

*A Permanent Income Model of Public Consumption**

This paper tests the permanent income hypothesis (PIH) for public consumption. Unlike private agents, a government is a representative national, infinitely-lived agent that usually faces no liquidity constraints. Thus, the expectation is that the PIH restrictions should not be rejected for public consumption. However, using U.S. data, the paper is unable to find evidence supporting the permanent income model of public consumption. Public consumption is found to be sensitive to lagged public income and too smooth relative to permanent public income. The results therefore cast doubt on the characterization of the public sector as a social welfare optimizing agent.

1. Introduction

This paper tests the permanent income hypothesis (PIH) for *government* consumption, using U.S. data. Thus far, most tests of PIH have been on private consumption.¹ In a number of cases, the tests fail for private agents. Reasons often cited are that these agents face liquidity constraints, engage in precautionary saving, are non-optimizing, or other. One possibility, then, is that private consumers do not possess the characteristics required for the hypothesis to be valid. However, governments are likely to possess them: the institution of government, for example, is infinitely-lived, acts as a representative national agent, and should not be liquidity constrained (at least in developed countries), given its powers over current and future taxation. Thus the permanent income hypothesis should be less restrictive for public consumption.

This paper, therefore, develops a model in which an optimizing government chooses a stream of public consumption expenditures over time to maximize discounted social welfare, constrained only by its permanent income. As in the private consumption literature, the paper tests whether

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¹See, for example, Hall (1978), Flavin (1981), Hayashi (1987), Zeldes (1989), and Runkle (1991).

public consumption is excessively sensitive to lagged income and whether it is too smooth relative to income innovations. As Campbell-Deaton (1989) and Flavin (1993) show, “excess sensitivity” and “excess smoothness” are related phenomena (the same feature of the data can lead to both) and are evidence against the PIH.

The significance of this study is that it tests whether governments optimize (in the sense of maximizing social or private welfare) or behave *exogenously*. Most fiscal policy studies treat government expenditures as exogenous. If government behavior is to be treated endogenously, it is important to determine which model characterizes it, and whether that model is the benevolent social planner that is often (but not always) associated with the public agent.

A few attempts to test the PIH for government expenditures exist.² These studies, however, contain a number of weaknesses that are addressed in this paper. First, they do not specify the government’s objective function—whether it is the consumer’s welfare, a bureaucracy’s, or other. Hence it is difficult to know what to find in the data; for example, what pattern of government expenditures should be expected for a given type of fiscal behavior? If, implicitly, these studies assume the government cares about private welfare, private consumption should also have been treated (unless they *assume* that private and public consumption are separable in private utility). Secondly, their focus on testing whether government expenditures follow a random walk is a narrow interpretation of PIH; for example, if the real interest rate were variable or constant but not equal to the time preference rate, optimizing behavior need not result in a martingale for government spending. Other differences between this paper and theirs are that this paper nets out durables and defense from government expenditures, examines excess smoothness in addition to excess sensitivity, and uses government revenues as a measure of public sector income.³

The paper is organized as follows: Section 2 presents a simple intertemporal model of optimal public consumption choice and derives the testable implications of an optimizing government. Section 3 presents the empirical results. First, tests of specification are presented—namely, of whether private and public consumption are separable in utility. Second, the two sides of the permanent income hypothesis (PIH) debate are examined: *excess sensitivity* and *excess smoothness*. Overall, the results are not supportive of the PIH for public consumption. Section 4 concludes by discussing reasons

²See Borooh (1988) and Speight-MacDonald (1989).

³Their papers assume GDP is the measure of government income. Since only a part of it is collected as tax revenues, and not always in the same percentage (over time), GDP is an imperfect signal of government income.

why the PIH might fail for public consumption and thereby suggests extensions for further research.

2. Model

This section presents a simple model of optimal fiscal policy in an open economy. For purposes of illustration, the analysis will be in a deterministic framework. The main objective of this section is to show how public (non-transfer) spending affects private welfare and thereby describe the characteristics of optimal public spending.

For simplicity, assume no physical capital and that output is exogenous. Assume further a representative agent economy. The private intertemporal welfare function is given by

$$V = \sum_{t=0}^{\infty} \beta^t U(C_t, G_t), \quad 0 < \beta < 1, \quad (1)$$

where C denotes private goods consumption and G public goods consumption.⁴ β is the subjective discount factor.

The private agent and government are assumed to interact in “Nash” fashion; that is, each chooses its actions to maximize its welfare while taking the actions of the other as given. Accordingly, the private agent chooses a stream of consumption expenditures $\{C_t\}$ to maximize (1) subject to its budget constraint:

$$A_{t+1} = (1 + r_t)(A_t + Y_t - T_t - C_t), \quad (2)$$

taking the stream of public consumption expenditures $\{G_t\}$ as given. In (2), A denotes the stock of non-human wealth, Y income, T taxes, and r the real interest rate. The government, on the other hand, chooses a stream of public consumption expenditures, while taking $\{C_t\}$ as given, to maximize (1) subject to its budget constraint:

$$B_{t+1} = (1 + r_t)(B_t + G_t - T_t), \quad (3)$$

where B is the stock of government debt and T government revenues:

⁴ G can include expenditures on law and order, health and social services, education, recreation, environment, transportation and communication services, among other public goods and services.

$$T_t = \tau_t Y_t, \quad 0 < \tau_t < 1. \quad (4)$$

Note that the government's utility function is private welfare.

The aggregate resource constraint (or GDP identity) is obtained by summing (2) and (3):

$$Z_{t+1} = (1 + r_t)(Z_t + Y_t - C_t - G_t), \quad (5)$$

where Z is the stock of net external assets and $A = B + Z$. In a command economy, the social planner chooses $\{C_t\}$ and $\{G_t\}$ to maximize (1) subject to (5). However, for a decentralized economy, the separate decisions of the private and public agents must be characterized instead.⁵

The solution to the private agent's problem is given by

$$U_C(C_{t+1}, \bar{G}_{t+1})(1 + r_t)\beta = U_C(C_t, \bar{G}_t), \quad (6a)$$

and the solution to the government's problem by

$$U_C(\bar{C}_{t+1}, G_{t+1})(1 + r_t)\beta = U_C(\bar{C}_t, G_t). \quad (6b)$$

At the margin, neither agent can alter welfare by reducing a unit of its consumption at time t to raise its consumption by $(1 + r_t)\beta$ at $t + 1$.

For illustration, consider the following specification for $U(C_t, G_t)$, similar to that studied in Mankiw, Rotemberg and Summers (1985):

$$U(C_t, G_t) = \frac{1}{1 - \gamma} \left[\alpha \frac{C_t^{1-\sigma}}{1 - \sigma} + (1 - \alpha) \frac{G_t^{1-\sigma}}{1 - \sigma} \right]^{1-\gamma}, \quad (7)$$

where α, γ, σ are preference parameters. The distribution parameter $0 < \alpha < 1$ will influence the share of private goods consumption in total consumption. The composite intertemporal elasticity of substitution is given by $1/\gamma > 0$ and the intertemporal elasticity of substitution of either private or public consumption is given by $1/\sigma > 0$. Here an important assumption made is that both private and public consumption have the same degree of intertemporal substitution (i.e., say $\sigma_C = \sigma_G$). This leads to (a) C and G growing at the same rate (if both private and public agents are optimizing) and (b) Euler equations that are functions of stationary variables (more on this later).

From (6a, 6b), it is evident that the marginal utilities of private and public goods consumption grow at the same rate:

⁵Implementing the command solutions in a decentralized economy requires the government to have access to time and age-specific lump taxes-cum-transfers. See Calvo-Obstfeld (1988).

$$U_C(C_{t+1}, \bar{G}_{t+1})/U_C(C_t, \bar{G}_t) = U_C(\bar{C}_{t+1}, G_{t+1})/U_C(\bar{C}_t, G_t).$$

Hence using (7);

$$C_{t+1}/C_t = G_{t+1}/G_t = k_t,$$

where $k_t = [(1 + r_t)\beta]^{1/(\sigma(1-\gamma)+\gamma)}$. Thus, the usual or standard *Euler equations* are obtained if C and G are separable in the utility function (i.e., $\gamma = 0$).

The above result is conditional on both the private and public agents optimizing; that is, if the private agent does not optimize (i.e., (6a) fails while (6b) holds), neither C_{t+1}/C_t nor G_{t+1}/G_t would equal k_t , unless C and G are separable in utility, in which case G_{t+1}/G_t would equal k_t (with $\gamma = 0$). But if $\gamma \neq 0$ and (6a) fails, the government is *not* optimizing if $G_{t+1}/G_t = k_t$. Conversely, it is not failing to optimize if $G_{t+1}/G_t \neq k_t$.

Up to now, the discussion has focused on the *paths* of private and public consumption. Next, the *levels* of consumption are determined. For simplicity, assume the real interest rate r is constant; the results in the rest of this section are not affected by a variable r . Thus k is constant, and at any time $t + i$, the levels of consumption are

$$C_{t+1} = k^i C_t; \tag{8a}$$

$$G_{t+i} = k^i G_t. \tag{8b}$$

Solving (2) and (3) forward, imposing transversality conditions,⁶ and using (8a) and (8b), yields

$$C_t = \theta(A_t + H_t); \tag{9a}$$

$$G_t = \theta(-B_t + R_t); \tag{9b}$$

where $\theta = (1 - k/1 + r)$ and

$$H_t = \sum_{i=0}^{\infty} \frac{(1 - \tau_{t+i})Y_{t+i}}{(1 + r)^i}$$

is the stock of human wealth and

⁶As $\lim T \rightarrow \infty, X_{t+T}/(1 + r)^T \rightarrow 0$, for $X = \{A B\}$.

$$R_t = \sum_{i=0}^{\infty} \frac{\tau_{t+i} Y_{t+i}}{(1+r)^i}$$

the present discounted value of government revenues.⁷ The sum of (9a) and (9b) is

$$C_t/\theta + G_t/\theta = Z_t + \text{PDV}(Y_t), \tag{9c}$$

where $\text{PDV}(Y_t)$ is the presented discounted value of the stream of exogenous output (or income).

Equations (9a-c) form the basis for tests of “smoothness” of private, public, or total consumption (that is, for comparing changes in consumption (LHS) to income innovations (RHS)).

To summarize, the optimal spending plan is one that satisfies the necessary condition (6b), which describes the path of public consumption. Condition (6b) is sensitive to the value of γ ; under separability ($\gamma = 0$), (6b) is independent of private consumption. The level of public consumption, under PIH, equals the annuity value of lifetime public income (net of debt), as shown by (9b); using this property, the change in public consumption can be related to “news” about public income.

3. Empirical Analysis

Empirically, the model from the previous section predicts that government consumption should respond to new information about lifetime government income and not to past information. This section has three parts: the first deals with a specification issue and the next two with the hypothesized relationship between government consumption and income.

Consider first the stochastic version of the model. The government’s problem is now to choose $\{G_t\}$ to maximize

$$V = E_0 \sum_{t=0}^{\infty} \beta^t U(\bar{C}_t, G_t), \tag{1}$$

subject to (3), where E_0 denotes expectations conditional on information available at $t = 0$. The necessary condition becomes

$$E_0 \left[\frac{U_G(\bar{C}_{t+1}, G_{t+1})}{U_G(\bar{C}_t, G_t)} (1+r_t)\beta - 1 \right] = 0.$$

⁷It is assumed that $\theta > 0$, which requires that the discount factor satisfy $\beta < (1+r)^{-(1-\sigma)(1-\gamma)}$.

This orthogonality condition captures the key restriction imposed by the model—namely that past information (which the decision-maker should have known about) must be uncorrelated with the forecast errors of this equation. The methodology for testing this assumption is based on Hansen-Singleton (1982). The test would succeed for the intertemporally optimizing government constrained only by its permanent income and would fail if the government were liquidity constrained, rationed by other national governments, or not maximizing private welfare. It would also fail if private consumers are not following the permanent income model and C and G are non-separable in utility (more on this later).

The data here are quarterly from 1957:*i* to 1993:*iv* (except where indicated) and in real per capita 1987 dollars. Private consumption is net of durables, and government spending is net of durables and structures.⁸ Government spending is also separated between Federal and Aggregate State spending. Federal government spending either includes or excludes defense purchases. To the extent defense purchases behave exogenously, it would be useful to net them out. When defense is netted out, the sample period is 1972:*i*–1993:*iv* (due to incomplete separation of data prior to 1972). Government revenues are receipts from taxation and are net of transfer payments and of rental income (for example, income from asset sales).

As a measure of private incomes, the Blinder-Deaton (1985) procedure was followed for deriving labor income.⁹ Real spending and income data are from the *National Income and Product Accounts*. Interest rate data are from the *Federal Reserve Bulletin* and population from the *Statistical Abstract of the U.S.A.*¹⁰ The quarterly real interest rate is derived as: $(1 + r_t) = (1 + i_t)/(1 + \pi_t)$ where i_t is the quarterly nominal interest rate and π_t the quarterly inflation rate (obtained from the GDP implicit deflator).

It is necessary to begin with a test for separability because the test for excess sensitivity will be affected by whether or not the PIH restrictions hold for private consumption. If U is non-separable in C and G , and C is dependent on past information, then G will itself be sensitive to past information, as the growth of the marginal utility of G (i.e., $U_G(C_{t+1}, G_{t+1})/U_G(C_t, G_t)$) is a function of C .

⁸It is assumed that public consumption goods are non-excludable but congestible. Hence the supply of government goods is considered in per-capita terms. The empirical results are very similar if the supply is not divided by population.

⁹Personal income was split between “labor” income (wages, salaries, and other) and “capital” income. Using the percentage composition of labor vs. capital income, personal taxes were split in the same manner (since data on labor vs. capital taxes are not available). Personal disposable labor income was then obtained by deducting personal “labor income taxes” from personal labor income, adding transfers and deducting contributions to social insurance.

¹⁰Quarterly population figures are obtained by simple linear interpolation, using reported annual figures as mid-year values.

Tests of Separability

A functional form for $U(C_t, G_t)$ needs to be assumed. A tractable one is given by (7) from the previous section. Of course, other non-separable functional forms could have been specified; however, the choice is limited since many yield Euler equations that are functions of non-stationary variables, such as C and G in levels.¹¹ The first-order condition becomes

$$\left(\frac{G_t}{G_{t+1}}\right)^{\sigma(1-\gamma)+\gamma} \left[\frac{\left(\frac{C_t}{G_t}\right)^{1-\sigma} + \delta}{\left(\frac{C_{t+1}}{G_{t+1}}\right)^{1-\sigma} + \delta} \right]^\gamma (1 + r_t)\beta - 1 = \varepsilon_{t+1}, \quad (10)$$

where $E(\varepsilon_{t+1}|\Omega_t) = 0$, $\delta = (1 - \alpha)/\alpha$, and Ω_t denotes the information set at time t .

Note that under the null hypothesis of separability (i.e., $\gamma = 0$), δ cannot be estimated. Hence, δ is constrained to be 0.25. This assumes $\alpha = 80\%$, which is roughly the share of private consumption in total (private and public) consumption on average during the sample period. The conclusions below, however, were found not to be sensitive to the choice of value of α (or δ).

The parameter estimates of (10) are in Table 1 for four different measures of government purchases, corresponding to levels of government: Total, Federal, Federal excluding Defense, and (Aggregate) State. The results do not support the non-separable specification; the estimate of γ is insignificantly different from zero.¹² The remainder of this paper therefore imposes separability, and until then the discussion of the model's other parameter estimates (α and β) is deferred.

Tests of Overidentification

Given separable utility, the government can obey the Euler equation restriction even if private agents do not. This section tests whether public consumption is sensitive to past information, thereby violating the PIH. With $\gamma = 0$, (10) becomes

$$\left(\frac{G_t}{G_{t+1}}\right)^\sigma (1 + r_t)\beta - 1 = \varepsilon_{t+1}, \quad (10)$$

where $E(\varepsilon_{t+1}|\Omega_t) = 0$.

¹¹An example is where, in (7), private and public consumption have different intertemporal elasticity parameter values—i.e., $\sigma_C \neq \sigma_G$. In this case, the LHS of Equation (13) becomes a function of the levels of C and G .

¹²Campbell-Mankiw (1990) also find no evidence of non-separability of private and government consumption.

TABLE 1. *Tests of Non-Separability*

	Type of Government Purchase:			
	<i>Total</i> (1)	<i>Federal</i> (2)	<i>Federal</i> <i>Non-Defense</i> (3)	<i>State</i> (4)
β	0.988 (0.0006)	0.987 (0.0006)	0.987 (0.0008)	0.987 (0.0007)
σ	0.116 (0.051)	0.061 (0.024)	-0.005 (0.020)	-0.053 (0.085)
γ	-0.052 (0.108)	-0.026 (0.094)	-0.046 (0.131)	-0.004 (0.088)
Wald	0.234	0.078	0.126	0.0018
p	0.629	0.780	0.723	0.966

NOTES: Estimation is by Nonlinear Least Squares. Standard errors are in parentheses. Wald denotes the Wald Statistic for testing the null hypothesis that $\gamma = 0$, and p the associated p -value. The value of δ is constrained to 0.25 (see Text for discussion). All purchases and consumption are net of durables and structures.

The results and information sets are indicated in Table 2. The instruments are formed from lagged values of the real interest factor and of the ratios of government purchases and revenues. The number of overidentifying restrictions is 11 (since there are 13 instruments and 2 parameters). Note that the measure of government revenues matches the measure of government purchases by level (i.e. Total, Federal, or State). The results (estimates and standard errors) are robust to moving average errors of order one. These errors would arise if random preference shocks occur each period, due to fads, changes in fashion, or changes in the age-distribution of the underlying representative consumer; hence it would be prudent to control for them. For this reason the instruments are all lagged an additional period to ensure that they are all predetermined with respect to the error term in (10)′.

First, if the measure of spending is federal government purchases, the model *cannot* be rejected at the conventional 5% level of significance (it can be rejected, however, at the 6.3% level).¹³ The estimate of σ indicates a

¹³The model also cannot be rejected when the sample period is 1972:*i*–1993:*iv* (which is the sample period used to examine the effects of netting out defense). For this shorter period, column 1 (Table 2) results would be $\beta = 0.98$ and $\sigma = 0.73$, both of which are significantly different from zero at better than the 1% level, and the p -value for the J -Statistic would be 0.62.

TABLE 2. *Overidentification Tests*

	Federal Purchase (1)	Federal Non-Defense Purchase (2)	State Purchase (3)	Private Consumption (4)
β	0.987 (0.0007)	0.986 (0.0008)	0.988 (0.0009)	0.986 (0.0011)
σ	0.515 (0.106)	0.103 (0.049)	0.033 (0.134)	-0.41 (0.205)
J-Stat	18.9	24.2	29.4	28.9
p	0.063	0.012	0.002	0.0024

NOTES: Estimation is by Generalized Method of Moments (GMM). Heteroskedastic-consistent standard errors (robust to MA(1) errors) are in parentheses. J-Stat denotes the test statistic for testing the overidentifying restrictions, and p the associated p -value.

Instruments for:

(1): CN, $F(-i-1)/F(-i)$, $FR(-i-1)/FR(-i)$, $(1+r(-i))$, $i = 2, \dots, 5$

(2): same as (1)

(3): CN, $S(-i-1)/S(-i)$, $SR(-i-1)/SR(-i)$, $(1+r(-i))$, $i = 2, \dots, 5$

(4): CN, $C(-i-1)/C(-i)$, $LI(-i-1)/LI(-i)$, $(1+r(-i))$, $i = 2, \dots, 5$

where CN denotes the constant, F federal government purchases per capita, S state government purchases per capita, FR federal government revenue per capita, SR state government revenue per capita, C private (nondurables) consumption per capita, LI disposable labor income per capita, and r the real interest rate. All government purchases are net of durables and structures, and all government revenues are net of transfer payments.

fairly high elasticity of intertemporal substitution. Thus increases in the real interest rate would encourage the federal government to save and postpone purchases. The point estimate of β (of 0.987) implies a time preference rate of $\rho = 1.32\%$. The sample mean quarterly real interest rate is smaller, at 1.27%. Hence a declining time profile of federal purchases should be expected, which is the case during the sample period; the sample mean ratio of G_{t+1}/G_t for federal purchases is 0.96.

Recall that the above measure of federal purchases excluded durables and structures (including those of defense). But once defense purchases are fully netted out (that is, once defense nondurables and services are excluded also), the hypothesis that the instruments are all orthogonal to the disturbances can be rejected at the 1.2% level of significance. Two related possibilities can be suggested as to why the model is rejected when defense purchases are fully excluded and not rejected when they are not. One is that federal purchases (excluding defense) respond to business cycles or other shocks, while defense purchases do not. In that event, federal purchases net of defense would be sensitive to lagged income, while defense purchases need not be.

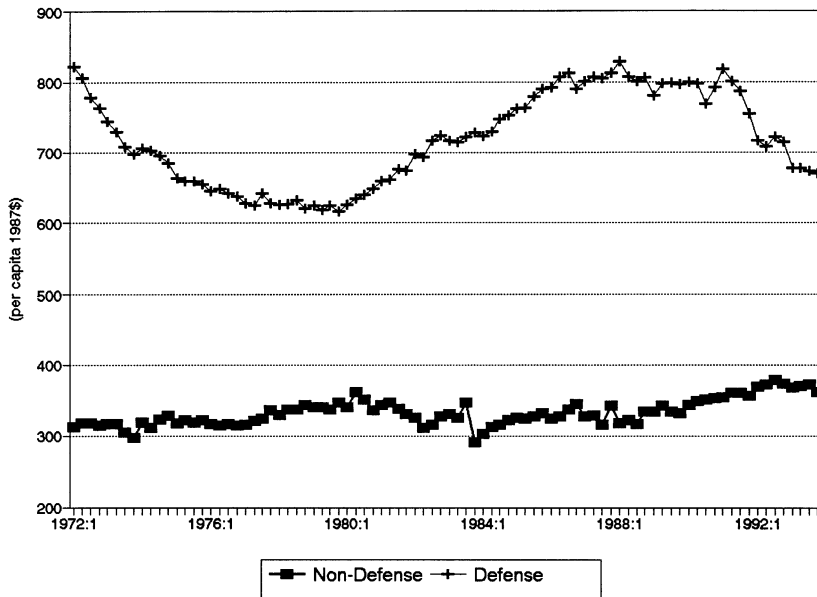


Figure 1.
Federal Purchases Net of Durables and Structures

A second possibility is that governments take a longer-run view vis-a-vis military spending needs, while deploying primarily non-defense purchases to meet short-run needs (political, economic, or other). Figure 1 shows the different pattern of spending between federal defense and non-defense purchases (both of which are net of durables and structures). Defense purchases have wider variations and generally longer intervals between turning points. The longer-run changes in spending are associated with some key events. The decrease from 1972:*i*, for example, is due largely to the ending of the Vietnam War; the build-up from 1980:*i* to 1989:*iv* is due largely to the Reagan-era policy of trying to end the Soviet “Empire”; and the decrease thereafter is due largely to the ending of the Cold War.¹⁴ Thus, as long as the federal government targets defense purchases to follow specific

¹⁴Other wars, like the Gulf War of 1991, appear as small temporary increases in defense purchases. For conflicts like that between the U.S. and Nicaragua-El Salvador during the early 1980s, the spending is not reflected in Figure 1 since the U.S. Congress did not approve its financing (hence the Iran-Contra controversy). Thus, while short run wars/conflicts do arise, movements in defense in Figure 1 are dominated by the longer term military objectives. See Kapstein (1992) for discussions of other developments.

military plans, it is likely to adapt to a longer horizon in relation to them. If so, this would contribute to the non-rejection of PIH for defense related purchases. Since defense purchases comprise a significant share of total federal purchases (at least two-thirds), they tend to influence overall federal purchase behavior.

As for aggregate State data, the PIH model is rejected. The model is likely to fail for States because State governments have relatively less control over their own resources, as compared to that which the Federal government has over federal resources. States, for example, have balanced budget requirements, face mandates from the Federal government, do not have their own Central Banks, and may experience *invisible foot* type phenomena—that is, changes in their tax bases due to taxpayers (or their incomes) moving in and out of states in response to differential state taxes.

For comparison, the same orthogonality test is carried out for private consumption. Labor income is used instead of revenues in the information set. The PIH restrictions are also rejected for private consumption. Moreover, another factor casting doubt on the model is the negative estimate of σ which implies that the private utility function is non-concave.¹⁵ This negative estimate helps explain why the estimates of σ for government consumption in Table 2 differ from those in Table 1. In Table 1, the model imposes the same σ for both private and public consumption. Thus the σ estimates in Table 1 are likely to be low positive (or near zero) values because they are averages of positive estimates for public consumption and negative estimates for private.

In summary, the overidentification tests reject the permanent income model of government consumption (except when federal purchases include defense). These findings are compatible with previous findings. Borooah (1988) also rejects the PIH, but his results are questionable because, like Flavin (1981), he detrends the income variable, which if $I(1)$ biases the results towards rejection. Speight-MacDonald (1989) generally reject the PIH but support it for the U.S. case when their instruments are lagged two periods or more (but not when the first-period lags are included). Their U.S. data, however, do not separate between the different levels of government or between defense and non-defense. Moreover, they find the first-period lag of government spending to have a strong, negative effect on changes in government spending. This is due to including durables and structures in their measure of government expenditures. Increased durables spending in one period tends to be followed by decreases in the period(s) thereafter.

¹⁵Given the sample mean interest rate of 1.27% and implied ρ of 1.42%, a negative estimate of σ for private consumption should not be surprising. Otherwise, the Euler equation with $r < \rho$ would not fit the data with private consumption growing at a positive rate.

Tests of Smoothness

This section looks at another side of the PIH debate and tests whether public consumption is “too smooth” relative to what is warranted by the permanent income model—that is, whether the standard deviation of the *actual* change in public consumption is less than the standard deviation of the *predicted* change. The same feature of the data can be responsible for both excess sensitivity to predictable changes in income and excess smoothness relative to permanent income. The intuition is that if consumption is slow to adjust to innovations in income, changes in consumption then become affected by averages of past innovations.

From the government’s intertemporal budget constraint, permanent public income is derived as the annuity value of the government’s expected net wealth. That is,

$$G_t = T_t^p = \left(\frac{r}{1+r} \right) \left[-B_t + \sum_{i=0}^{\infty} \frac{E_t T_{t+i}}{(1+r)^i} \right],$$

where in brackets on the RHS is the government’s discounted lifetime revenues net of debt (recall (9b)).¹⁶ Note that r is treated as constant. This constant rate can be interpreted to be the average value of r over the long term.¹⁷ Using (3), the first difference of G can be obtained as

$$\Delta G_t = \left(\frac{r}{1+r} \right) \sum_{i=0}^{\infty} \frac{(E_t - E_{t-1})T_{t+i}}{(1+r)^i}.$$

Next it is necessary to specify a revenue process for T . As in Campbell-Deaton (1989), T is assumed to follow an AR1 in first-differences:¹⁸ $\Delta T_t = \rho_0 + \rho_1 \Delta T_{t-1} + \mu_t$. Substituting this equation into the previous equation gives

$$\Delta G_t = \lambda \mu_t,$$

¹⁶Note an implication for *Wagner’s Law*, which posits that government goods and services are ‘luxuries’ (income elasticities exceeding unity)—see, for example, Ram (1987). Tests of the hypothesis are usually conducted with current income measures, not permanent. Under the PIH, the *permanent* income elasticity of public consumption should be unity (as long as $G = T^p$).

¹⁷The assumption of a constant r helps to keep the following analysis tractable and comparable to the excess smoothness found in the private consumption literature. Also, it is assumed the constant r equals the time preference rate; that is, $\beta = 1/(1+r)$. In that case, (9b) becomes $G_t = T_t^p$.

¹⁸Revenues were found to be difference-stationary, and no statistically significant MA terms or further AR lags could be identified.

TABLE 3. *Excess Smoothness Tests*

<i>Spending Measure:</i>	<i>Actual Change</i>	<i>Standard Deviations of:</i>	
		<i>Predicted Change</i>	
		(A)	(B)
Federal Government	28.4	83.2	83.3
Federal (Non-Defense)	43.2	88.4	88.8
State Government	8.23	22.5	22.6
Private Consumption	49.7	70.6	70.8

NOTES: Entries are in per capita 1987 dollars. Version A (B) assumes a real interest rate of 5% (10%) per annum.

<i>Estimates of Revenue/Income Processes:</i>		<i>Sample Period:</i>
Federal:	$\Delta FR = -6.43 - 0.054 \Delta FR(-1)$, SER = 88.0	1957:iii-1993:iv
	(7.31) (0.083)	
	$\Delta FR = -8.54 - 0.149 \Delta FR(-1)$, SER = 102.5	1972:iii-1993:iv
	(11.1) (0.108)	
State:	$\Delta SR = 8.97 - 0.209 \Delta SR(-1)$, SER = 27.3	1957:iii-1993:iv
	(2.33) (0.082)	
Private:	$\Delta LI = 50.59 - 0.27 \Delta LI(-1)$, SER = 89.8	1957:iii-1993:iv
	(8.08) (0.080)	

See Table 2 for variable definitions. Standard errors are in parentheses and SER denotes standard error of regression.

where μ_t is the innovation in revenues and $\lambda = (1 + r)/(1 + r - \rho_1)$. This states that the change in G should be a multiple λ of the revenue shock. Smoothness tests are conducted by comparing the standard deviation of the actual change in G with the predicted change in G given by the RHS of (11).

There is of course a problem with testing for smoothness. A crucial assumption is that revenues, T , be treated exogenously by the government. Otherwise, if T can be chosen by the government, it does not make sense to speak of “innovations” in income. Now, while tax rates τ are chosen or set by the government, the tax base is not, namely output. Thus $T (= \tau Y)$ is treated exogenously in so far as output, Y , is treated exogenously by the government. This is not inconsistent with the idea or observation that governments often make projections of their future revenues, for this is the kind of forward-looking behavior the theory describes. The issue is how sensitive their consumption is to “exogenous” shocks to their permanent revenue.

The results are in Table 3, along with estimates of the revenue/income processes. The standard errors of the regressions (S.E.R.) give the values of μ , the revenue/income shocks. The real interest rate is either 5% or 10% per annum for purposes of computing the value of λ in (11). Since only a

subset of total consumption is used, due to the netting out of durables and structures (or defense, as the case may be), the standard deviations of actual changes are scaled up by the inverse of the mean fraction of actual consumption to total.¹⁹

As found in the private consumption literature, the standard deviation of actual changes in government purchases falls short of that of changes in permanent revenues. In the case of both state and federal governments, the standard deviation of actual changes is about a third of the predicted standard deviation; in the case where federal defense purchases are netted out, the standard deviation of actual changes is half the predicted. These findings are not sensitive to assumptions about the value of the real interest rate.

For comparison, private consumption is also tested for excess smoothness. The standard deviation of actual changes in private consumption is about 60% of the predicted.²⁰ Thus government purchases exhibit greater “excess smoothness” than does private consumption. The smoothness puzzle is thus even more acute for the government which should have better information about its permanent income and the capacity to match spending in line with it.

4. Conclusions

This paper developed a normative model of optimal public consumption and tested whether the model is a positive description of U.S. fiscal spending behavior. The results do not support the idea of a rational, forward-looking government that maximizes the representative consumer’s (discounted) welfare subject to the government’s permanent income constraint. The results, of course, do not indicate whether the reason is that the government is unable to consume out of permanent income or that the government has a different objective function. Either way, this social planner-like paradigm, as specified, is rejected; it does not describe how U.S. fiscal authorities actually behave.

¹⁹The mean fraction of federal purchases (net of durables and structures) to total federal purchases is 0.76; of federal purchases (net of defense also) to total is 0.25; of state purchases (net of durables and structures) to total state purchases is 0.77; and of private consumption (net of durables) to total private consumption is 0.88.

²⁰Note that the sample period and estimates of the labor income process are different from those in previous tests (in particular, changes in labor incomes here are negatively autocorrelated). This would explain why the predicted standard deviation of private consumption is smaller (in common real terms) than, for example, in Campbell-Deaton (1989). Yet, the relative magnitude of volatility of private consumption here is consistent with previous findings. In Campbell-Deaton (1989), the standard deviation of actual changes is also about 60% of the predicted, and in Flavin (1993) it is about 53%. Patterson (1995), using a VAR model, obtains somewhat higher percentages for the United Kingdom.

Future work could explore in more detail the precise reason(s) for the failure of the PIH for public consumption. For example, governments may not be able to consume their permanent income because, although they are technically or legally not liquidity constrained, existing institutions (such as the system of elections and budgetary rules and restrictions) might induce short-term public consumption behavior. Other institutional features, like the progressivity of the tax system, might in part explain why federal spending is smoother than tax revenues. Furthermore, government objectives may be less utilitarian. They may in practice be more concerned with the welfare of certain special interest groups or with stabilizing business cycles (which could explain why government spending is sensitive to past income). It is also not clear that maximizing the representative agent's welfare is the right (normative) model for evaluating fiscal policies, as it ignores income distribution which governments do presumably care about.

Finally, future work could also address some methodological issues. Tests of smoothness, for example, are sensitive to the order of integration of the revenue process,²¹ and tests of orthogonality are sensitive to time aggregation (especially if the PIH holds in continuous time).²² It would be interesting to know if the optimizing government-cum-Representative Agent model survives these modifications.

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²¹Diebold-Rudebusch (1991), for instance, show that under fractional integration (e.g., when the order of integration is between 1/2 and 1), permanent income is not as noisy as believed.

²²See Christiano, Eichenbaum and Marshall (1991).

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