1997. 30 p. ISBN 951-686-541-0. (KASI)

2/97 Anne Brunila **Fiscal Policy and Private Consumption – Saving Decisions: Evidence from Nine EU Countries**. 1997. 36 p. ISBN 951-686-542-9. (TU)