The Precautionary Effect of Government Expenditures on Private Consumption

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PRELIMINARY AND INCOMPLETE

Abstract

We estimate the effects of different government consumption categories on private consumption. First, we build a unique panel dataset which links household's private consumption to the government consumption of the region where the household lives, for Italy. Then, we use regional variability of government consumption and measure its effect on individual consumption for different categories of government expenditures. We find two main results. First, household's consumption expenditure increases as consumption's variance increases. Second, using regional variability of government consumption we estimate a negative impact of public health care on household consumption variance. Within our model, the results are interpreted in the light of a precautionary saving motive, with public health care expenditures acting as a form of consumption insurance for households. Finally, in order to compute the implied *multiplier effect* of government consumption, we use our estimates from micro data to calibrate a general equilibrium model with fully flexible prices and incomplete insurance markets. We quantify how much of the observed reaction of private consumption to public expenditures can be accounted by precautionary saving effects alone.

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1 Introduction

Over past years, the relationship between private consumption and government spending has been at the heart of the economics and government policy debates. In particular, the sign of the empirical response of private consumption to government spending shocks has been suggested as a crucial discriminant between the plausibility of the Neoclassical versus the Keynesian models.

In the standard RBC model (Baxter and King (1993)) - where public spending is assumed to be pure waste - government spending *crowds out* private spending because the tax increase induced by the increase in government spending reduces net present value of disposable income which decreases consumption. In models with nominal rigidities consumption may increase as a consequence of an increase in government spending. In fact, Linnemann and Schabert (2003) show that - although the strength of the demand effect depends on the response of the real interest rate governed by the monetary policy regime - stickiness alone is quantitatively not sufficient to explain a rise in consumption as predicted by Keynesian theory. The negative effect on permanent income tends to dominate the demand effect due to sticky prices. Gali, Lopez-Salido and Valles (2007) strengthen the Keynesian effect due to nominal rigidities by introducing a share of liquidity constrained (and myopic) consumers in the economy, and show that their New-Keynesian model is able to generate a positive reaction of private consumption to public spending.

Other authors have allowed government consumption to directly affect the welfare of agents. Among others, Bailey (1971) and Barro (1981) argue that a general model of consumption should allow for the direct effect of government purchases of goods services on a consumer's utility. In this case, the response of private consumption to public spending is affected, ceteris paribus, by the degree of substitutability (complementarity) between the two items of interest.

The aim of this paper is to provide new evidence on the sign and magnitude of the reaction of private consumption to public consumption changes, focusing on a possibly new mechanism at the base of this relationship. That is, we take advantage of the availability of individual data to identify a new channel of action - precautionary savings - and quantify the effect in general equilibrium. This paper constitutes the first attempt to estimate the effects of government consumption on private consumption, using individual data.

We exploit information from two datasets: The Survey of Households Income and Wealth (SHIW) from Bank of Italy, and The Regional Economic Accounts (REA) from

ISTAT. The first dataset provides information on households, such as private consumption, wealth, demographic characteristics and so on. REA delivers data on government consumption consolidated at a regional level. Moreover, for each region, REA disaggregates government consumption along a functional scheme based on COFOG classification (defense, justice, health, education, economics services and so on).

We build a permanent income model where government consumption changes are allowed to affect the variability of private consumption. The model generates three key processes: the Euler equation, a stochastic process for the variance of private consumption, and one for government consumption. Then, we build a unique panel data set linking Italian household's private consumption to various categories of government consumption of the region where the household lives. We find three key results. First, household's consumption expenditure increases as consumption's variance increases. Second, using regional variability of government consumption we estimate a negative impact of public health care on household consumption variance. Third, government consumption, in particular health care, shows a high degree of persistence over time. Within our model, the results are interpreted in the light of a precautionary saving motive, with public health care expenditures acting as a form of consumption insurance for households. As public spending for health increases, and the process for health care expenditure happens to be persistent over time, individuals have to save less today to insure themselves for future negative health shocks. This creates an increase in today private consumption. In order to compute the implied multiplier effect of government consumption, and compare our findings with those obtained using aggregate data, we use our estimates from micro data to calibrate a general equilibrium model with fully flexible prices and incomplete insurance markets. The quantitative analysis [still incomplete] aims at measuring how much of the observed reaction of private consumption to public expenditures can be accounted by precautionary saving effects alone. Preliminary results show that the precautionary effect of public health expenditures on private consumption can be potentially important, particularly, it can significantly contribute to the positive response of private consumption to government consumption variations.

The existing empirical evidence is all based on aggregate data and uses different methodologies, with contrasting results. Ramey and Shapiro (1997) use a 'narrative' or 'dummy variable' approach and find that private consumption reacts negatively to public expenditure shocks for US. This contrasts to the positive relationship estimated by Blanchard and Perotti (2002) within a SVAR methodology, for the same country. Other studies estimate the response of private consumption to government spending shocks within general equilibrium models. Smets and Wouters (2003) estimate a negative response of consumption, while Forni, Monteforte and Sessa (2007) estimate a positive one, both with Euro data. A number of studies analyze the complementarity/substitutability between public and private consumption following a partial equilibrium-approach based on Euler equations. Among others, Auscher (1985) finds a significant degree of substitutability between the two variables of interest for the US, while, Amano and Wirjanto (1998), for the same country, find a weak complementarity.

In our analysis the use of individual data is essential since otherwise we would be unable to identify the mechanism underlying the relation of interest, i.e. the precautionary saving motive. The use of micro data has several other advantages in comparison with aggregate data. First of all, since Attanasio and Weber (1993) it is well know that aggregation problems might cause biased estimates of individual parameters based on Euler equation defined on aggregate data. Second, few important endogeneities that are well known issues at the aggregate level, are more credibly excluded when using individual data. For example, it is realistic to suppose that government consumption may affect the consumption of a single household, but the contrary is unlikely to occur. Third, the regional dimension of public consumption considerably improves the identification scheme over existing ones. Indeed, the distribution of the general government expenditure is not homogenous across the Italian territory, so that using cross-sectional variability of consumption expenditure permits us to identify the parameters of interest while remaining agnostic about the determinants of the business cycle. Finally, we are able to study how heterogeneity among households can affect the relation between private and government consumption. Indeed, in principle, the response of private consumption to a government consumption shock could depend on the composition of the population when some items of public consumption affect more heavily certain groups of individuals.

The use of individual data makes our paper somewhat related to the extensive microeconometric literature on the evaluation of *specific* policy interventions (e.g., see the summary by Heckman et al. (1999)). Unlike them, we are interested in quantifying the effect of general government spending changes on private consumption in normal times.

The paper is structured as follows. In Section 2 we outline the model while the data is described in Section 3. In Section 4, we describe our empirical strategy and present the estimation results. In Section 5 we perform the calibration and measurement exercises accounting for the general equilibrium effects. Section 6 concludes and outlines our future plans.

2 Model

The framework is a standard consumption saving problem under uncertainty with inelastic labor supply. We assume that households have isoelastic preferences with $\frac{1}{\sigma}$ being the intertemporal elasticity of substitution and can trade physical capital (K) at rate r. The resulting Euler equation for individual i is:

$$\mathbf{E}_t\left[\left(\frac{C^i_{t+1}}{C^i_t}\right)^{-\sigma}\right]=\frac{1}{\beta(1+r)}, \tag{1}$$

where C^i_t is the individual i's non-durable consumption and β is the subjective discount factor. The corresponding approximated Euler equation reads:

$$\Delta c^i_{t+1}\simeq\frac{1-(1+r)\beta}{\sigma}+\frac{1+\sigma}{2}\mathbf{E}_t\left(\Delta c^i_{t+1}\right)^2+\varepsilon^i_{t+1,} \tag{2}$$

where small letters indicate the log of the original variable. The error component ε^i_{t+1} represents the individual forecast error which, under rational expectations, satisfies $\mathbf{E}_t(\varepsilon^i_{t+1})=0$. See Appendix for details on derivation.

We assume that the consumption dispersion follows a process like this[1]:

$$\begin{aligned}\mathbf{E}_t\left(\Delta c^i_{t+1}\right)^2 \;=\;& \delta+\beta_0\left(\Delta c^i_t\right)^2+\beta_1\mathbf{E}_t\left(\Delta y^i_{p,t+1}\right)^2+\beta_2\mathbf{E}_t\left(\Delta g_{p,t+1}\right)^2+\\ & \mathbf{E}_t\pi\left(G_{t+1},G_t;d_{t+1},d_t\right)\end{aligned} \tag{3}$$

The variables y^i_p and g_p are defined to be the permanent components of individual i's income and government consumption, respectively. Furthermore, we define π as a possibly non-linear transformation polynomial with coefficients that may depend on demographics (d) and government consumption (G). One special case for π is when demographics are

[1] This is a simplified version of the 'true' equation derived from a PIH equation for Δc. See for example Blundell, Pistaferri and Preston (2008) or Blundell, Low andPreston (2005). Roughly, we should compute the permanent income equation for Δc and then take the variance.

absent and we assume that what matters are logs, hence:

$$\pi\left(G_{t+1}, G_t; d_{t+1}, d_t\right) = \beta_3(L) g_{t+1} \tag{4}$$

where L denotes the lag operator.

Agents are subject to health expenditure shocks (h_t^i). Such shocks enter into the budget constraint of the individuals as follows:

$$C_t^i + K_{t+1}^i = (1+r)K_t^i + W_t^i s_t^i N_t^i - \left[1 - \rho_g\left(g_{t-1}, g_t\right)\right] h_t^i - T_t^i \tag{5}$$

where W_t^i is the price of skill, s_t^i is the individual skill, N_t^i represents hours worked and T_t represents lump sum taxation paid to the government[2]. The term $\rho_g\left(g_{t-1}, g_t\right)$ is a function (a polynomial in the empirical application), related to the extent of government consumption, stating the degree with which health shocks are insured by the public sector. This function is allowed to vary between zero and one. If $\rho_g\left(g_{t-1}, g_t\right) = 0$, no insurance is provided by the government to individuals, so that, whenever a health shock manifests itself individuals have to finance the needed treatments by themselves. If $\rho_g\left(g_{t-1}, g_t\right) = 1$, medical expenses caused by health socks are paid by the government. This implies that $\rho_g\left(g_{t-1}, g_t\right)$ is increasing with g, especially if g is represented by transfers in kind like health care expenditures. Thus, the more public health care expenditures increase, the more the degree of insurance increases.

Given health shocks can be interpreted as expenditure shocks, we can follow the derivations used in the individual consumption literature (e.g., Banks et al. (2001)) to show that consumption risk is positively related to the variance of health shocks (σ_h^2) (which we assume to be independently distributed across periods, or unit root), while it is negatively related to the degree of insurance provided by the government to individuals, that is:

$$\mathbf{E}_t\left(\Delta c_{t+1}^i\right)^2 \propto \sigma_h^2 * \left[1 - \rho_g\left(g_{t-1}, g_t\right)\right]^2 \tag{6}$$

The polynomial π can be seen as proportional to $\left[1 - \rho\left(g_{t-1}, g_t\right)\right]^2 \sigma_h^2\left(d_t\right)$. In a simplified word we assume that $\rho_g\left(g_{t-1}, g_t\right) = \rho_g\left(\Delta g_t\right)$ and that demographics are absent, so for the

[2]So far, we are assuming uniform taxation. In a more refined version of the model, taxes may depend on demographics as well as labor supply

coefficient β_3 in (4) we can then write the following:

$$\beta_3 \propto \sigma_h^2 * \frac{\partial \left[1-\rho\left(\Delta g_t\right)\right]^2}{\partial \Delta g_t} = -2\left[\sigma_h^2 * \left[1-\rho\left(\Delta g_t\right)\right]\frac{\partial \rho\left(\Delta g_t\right)}{\partial \Delta g_t}\right] \tag{7}$$

The meaning for the negative sign of β_3 is straightforward. We believe that, ceteris paribus, an increase in government consumption, particularly transfers in kind like health care, reduces the individual consumption risk since these government expenditures can partly or totally cover the medical expenses associated with negative health shocks.

As a result of a decrease of the consumption's variance, the current need for precautionary saving decreases and so the today private consumption increases. This is true by the Euler equation (2).

Regarding the behavior for government consumption, we assume that its realization can be observed by individuals within the period. Furthermore, we assume that the process for government consumption follows an AR(1) like this:

$$g_{t+1} = \alpha + \rho g_t + \varepsilon_t^g \tag{8}$$

with $0 < \rho < 1$ and ε_t^g being a white noise error term.

2.1 Why does the precautionary effect increase consumption?

We here discuss more formally why we can get an increase in private consumption through the precautionary effect of public health expenditures, and how this depends on the persistence of the government process.

In order to understand the mechanism of the precautionary saving we will compare Euler equations in multiperiods. We consider two possible levels of government spending at t: $g_t^2 > g_t^1$ (or two different innovations in logs $\varepsilon_t^{g^2} > \varepsilon_t^{g^1}$). Now, let $t+s$ be the period after t where:

$$\mathbf{E}_t^1 c_{t+s} = \mathbf{E}_t^2 c_{t+s} \tag{9}$$

Obviously, the number s exists when time is continuous. In discrete time, we take the 'crossing' time in the obvious way. Note that we are taking expectations conditional on all information till t plus the information over government expenditures (the superscript).

This is the only difference in expectations. From the Euler equations in the two cases:

$$\mathbf{E}_t^i c_{t+s} = c_t^i + \sum_k^{s-1} \Phi_{T+k} + \frac{1+\sigma}{2} \mathbf{E}_t^i \left[\sum_k^{s-1} \Delta c_{t+k}^2 \right], \tag{10}$$

we have:

$$c_t^2 - c_t^1 = -\frac{1+\sigma}{2} \left(\mathbf{E}_t^2 - \mathbf{E}_t^1 \right) \left[\sum_k^{s-1} \Delta c_{t+k}^2 \right] \tag{11}$$

We are guessing that if g has an insurance effect, that is, $\mathbf{E}_t^i \left[\sum_k^{s-1} \Delta c_{t+k}^2 \right]$ is decreasing in g, then $\left(\mathbf{E}_t^2 - \mathbf{E}_t^1 \right) \left[\sum_k^{s-1} \Delta c_{t+k}^2 \right] < 0$. The latter is true since $g_t^2 > g_t^1$. As a consequence, we have that $c_t^2 > c_t^1$. This is what we call 'precautionary effect' and in particular the precautionary effect of g.

If we refer to a world where government consumption process is governed by (8), the precautionary motive described above is larger the larger is the degree of persistence characterizing this process. Individuals interpret a current increase in public health care as a long-lasting one, and this dampens their need for precautionary savings. This would be captured by a larger value for s.

3 Data

Individual data, such as non-durable private consumption and disposable income, are taken by the SHIW of Bank of Italy. We take into account four waves of data (1995-'98-'00-'02). For more information regarding the way of treating data, see Appendix.

Regional data, government consumption in particular, are taken by REA issued by ISTAT. REA follows the general principles of the European System of National Account (ESA '95). Government consumption is the sum of the spending of the Central Government, Regions, Provinces, and Towns. REA consolidates government consumption at a regional level. Specifically, government consumption contains purchases of goods and services, transfers in kind and wages. Moreover, this dataset provides a functional classification of the government consumption following the COFOG scheme. It divides public consumption in ten categories, such as, general services, defense, economic affairs, public order, education, health, social security and some other minor items. The period covered from REA goes from 1995 to 2002[3].

We merge the two datasets and create a unique panel dataset which links household's private consumption to the government consumption of the region where the household lives.

In Table 1, we present government consumption as a share of GDP for each region. Furthermore, following the national accounts (ESA '95), we disaggregate government consumption in two categories: the collective goods and services and the individual goods and services. The first category groups goods which are provided simultaneously to all members of the community or all households living in a particular region. They are public goods, such as, defense, public order, bureaucracy, etc. The second category is represented by goods that are provided to households for which is possible to observe and record its acquisition by an individual household. These goods are referred to as publicly provided private goods or merit goods (e.g. education and health).

The share of the government consumption for Italy is around 20% of GDP, in particular, it ranges from 13.5% of Lombardia to 30% of Sicily. Moreover, we see that individual goods (merit goods) are the lion's share of the government consumption, indeed they are roughly twice as much as collective goods (public goods). Importantly, the distribution of government consumption is not uniform across regions.

[**insert Table 1 here**]

Table 2 represents the share of each category of spending on total government consumption for Italy from 1995 to 2002. Important to say is that education and health represent the largest items among merit goods.

[**insert Table 2 here**]

Figure 1 represents the residuals of the regression of the logarithm of government consumption on time dummies, pooled by regions. Figure 2 represent the residuals of the regression of the first difference of the logarithm of government consumption on time dummies, pooled by regions. The implication we draw from these figures is that government consumption shows a certain degree of variability within and across regions despite we control for common macro shocks.

[3] It is worth noting that similar datasets don't exist for US. In fact, on the one hand the definition of consumption taken from PSID covers just food. On the other hand, CEX does not have detailed information on the location of households. Finally, US does not have measures of government consumption consolidated at a federal level.

[**insert Figure 1 here**]
[**insert Figure 2 here**]

4 Estimation

This section has three main targets. First, we aim at quantifying the effect of household's consumption variance on consumption expenditure growth by estimating the Euler equation (2). Secondly, we estimate the impact of various categories of government consumption on household's consumption variance by taking to the data an equation like (3). Finally, we estimate the process for government consumption (8), in particular for health care expenditures and its degree of persistence.

To estimate Euler equation (2), we take to the data the following specification:

$$\Delta c_{t+1}^{i} \simeq \phi_0 + \phi_1 \mathbf{E}_t \left(\Delta c_{t+1}^{i}\right)^2 + Z_{t+1} + d_t + \varepsilon_{t+1,}^{i} \tag{12}$$

where Z_t includes demographics such as age, age squared and the level of education of the head of family and d_t represents a time dummy which is supposed to capture common macro shocks (like interest rate shocks).

Following Bertola et al. (2005) we note that consumption risk, $\mathbf{E}_t \left(\Delta c_{t+1}^{i}\right)^2$, is not directly observable; we just observe the realization $\left(\Delta c_{t+1}^{i}\right)^2$. We define the expectational error $\varkappa_{t+1}^{i} = \left(\Delta c_{t+1}^{i}\right)^2 - \mathbf{E}_t \left(\Delta c_{t+1}^{i}\right)^2$, so that we can rewrite (12) as:

$$\Delta c_{t+1}^{i} \simeq \phi_0 + \phi_1 \left(\Delta c_{t+1}^{i}\right)^2 + Z_{t+1} + d_t + \zeta_{t+1}^{i} \tag{13}$$

where $\zeta_{t+1}^{i} = \varepsilon_{t+1}^{i} - \phi_1 \varkappa_{t+1}^{i}$. Given the nature of the error term, we exploit lagged information to instrument for the consumption risk. Precisely, we estimate (13) through 2SLS technique. In the first stage, we regress $\left(\Delta c_{t+1}^{i}\right)^2$ on Δc_t^i, c_t^i , Δy_t^i, y_t^i , Δw_t^i and w_t^i , with the latter being the real total wealth of the household. In the second stage, we use the predicted value for $\left(\Delta c_{t+1}^{i}\right)^2$, and measure its direct effect on Δc_{t+1}^{i}.

The estimation results for (13) are visible in Table 3[4]. In column 1, we see that the coefficient of consumption dispersion (ϕ_1) is estimated to be around 3, with an associated p-value which is lower than 1%. This value finds confirmation in the recent literature. Jappelli and Pistaferri (2000) find that the coefficient associated to consumption risk is

[4] We report the results just for the second stage regression. First stage's estimates are available upon request.

roughly equal to 5, while Bertola et al. (2005) find a lower value, i.e. roughly 1.6. Both works share the same dataset as ours but they use different time spans. With isoelastic preferences all these results are reasonable since they imply a value for the coefficient of relative risk aversion varying from 1 to 6. Furthermore, the only demographic which is significantly different from zero is the level of the education of the head, and it enters with a positive sign as expected. Finally, the value for the Sargan test certifies that the moments conditions used in the estimation are valid and, furthermore, no first-order autocorrelation is detected in the residuals. Column 2 of Table 3 presents some robustness results. First, we note that private consumption is not sensitive to predictable changes in individual income. Passing this test is somewhat important as it can be seen as validation of our estimation strategy based on the Euler equation. It is well known that this test tend to be rejected when aggregate data is used instead (e.g., Attanasio and Weber (1993)). Secondly, we augment the Euler equation with various items of government consumption, namely public goods (*publ*), education (*edu*), health and social protection (*health*), and recreation and culture and religion (*cult*). We want to control if there is any possible direct effect of government consumption on private consumption[5]. None of these items have a coefficient which is significantly different from zero.

[**insert Table 3 here**]

In order to estimate the process for the observed consumption variance, we take to the data the following specification:

$$\begin{aligned}\left(\Delta c_{t+1}^{i}\right)^{2} = \; & \psi_0 + \psi_1\left(\Delta c_t^i\right)^2 + \psi_2\left(\Delta c_{t+1}^i\right)^4 + \psi_3\left(\Delta y_{t+1}^i\right)^2 + \psi_4\left(\Delta y_t^i\right)^2 + \\ & \psi_5\left(\Delta health_{t+1}^r\right)^2 + \psi_6\left(\Delta health_t^r\right)^2 + \psi_7\left(\Delta g\_noh_{t+1}^r\right)^2 + \\ & \psi_8\left(\Delta g\_noh_t^r\right)^2 + Z_{t+1} + d_t + \psi_9 publ_{t+1}^r + \psi_{10} publ_t^r + \psi_{11} health_{t+1}^r + \\ & \psi_{12} health_t^r + \psi_{13} edu_{t+1}^r + \psi_{14} edu_t^r + \psi_{15} cult_{t+1}^r + \psi_{16} cult_t^r + u_{t+1,}^i \end{aligned} \tag{14}$$

where the polynomial π is represented by the levels (in logs) of the various items composing regional government consumption, namely, public goods, education, health care, and recreation and culture expenditures. The variables $\left(\Delta c_t^i\right)^2$ and $\left(\Delta c_{t+1}^i\right)^4$ serve as controls

[5]The presence of various categories of government consumption in the Euler equation can be obtained by including these items in the agents' utility function.

for some forms of habits in the consumption variance and potential effects of higher order moments of consumption, respectively. The squares of both individual income and government consumption items should capture the permanent component effects of the two respective variables. Note that, to be more parsimonious, we aggregate all items of government consumption of region r but health care under the variable labelled as g_noh^r. The estimated equation includes also some other control variables, namely, the respective covariances between all the regressors, the current and the lagged difference of individual income, and some regional controls such as GDP, a proxy for public wages, and total government expenditures[6]. Finally, we just assume u^i_{t+1}being a white noise error term. We estimate (14) by OLS and we cluster the residuals by regions given that we regress individual variables on regional ones.

The estimation results for (14) are visible in Table 4. From column 1, we can see that the levels of health care both at t and $t-1$ are the only government consumption's items which significantly affect consumption variance. Furthermore, the estimated process exhibits a certain degree of persistence and $\left(\Delta c^i_{t+1}\right)^4$ has a positive impact on consumption variance, as expected. Interestingly, the estimated values for the government consumption items call for a restriction. Indeed, column 2 presents the results considering government expenditures in first differences. The most striking result is that $\Delta health^r_{t+1}$ has a positive and significant impact on consumption variance. Column 3 presents the results obtained by estimating the process using regional averages of individual data. Specifically, we let the sample analog of $\mathbf{E}_t\left[(\Delta c_{t+1})^2\right]$ for region r, for given time t, be:

$$\overline{(\Delta c_{t+1})^2}^r = \frac{\sum_{i=1}^{I^r}\left(\Delta c^i_{t+1}\right)^2}{I^r}, \tag{15}$$

where I^r is the number of households in region r. By working with regional averages presents two advantages. First, our identification strategy improves since both individual variables, i.e. consumption variance, and regional variables, i.e. health care, share the same cross-sectional variability. Secondly, the measurement error problem is mitigated. As it is visible from column 3, the results with regional averages tend to confirm the ones obtained in column 2. As a further robustness check, we estimate all the three specifications in Table 4 by instrumenting government consumption's items at time t with themselves lagged at

[6]All these variable but total government expenditure, are taken by ISTAT. Total government expenditure is drawn from Italian Treasury (CPT dataset) and is the sum of the current part of government spending (less government consumption) plus public investment.

$t-1$. All the above results are confirmed.

[**insert Table 4 here**]

Finally, Table 5 presents the results for government process (8), particularly for health care consumption expenditures. In all the three columns, the process for health care shows a pretty high degree of persistence over time since the coefficient associated to the lagged dependent variable is around 0.9. Another thing is worth noting. In column 2 and 3 we augment the estimation of process (8) by including $\overline{c_{t+1}}^r$, i.e. the regional averages of non-durable private consumption. Column 2 presents an OLS regression, whilst column 3 a 2SLS regression where $\overline{c_{t+1}}^r$ is instrumented with lagged levels and differences of both $\overline{c}^r$ and GDP^r. In both cases, $\overline{c_{t+1}}^r$ has not a direct effect on g^r_{t+1}. The motivation for which we include $\overline{c_{t+1}}^r$ is to control for a potential feedback effect of private consumption on government consumption. Indeed, there could be preference shocks that increase private consumption. As a consequence of these shocks, individuals consume more of any kind of goods and services, on average. Thus, they can ask more even for those services which are freely provided by government (e.g. medical treatments), inducing government to increase the expenditures for these services.

[**insert Table 5 here**]

4.1 Interpreting the Results

The previous section presents three key results. First, household's consumption expenditure increases as consumption's variance increases. Second, using regional variability of government consumption we estimate a negative impact of public health care on household consumption variance; more specifically, if public health care expenditures increase by one period to another one, then consumption variance will decrease by a corresponding amount in the same period. Third, government consumption, in particular health care, shows a high degree of persistence over time.

Within our model, the results are interpreted in the light of a precautionary saving motive, with public health care expenditures acting as a form of consumption insurance for households. As public spending for health increases, and the process for health care expenditure happens to be persistent over time, individuals have to save less today to insure themselves for future negative health shocks. This creates an increase in today private consumption.

5 The Macroeconomic Effect of Government Consumption

So far, we have found that there is a positive relation between private consumption growth and consumption variance, furthermore we detected a negative relation between the latter and public health care expenditures. In order to measure the effect of government consumption changes on aggregate private consumption, i.e. the implied multiplier, we need to insert our estimates into a dynamic general equilibrium model. This way for example, we will be able to account for the negative wealth effect implied by an increase in G. When a positive government spending shock hits the economy, individuals expect an increase in taxes hence revise downwards their permanent income so that they decrease their consumption. In order to perform such computation, we resort to an otherwise standard RBC with incomplete insurance markets model and we calibrate it for the Italian economy, using as input our estimates from micro data.

The aim is to relate our measurements to those ones in the literature who investigate on the response of private consumption to government spending shocks. All of these studies utilize macro data. Some of them use a VAR analysis (e.g. Ramey and Shapiro (1998), Blanchard and Perotti (2002), and Mountford and Uhlig (2005)). Others estimate the response of private consumption to government spending shocks within general equilibrium models (e.g. Smets and Wouters (2003), Bouakez and Rebei (2007), and Forni, Monteforte and Sessa (2007)). The results are mixed even using similar approaches. For example, Ramey and Shapiro (1998) find a negative response of consumption while Blanchard and Perotti (2002) estimate a positive one, both with US data. Moreover, Smets and Wouters (2003) estimate a negative response of consumption while Forni et al. (2007) estimate a positive one, both using Euro data.

5.1 General Equilibrium Model

We refer to a framework similar to Aiyagari (1994). In each period, the economy features a continuum agents with unit mass. Each period, on top of skill shocks, agents face an idiosyncratic health expenditure shock (h_t^i). We assume that h_t^i follows a finite state Markov process with transition probability matrix $P(h, h^{'}) = \Pr(h_{t+1}^i = h^{'} | h_t^i = h)$. As explained in Section 2, the medical expenses caused by health shocks can be partly or totally covered by the government. The larger is the term $\rho_g\left(g_{t-1}, g_t\right)$, the more health insurance is provided by the government.

Markets are incomplete as agents can only self-insure through capital accumulation.

The more likely individuals are hit by health shocks, the more they need to increase savings to insure themselves. Clearly, precautionary saving motives can be dampened by public health insurance.

Agents' labor supply is discrete, that is, we neglect the intensive margin. Agent i's maximization problem can be represented as follows:

$$\max_{\{C_t^i, N_t^i, K_{t+1}^i\}_{t=0}^{\infty}} \mathbf{E}_0 \sum_{t=0}^{\infty} \beta^t p(d_t^i) \left[\frac{\left(C_t^i\right)^{1-\sigma}}{1-\sigma} - vN_t^i \right] \tag{16}$$

s.t.

$$C_t^i + K_{t+1}^i = (1+r_t)K_t^i + W_t^i s_t^i N_t^i - [1 - \rho_g (g_{t-1}, g_t)] h_t^i - T_t, \tag{17}$$

where all the variables have the meaning described in Section 2. In particular, $N_t^i \in \{0, \bar{N}\}$ with $\bar{N}$ corresponding to a full time job. If individuals take the job, they bear the cost v. The term $p(d_t^i)$ represents the survival probability of agent i which depends on demographics.

Markets are competitive and firms have a standard Cobb-Douglas production function with constant returns to scale. The aggregate production function is:

$$Y_t = K_t^{\theta} \hat{N}_t^{1-\theta}, \tag{18}$$

where K_t is the capital stock and $\hat{N}_t$ is aggregate labor in efficiency units. Firms maximize profits by choosing labor and capital inputs taking factor prices as given.

The government budget constraint is:

$$G_t = T_t, \tag{19}$$

where $\ln G_t$ is assumed to follow a standard autoregressive process as in (8)[7].

The public health sector is very stylized so far, but it corresponds to a linear production technology delivering $\rho_g (g_{t-1}, g_t)$ as equilibrium outcome which depends on the distribution of health shocks in the economy. For a more complete specification of the health sector we can refer to Chatterjee, Corbae, Nakajima, and Rios Rull (2007).

The definition of equilibrium is standard. In the benchmark version of the model, we consider a closed economy. We will also consider the case with an exogenous interest rate.

[7] In a more refined version of the model, we allow government to hold debt so that different processes for taxation can be assumed.

5.2 Calibration

The model is calibrated at a quarterly frequency for the Italian economy. To calibrate these parameters we exploit information from our dataset and resort to previous studies available in the literature. We calibrate the parameters of the model as follows:

- health shocks have to be calibrated such that they depend on age of the household head and on other demographics as well as on past shocks (see De Nardi et al. (2010))
- the polynomial $\rho_g(g_{t-1}, g_t)$ of the public health services production is calibrated in a way to match the point estimate of the effect of health care on consumption's variance. That is, we make use of the results of Table 4
- the cost v is calibrated so that to generate the aggregate participation rate
- the process for the skills, s_t^i, is recovered from the process for individual wages
- the capital share θ is set such that to be consistent with the labor share calculated with the data (see Censolo and Onofri (1993))
- the discount factor β is calibrated to match the capital-output ratio for Italy
- the coefficient of government consumption process, ρ, is set to point value estimated in Section 4 (see Table 5)
- we set σ in line with the micro estimates for other countries (e.g., Attanasio and Weber (1993)), and we do sensitivity analysis on this parameter
- in the baseline model, we set $p(d) = 1$ for all d
- in the baseline model we set T to solve the government budget period by period, we then experiment on different rules used in the literature.

5.3 The Effect of a Government Consumption Shock

The present Section describes a preliminary exercise that has a qualitative objective, i.e. to highlight the precautionary effect of government consumption on private consumption within a general equilibrium framework. Since this exercise does not take into account the calibration technique described in Section 5.2, the following results has to be taken with cautions and, for sure, cannot be interpreted quantitatively.

We simplify further the model presented in Section 5.1. In particular, agent i's problem becomes the following:

$$\max_{\{C_t^i, K_{t+1}^i\}_{t=0}^{\infty}} \mathbf{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{\left(C_t^i\right)^{1-\sigma}}{1-\sigma} \right] \tag{20}$$

$s.t.$

$$C_t^i + K_{t+1}^i = (1 + r_t)K_t^i + W_t^i N - (1 - \rho_g G_t)h_t^i - T_t, \tag{21}$$

where we assume that the polynomial $\rho_g\left(g_{t-1}, g_t\right)$ in (17) is equal to $\rho_g G_t$. This means that, for a given value of ρ_g, the larger is G the more individuals are insured against health shocks. In this respect, G can be seen as public health care transfers and ρ_g is set to 1. Furthermore, in this simpler version of the model households are assumed to supply a fix amount of labor, i.e. N is fixed to 1 and s_t^i is assumed to be 1 in every period. Regarding health shocks, we assume that agents face an idiosyncratic shock (h_t^i) that can take just two values, $h_t^i = 0.7$ (if it's a negative health shock), and $h_t^i = 0$ (if it's a 'neutral' health shock)[8]. If the agent receives a bad health shock, then agent's resources will decrease by 0.7, i.e. the amount needed to finance the treatments. On the other hand, if $h_t^i = 0$, agent's resources will be unaffected. As specified in Section 5.1, we assume that h_t^i follows a Markov process with transition probability matrix $P(h, h') = \Pr(h_{t+1}^i = h' | h_t^i = h)$. Thus, we have a square matrix of four entries. So far, we chose these values-entries in order to obtain both a certain degree of persistence in the health shocks process, and a larger probability to be hit by health shocks in the future when agents have already received them today. Specifically, the probability of being ill next period ($h' = 0.7$), given that the agent is sick now ($h = 0.7$), is set to 0.4. Accordingly, the probability of being healthy next period, given that the agent is sick now, is 0.6. The probability of being ill next period given that the agent is healthy now is set to 0.1, the probability of being healthy next period given that the agent is healthy now is set to 0.9. This structure probability implies that in equilibrium we have a share of people hit by negative health shocks -ill people- equal to almost 0.15, while a share of people not receiving any negative health shocks equal to 0.85. The production side remains the same as the one presented in Section 5.1.

We calculate the stationary distribution for households' capital (see Appendix for details) by assuming that there is no publicly provided health system, i.e. individuals finance

[8]The magnitude of the health shocks has to be carefully calibrated, obviously. At this moment, we chose a number different from the value of the labor supply.

medical treatments by their own resources, i.e. $G = T = 0$. Furthermore, we fix the following parameters using standard values in the literature, i.e. $\sigma = 1$, $\beta = 0.96$, and $\alpha = 0.3$. Our stationary distribution implies the following values in equilibrium for interest rate, wage, aggregate capital, aggregate output, aggregate consumption, aggregate saving: $r = 0.0466$, $W = 1.0905$, $K = 4.3826$, $Y = 1.5578$, $C = 1.1949$, and $S = Y - C = 0.3630$.

We then assume that, at certain time t, there is an unexpected increase of G that passes from 0 to 0.5, and then decreases following a deterministic AR(1) process with autoregressive coefficient equal to 0.9 (see Figure 3)[9].

[**insert Figure 3 here**]

After the increase in G, we consider 80 periods (quarters) along which we assume a constant profile for taxes, i.e.:

$$T_t = \frac{1}{80} \sum_{i=1}^{80} (G_t * 0.15 * 0.7) \tag{22}$$

As it is visible from (22), taxes need to cover the amount of money (G_t*0.7) that government gives -each quarter- to the fraction of sick people (0.15). Note that all people pay taxes but just sick people receive transfers from the government. Indeed, when the agent is not hit by a negative health shock ($h = 0$), G_t disappears from his individual budget constraint, but still he has to pay taxes to finance the government transfers given to the sick guys.

We want to study the transition of the whole economy along the evolution of G (see Appendix for technical details). In particular two effects manifests themselves as soon as G increases. First, consumers become partially insured against present and future health shocks so that their precautionary needs for saving should be dampened. Secondly, all agents bear a negative wealth effect given that everyone pay taxes to finance G.

Figure 4 describes the evolution over time of aggregate saving, aggregate consumption and consumption of ill and healthy people as well. The "precautionary saving" effect dominates the negative wealth effect. Indeed, saving falls below steady state on impact while consumption does the opposite. Interestingly, sick agents' consumption -as a percentage of their steady state level- increases more than the one of the healthy agents. This is reasonable since sick agents have an higher probability to be sick in the next period and then an

[9]Note that G is never larger than the values of the health shocks, this means that individuals are never totally insured by the public sector against health shocks.

increase of G -which is persistent over time- can significantly dampen their precautionary needs for saving. All variables come back to the initial respective steady states as G dies out.

[**insert Figure 4 here**]

Figure 5 describes the evolution of interest rate, capital, and output. Interest rate falls on impact. Given that labor supply is fixed, output is completely driven by the dynamics of capital.

[**insert Figure 5 here**]

In Figure 6, we isolate the effects of the precautionary saving motive by shutting down the negative wealth effect from the model. The facts of figure 4 are confirmed, in particular, sick agents' consumption increase -as a percentage of their steady state level- more than the one of the healthy consumers.

[**insert Figure 6 here**]

6 Conclusions and Extensions

We estimated the effects of different government consumption items on private consumption, exploiting micro data. We have set up a permanent income model where government consumption changes are allowed to affect the variability of private consumption. The model generates three key processes: the Euler equation, a stochastic process for the variance of private consumption, and one for government consumption. We have built a unique panel data set linking Italian household's private consumption to the government consumption of the region where the household lives. We made use of regional variability of government consumption and measured its effect on individual consumption for different categories of government expenditures.

We found three key results. First, household's consumption expenditure increases as consumption's variance increases. Second, using regional variability of government consumption we estimate a negative impact of public health care on household consumption variance. Third, government consumption, in particular health care, shows a high degree of persistence over time. Within our model, the results are interpreted in the light of a precautionary saving motive, with public health care expenditures acting as a form of consumption insurance for households. As public spending for health increases, and the process for health care expenditure happens to be persistent over time, individuals have to save less today to insure themselves for future negative health shocks. This creates an increase in today private consumption.

Finally, in order to compute the implied multiplier effect of government consumption, and compare our findings with those obtained using aggregate data, we used our estimates from micro data to calibrate a general equilibrium model with fully flexible prices and incomplete insurance markets. The quantitative analysis [still incomplete] aims at measuring how much of the observed reaction of private consumption to public expenditures can be accounted by precautionary saving effects alone. Preliminary results show that the precautionary effect of public health expenditures on private consumption can be potentially important, particularly, it can significantly contribute to the positive response of private consumption to government consumption variations.

Our dataset gives us the possibility to study how individual heterogeneity affects the relation between government and private consumption. In principle, various groups of individuals can move their consumption differently in response to an increase in government consumption. We plan to study these heterogeneous responses across households, and quantify the effects in general equilibrium.

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8 Appendix

8.1 Approximated Euler Equation

With isolelastic utility function and the usual budget constraint, the Euler equation is (1), that is (neglecting the symbol i):

$$u'_c(C_t) = \frac{\beta}{q}\left[u'_c(C_{t+1})\right] \tag{23}$$

where $u'_c(C_t) = C_t^{-\sigma}$. Let's approximate $u'_c(C_{t+1})$ around $u'_c(C_t)$ in the second order:

$$u'_c(C_{t+1}) = u'_c(C_t) + u''_{cc}(C_t)(C_{t+1} - C_t) + \frac{1}{2}u'''_{ccc}(C_t)(C_{t+1} - C_t) + o\left(\|[\Delta C]\|^2\right) \tag{24}$$

where $u''_c(C_t) = -\sigma C_t^{-\sigma-1}$ and $u'''_{ccc}(C_t) = -\sigma(-\sigma - 1)C_t^{-\sigma-2}$. If we divide (24) by $u''_c(C_t)\,C_t$, we obtain:

$$\mathbf{E}_t\left(\frac{\Delta C_{t+1}}{C_t}\right) = \frac{1-(1+r)\beta}{\sigma} + \frac{\sigma+1}{2}\mathbf{E}_t\left(\frac{\Delta C_{t+1}}{C_t}\right)^2 \tag{25}$$

which can be easily related to the equation in the main text

8.2 Data

Individual data are treated before to be used in the estimation. We rule out households having negative values on income and consumption, with inconsistent data on age sex and level of education. We consider in the sample households with the age of the head ranging from 25 to 65. We do not consider observations when household's head change. In order to eliminate possible outliers, we rule out individuals having non-durable consumption less (above) the 1 (99) percentile of the distribution and those having the rate of growth of consumption less (above) the 1 (99) percentile of the distribution. Furthermore, individual variables (such as consumption and disposable income) are adjusted for the equivalent scale; specifically we refer to the "OECD-modified scale" which assigns a value of 1 to the household head, of 0.5 to each additional adult member, and 0.3 to each child (see Haangenars et al. (1994) for details). Regional data are divided by the number of household of the regions (census information issued by ISTAT). All data are deflated by a national deflator (NIC issued by ISTAT).

8.3 Computing Stationary Distribution and Transition

TO BE ADDED

Table1: government consumption (% of GDP), year 2002

Regions	government consumption	collective goods (public goods)	individual goods (merit goods)
Piemonte	15.9	6.1	9.8
Valle d'Aosta	26.1	14.6	11.5
Lombardia	13.5	5.1	8.4
Trentino-Alto Adige	20.9	8.4	12.5
Veneto	15.4	5.8	9.6
Friuli-Venezia Giulia	18.2	7.2	11.04
Liguria	17.8	6.8	11.0
Emilia Romagna	14.7	5.5	9.2
Toscana	17.4	6.5	10.9
Umbria	21.3	8.1	13.2
Marche	19.0	7.0	12.0
Lazio	18.5	6.1	12.4
Abbruzzo	22.6	8.1	14.5
Molise	25.6	9.6	16.0
Campania	27.7	9.9	17.8
Puglia	25.0	8.7	16.3
Basilicata	28.3	10.7	17.6
Calabria	31.5	11.6	19.9
Sicilia	30.0	12.0	18.0
Sardegna	27.2	10.6	16.6
Italy	**19.0**	**6.0**	**13.0**

Source: author's compilation using REA

Table 2: percentage of each category on total government consumption (Italy)

	categories	1995	1996	1997	1998	1999	2000	2001	2002	mean
public	**General public services**	12.0	12.8	12.3	12.3	12.2	12.2	12.3	12.3	**12.4**
public	**Defence**	6.3	6.0	5.6	5.6	5.9	5.7	5.7	5.7	**5.8**
public	**Public order and safety**	11.1	11.5	11.2	11.2	10.9	10.5	10.0	9.8	**10.8**
public	**Economic affairs**	7.7	7.5	7.4	7.3	7.1	6.7	6.7	6.7	**7.1**
public	**Environmental protection**	0.7	0.6	0.8	1.0	1.3	1.4	1.4	1.4	**1.1**
public	**Housing and community amenities**	1.3	1.2	1.3	1.3	1.4	1.3	1.3	1.3	**1.3**
merit	**Health**	28.8	28.8	29.6	29.7	29.9	31.4	32.2	32.6	**30.4**
merit	**Recreation, culture and religion**	2.3	2.3	2.4	2.4	2.3	2.2	2.1	2.2	**2.3**
merit	**Education**	25.3	25.6	25.6	25.6	25.2	24.7	24.0	23.8	**25.0**
merit	**Social protection**	3.8	3.8	3.7	3.7	3.7	3.9	4.2	4.2	**3.9**

Authors' calculation based on REA

Table 3: Euler Equation

	(1)	(2)
	IV	IV
	Δc	Δc
age	0.01	0.01
	[0.657]	[0.644]
age^2	0	0
	[0.681]	[0.656]
education	0.03*	0.02+
	[0.049]	[0.083]
[Δc]^2	**3.18****	**3.41****
	[0.000]	**[0.000]**
[Δy(-1)]		-0.02
		[0.525]
Δpubl		-3.53
		[0.513]
Δhealth		0.05
		[0.976]
Δedu		2.35
		[0.229]
Δcult		-0.15
		[0.743]
const	-0.57	-0.51
	[0.144]	[0.393]
Obs	2452	2452
Sargan (p-value)	0.49	0.49
Ar(1) resid. (p-value)	0.84	0.97

Data are in logs. p values in brackets (+ significant at 10%; * significant at 5%; ** significant at 1%). Standard errors are robust. Time dummies are added, regional controls and are added in column (2).

Table 4: Consumption's Variance process

	(1)	(2)	(3)
	OLS	OLS	OLS
	[Δc]^2	[Δc]^2	[Δc]^2
age	0	0	-0.04+
	[0.614]	[0.574]	[0.060]
age^2	0	0	0.00+
	[0.606]	[0.568]	[0.051]
education	0	0	0
	[0.974]	[0.913]	[0.975]
[Δc(-1)]^2	0.04**	0.04**	-0.01
	[0.000]	[0.000]	[0.941]
[Δc]^4	0.67**	0.67**	0.77**
	[0.000]	[0.000]	[0.000]
publ	0.21		
	[0.468]		
publ(-1)	-0.26		
	[0.362]		
Δpubl		0.16	0.29
		[0.563]	[0.256]
health	**-1.25****		
	[0.009]		
health(-1)	**1.25****		
	[0.008]		
Δhealth		**-1.20****	**-0.97****
		[0.008]	**[0.001]**
edu	0.12		
	[0.522]		
edu(-1)	-0.08		
	[0.641]		
Δedu		-0.04	0.07
		[0.834]	[0.714]
cult	0.05		
	[0.259]		
cult(-1)	-0.05		
	[0.279]		
Δcult		0.05	0.14*
		[0.173]	[0.017]
			[0.271]
const	0.15	0.09	1.04+
	[0.427]	[0.144]	[0.065]
Obs	2594	2594	39
R-squared	0.755	0.755	0.982
Ar(1) resid. (p-value)	0.11	0.11	0.67

Data are in logs. p values in brackets (+ significant at 10%; * significant at 5%; ** significant at 1%). Standard errors are cluster by regions in column (1) and (2), they are robust in column (3). Time dummies and regional controls are added.

Table 5: Government Consumption (Health) process

	(1)	(2)	(3)
	OLS	OLS	IV
	health	health	health
health(-1)	**0.89****	**0.88****	**0.95****
	[0.000]	**[0.000]**	**[0.000]**
c (regional mean)		-0.01	-0.01
		[0.576]	[0.746]
const	0.47+	0.59+	0.3
	[0.070]	[0.084]	[0.489]
Obs	60	59	39
Sargan (p-value)			0.21
Ar(1) resid. (p-value)	0.71	0.30	0.33

Data are in logs. p values in brackets (+ significant at 10%; * significant at 5%; ** significant at 1%). Standard errors are robust. Time dummies are added.

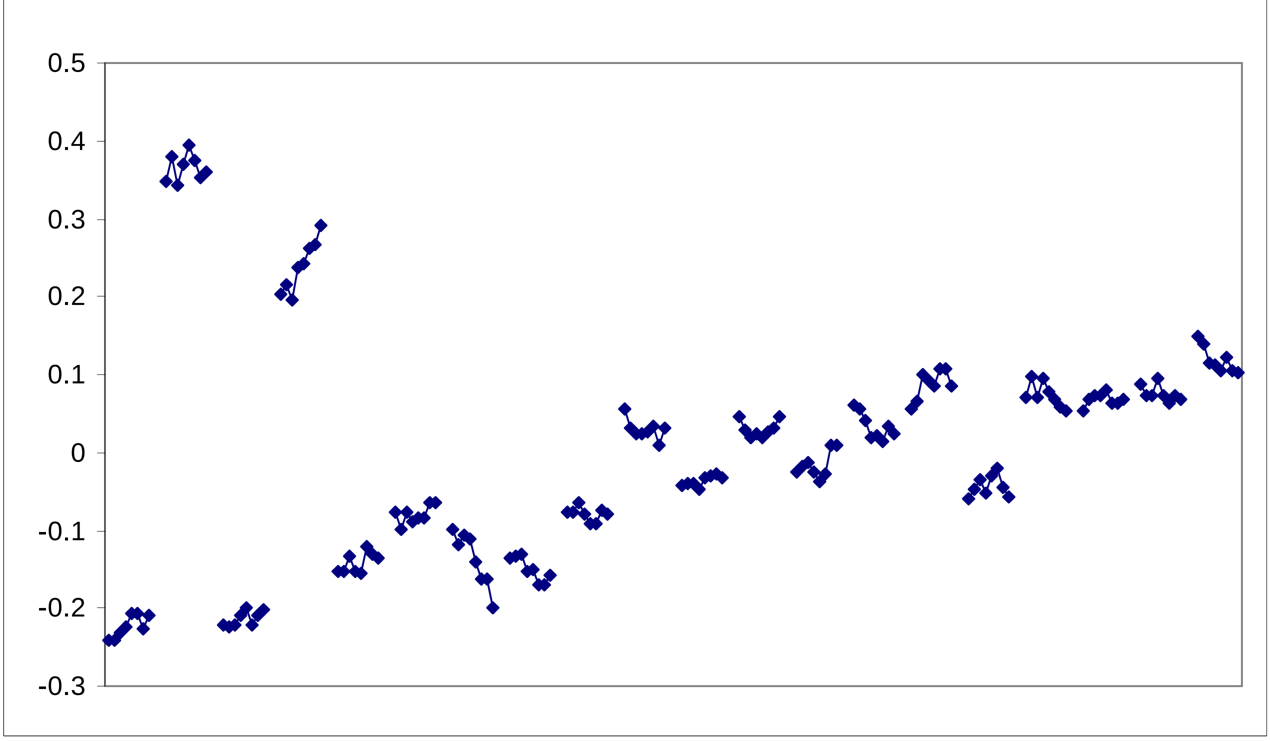

Figure 1: g residuals - all regions

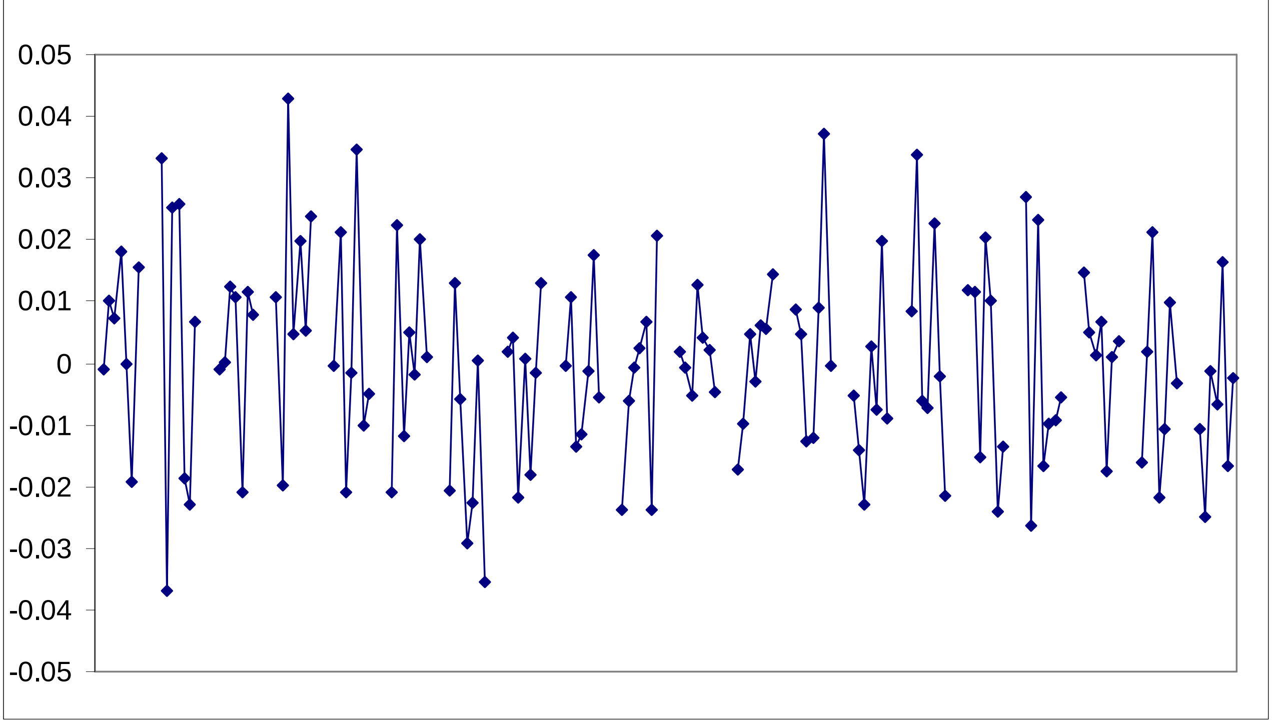

Figure 2: Δg residuals - all regions

Figure 3: Evolution of G

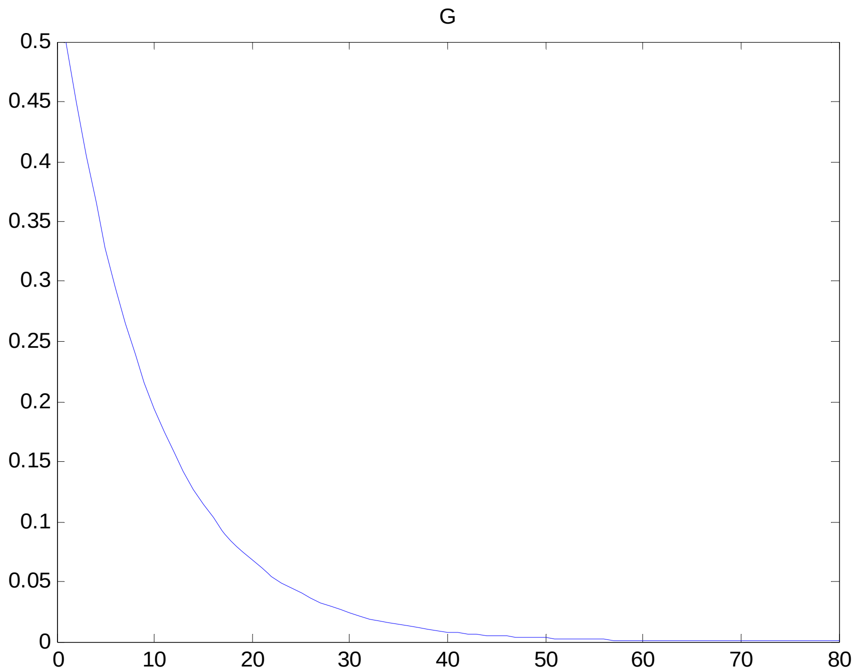

Figure 4: Model Variables

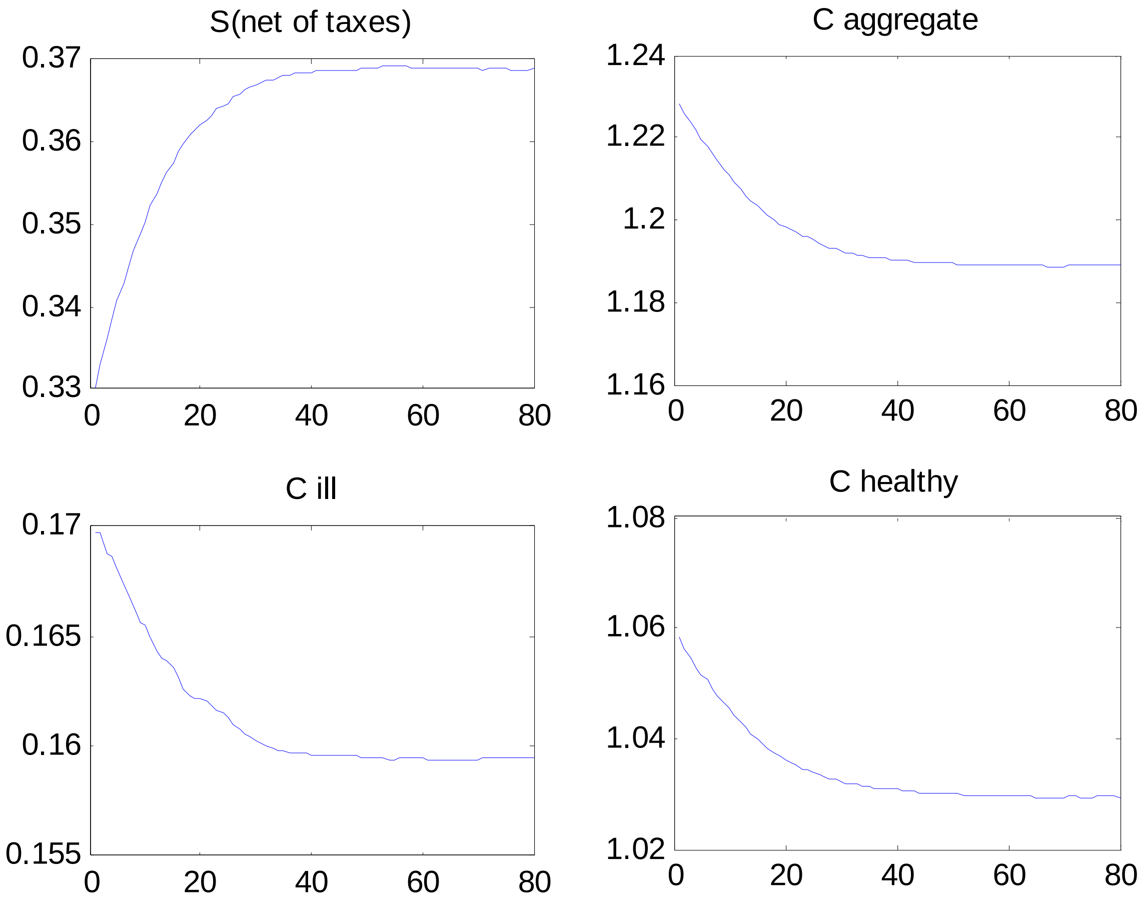

Figure 5: Model Variables

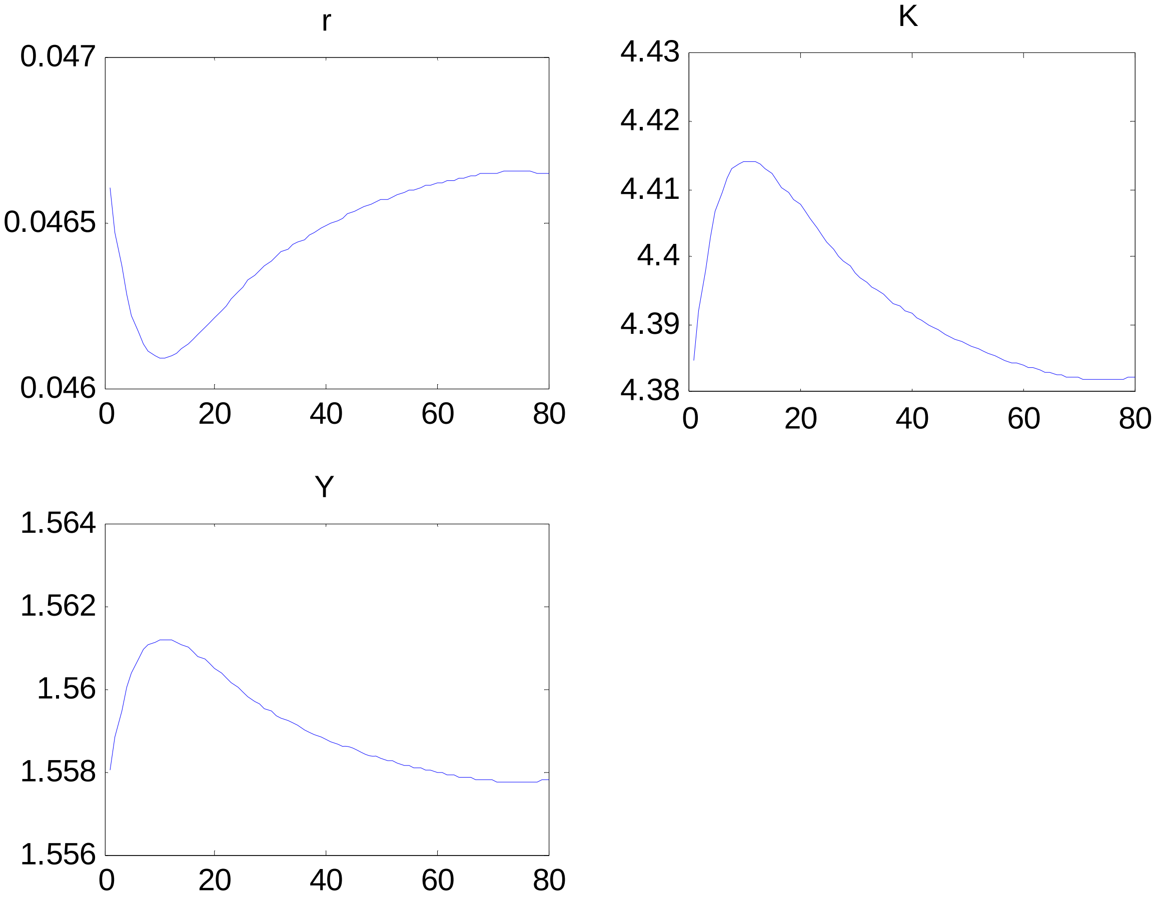

Figure 6: Model Variables (precautionary motive)