The Impact of Fiscal Policy and Inflation on National Saving: A Comment*

1. Introduction

The increasing concern about the sustainability of current fiscal policies in Italy has led, in recent years, to a number of attempts to assess the empirical content of Barro's (1974) debt neutrality proposition (known also as Ricardian Equivalence Proposition) stating that deficit financing and taxation produce the same intertemporal allocation of consumption.

In particular, Modigliani, Jappelli and Pagano (1985) and Modigliani and Jappelli (1987) (respectively MJP and MJ, hereafter) have thouroughly explored the behavior of private and national saving in Italy since 1860 and concluded that consumption functions estimated for Italy appear to reject convincingly the Ricardian Equivalence Proposition. Focusing on the postwar period, MJP (p. 120) find that "government debt has a substantial wealth effect, and that government deficits matter, in that they reduce national saving almost one for one". On the opposite front, Onofri (1987) and Nicoletti (1988), focusing on the most recent period, have provided a substantial amount of empirical evidence supporting the hypothesis that government debt has no impact at all on private consumption and that government deficits are, sooner or later, exactly offset by increased private savings.

The existence of mixed (if not contradictory) evidence on a macroeconomic hypothesis of central importance is far from being a novelty and should not be regarded as surprising. However, what is striking in the present case is that the amount and quality of information behind all the available evidence is, to a very large extent, the same.[1] Of course,

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[1] Modigliani, Jappelli and Pagano (1985) consider annual data over the period 1952-1982. Modigliani and Jappelli (1987) extend the previous data set back to 1862 with the only exception of government debt for which a slightly different series is used up to 1982.

contradictory results based on (approximately) the same evidence would cast very serious doubts on the underlying econometric methodology, over and above other (and more fundamental) doubts which are currently being raised.

Focusing on the postwar Italian experience, and thereby concentrating on the MJP's paper, this note will show that, fortunately, this is not the case since not the methodology should be blamed but its careless use. Infact, what appears as contradictory evidence is, to a large extent, the result of an incorrect treatment of dynamics by MJP (as well as by MJ). If use is made of the appropriate estimation and testing strategy, then all the available evidence turns out to support, by and large, the Ricardian Equivalence Proposition.

I would like to stress, though, that, in my opinion, this result should not at all be taken as a straightforward endorsement of the "ultrarationality" hypothesis. It is being increasingly recognized that the informational content of aggregate data is far below what is needed to discriminate among competing hypotheses about individual behavior.

In this respect, the conclusions of the present paper should be simply regarded as a warning against the danger of testing micro-hypotheses and consequently deriving policy prescriptions on the ground of an incorrect application of econometric tools to (rather uninformative) aggregate data.

2. The reference framework

Drawing on the work by Modigliani and Sterling (1986), MJP's analysis relies on the following simple specification of the consumption function which is intended to describe the salient features of the private sector behavior and which nests, as special cases, a number of competing hypotheses:[2]

$$C_p = \alpha_1 Y_d + \alpha_2 W + \alpha_3 DEF + \alpha_4 D \tag{1}$$

NICOLETTI's (1988) work covers eight OECD countries (among which Italy) and exploits annual information over the period 1961-1985. ONOFRI (1987) uses, instead, quarterly data over the period 1970 (first quarter) - 1984 (fourth quarter). Therefore, all these works largely focus on the recent Italian experience and basically draw on the same homogeneous set of National Accounts. Of course, some differences can be found in the definition of consumption and in the estimation of private wealth. However, the real difference among the four works cited undoubtedly lies (i) in the treatment of dynamic which is confined into the error term by Modigliani, Jappelli and Pagano and by Modigliani and Jappelli, while it is explicitly modelled by Nicoletti and Onofri, and (ii) in the selection of the functional form (linear in Modigliani, Jappelli and Pagano's and Modigliani and Jappelli's case, non linear in Onofri's and Nicoletti's case).

[2] Following MJP's own opinion (p. 113), the analysis focuses here on MJP's basic model disregarding their work on the effect of real interest payments on consumption and on inflation illusion. It should be underlined, though, that the substance of the argument would remain unaffected by those extensions.

where C_p is private sector consumption expenditure, Y_d is disposable income including *ex post* real interest payments (rD) on public debt, thereby subtracting the inflation loss (pD) and taxes (T) from the sum of net national product (NNP) and nominal interest payments (RD). W is beginning of period wealth of the private sector including government debt. D is beginning of period government debt net of the holdings of the central bank and of the foreign sector, DEF is the inflation adjusted government deficit. Finally, the α_i's are aggregate parameters depending on the age structure of the population, on the length of the planning horizon and on the personal discount and interest rates.

The consumption function (1) can be derived under the following assumptions: (a) a standard formulation of the life cycle hypothesis of saving, (b) static expectations about future income flows and taxes, (c) absence of inflation illusion, (d) absence of any adjustment process.

Under the Ricardian Equivalence Proposition, $\alpha_3 = -\alpha_1$, and $\alpha_4 = -\alpha_2$, and equation (1) reduces to:

$$\begin{aligned} C_p &= \alpha_1 (Y_d - DEF) + \alpha_2 (W - D) \\ &= \alpha_1 (NNP - C_g) + \alpha_2 (W - D) \end{aligned} \tag{2}$$

since $(Y_d - DEF) = (NNP + rD - T) - (C_g + rD - T)$.

Equation (2) clarifies that, under the "ultrarational" view, the relevant income variable is given by net national product minus government consumption (C_g) since the intertemporal budget constraint faced by private agents is defined by total physical output of the economy net of the resources used up by the government, irrespective of whether the government is using debt or taxes to finance the purchase of these resources.[3]

Finally, notice that both (1) and (2) impose the constraint that the coefficients of taxes and government expenditure, if considered separately, should equal the negative of the coefficient on income. In other words, "the loss of one unit of private resources to the government, whether perceived through tax payments or through government acquisitions of those resources, must reduce consumption by as much as the loss of one unit of income" (MJP, p. 100).

Estimation of the parameters of equation (1) by Ordinary Least Squares on yearly (1952-1982) data, with the addition of a constant term (α_0, say) yields:[4]

[3] MJP control also for the likely mismeasurement of government consumption (C_g) and deadweight debt in the available official statistics by means of an additional variable (ΔD - DEF) whose contribution in equation (1) turns out to be invariably negligible. Therefore, in what follows we shall assume, as MJP do in most of their paper, that "true" government consumption coincides with measured current account government expenditure.

[4] Estimation of the following equations (3) and (4) is based on MJP's original data set as reported in Table 5 (p. 124) and on their subsequent "errata corrige" (MODIGLIANI, JAPPELLI and PAGANO 1986). Notwithstanding unavoidable rounding errors, they reproduce quite

$$C_p = \underset{(3.84)}{0.025} + \underset{(32.72)}{0.637}\ Y_d + \underset{(7.31)}{0.040}\ W - \underset{(1.86)}{0.190}\ DEF + \underset{(0.44)}{0.018}\ D$$

$$DW = 0.912 \qquad \hat{\sigma} = 0.0100 \qquad F(2, 26) = 10.696 \qquad (3)$$

where t-statistics are in parentheses, and F (2, 26) is, under the null, an F-distributed test statistics jointly testing the two restrictions leading from equation (1) to equation (2). All variables are deflated and normalized by the population.

MJP note (p. 107) that "the serial correlation of the error of equation (3), *evidenced by a somewhat low DW statistic*, does not seriously affect the values and significance of the estimated coefficients" (*italics added*), therefore they feel safe in collapsing the whole dynamic structure of equation (3) into an autocorrelated error term, obtaining:

$$C_p = \underset{(2.98)}{0.035} + \underset{(17.75)}{0.596}\ Y_d + \underset{(7.49)}{0.047}\ W - \underset{(3.18)}{0.238}\ DEF + \underset{(0.48)}{0.024}\ D$$

$$\hat{\rho} = \underset{(4.66)}{0.656} \qquad \hat{\sigma} = 0.0081 \qquad F(2, 26) = 14.993 \qquad (4)$$

where F(2, 26) is now an F-type approximate test statistic testing, again, the validity of the two restrictions implied by the debt neutrality proposition.

Quite clearly, under the null hypothesis of correct specification, contrary to the Ricardian Equivalence Proposition, the coefficient of the deadweight deficit (α_3) is significantly different (in absolute value) from that of disposable income (α_1). Therefore, MJP conclude that: "results soundly reject the Ricardian Equivalence Proposition while being consistent with the Life Cycle Hypothesis" (p. 108). In addition, they point out that the constraint on the components of government deficit is not tenable. MJP admit that "it is impossible to attribute economic meaning to the rejection of this constraint and ... conjecture that the failure of this constraint is likely to reflect measurement errors and the possible omission of some important variable (including lags)" (p. 113). Nevertheless, they conclude that the results "provide, at the moment, the most reliable description of consumption behavior of the Italian economy and of the impact of fiscal variables on said behavior" (p. 113) and go on using those results "to help throw light on the causes of the extraordinary variation in national saving over the last thirty years" (p. 113).

accurately (up to the second digit) MJP's evidence as provided in Table 1 (p. 108) of their paper. Estimation was carried out by means of PC-TSP Version 4.1B. Notice that MJP would tend to regard a restricted version of the following equation (4) (with $\alpha_4 = 0$) as "the most reliable description of forces impinging on consumption" (p. 109). Differences between the two estimates are, however, absolutely minor. For additional details see MJP, section 5.

3. Modelling sample dependence[5]

A quarter of a century after Sargan's (1964) classic paper on econometric methodology and ten years after Hendry and Mizon's (1978) application to the demand for money in the U.K., most published research still regards the Durbin-Watson statistics as a test related to an AR(1) error autocorrelation and not as a general first-order dependence test. As the previous section has shown, MJP are no exception. In the context of this modelling strategy, whenever the null hypothesis of no autocorrelation is rejected, dynamics is entirely relegated to the error terms, instead of respecifying the model to account for sample dependence.

The "autocorrelation approach", however, is a valid one only if specific parametric restriction on the underlying general dynamic model (known as "common factor restrictions") are satisfied. If not, the invalid modelling of sample dependence in terms of the error term generally leads to inconsistent parameter estimates as well as invalid inference.

A correct use of the Durbin-Watson statistics (and indeed of any misspecification test) would instead call for a respecification of the model in the light of a departure from the underlying assumptions. In short, in the case of temporal dependence, this basically implies specifying and estimating a general m-th order dynamic model against which restricted dynamic specification can be then tested, one of them being the autoregressive error model.

For the sake of the argument, let us therefore consider a general first order dynamic version of (1), including a constant term (α_0) and an error term (u_t):[6]

$$C_{p,t} = \alpha_0 + \alpha_1 Y_{d,t} + \alpha_2 W_t + \alpha_3 DEF_t + \alpha_4 D_t + \beta_0 C_{p,t-1} + \\ + \beta_1 Y_{d,t-1} + \beta_2 W_{t-1} + \beta_3 DEF_{t-1} + \beta_4 D_{t-1} + u_t \qquad (5)$$

Under the restriction $\beta_i = -\beta_0\alpha_i$ (i= 1, ..., 4), equation (5) reduces to equation (1) with an autoregressive error term with autoregressive coefficient given by β_0.

Estimation of the general first order dynamic model as well as of the restricted version of it with the four (non-linear) common factor restrictions imposed provides the basis for a standard likelihood ratio tests, $\Psi(r)$,

[5] The topics briefly touched upon in this Section are discussed at length in most recent econometric textbooks. See among others HARVEY (1981), SPANOS (1986) and references therein. See in particular HENDRY, PAGAN and SARGAN (1984).

[6] Lack of degrees of freedom did not permit the estimation of a more general dynamic model.

distributed as a $\chi^2(r)$ under the null.[7] In the present case, $\Psi(4) = 29.944$ and the autoregressive error model is soundly rejected.[8]

If, instead, the "respecification approach" is thoroughly followed, it is easy to reach the conclusion that, among the many possible restricted version of equation (5), only the "good old" partial adjustment seems to imply restrictions which appear to be consistent with the data (*i.e.*, $\beta_i = 0$; i = 1,..., 4).[9] In this case, an F-type approximate tests yields $F(4, 20) = 1.176$ and the estimated parameter are as follows:

$$
\begin{aligned}
C_{p,t} = \underset{(0.37)}{0.002} + \underset{(7.89)}{0.342}\, Y_{d,t} - \underset{(0.004)}{0.0002}\, W_t - \underset{(5.83)}{0.355}\, DEF_t + \\
+ \underset{(2.76)}{0.066}\, D_t + \underset{(7.24)}{0.563}\, C_{p,t-1}
\end{aligned}
$$

$$
\begin{array}{lll}
\hat{\sigma} = 0.0055 & \tau_n(2) = 3.265 & F_l(3, 21) = 5.388 \\
F_w(5, 24) = 0.259 & F_b(5, 24) = 0.318 & F_e(4, 21) = 2.215 \\
F_c(2, 22) = 1.514 & F_c(7, 17) = 0.582 & F_g(1, 20) = 0.345 \\
F_g(2, 19) = 2.716 & F_g(4, 17) = 2.371 & F(2, 24) = 4.963
\end{array} \qquad (6)
$$

where $\tau_n(.)$ and $F_j(., .)$ are all misspecification tests assessing the validity of the assumptions underlying equation (6).[10] In particular $\tau_n(2)$, due to Bera and Jarque, tests for the normality of the error term and is $\chi^2(2)$-distributed under the null. $F_l(3, 21)$ is an F-distributed (with r and T-k degrees of freedom) small sample counterpart of a RESET type statistic testing for linearity. $F_w(5, 24)$, $F_b(5, 24)$ and $F_e(4, 21)$ are small sample counterpart of White's, Breusch and Pagan's, and Engle's tests for conditional heteroskedasticity and autoregressive conditional heteroskedasticity, respectively. $F_c(2, 22)$ and $F_c(7, 17)$ are Chow-tests for parameter structural invariance over the period 1981-1982 and 1976-1982, respectively. Finally $F_g(p, T\text{-}k)$ is

[7] Estimation of the general first order dynamic model over the shortened 1953-1982 period yields:

$$
\begin{aligned}
C_{p,t} = & - \underset{(0.36)}{0.002} + \underset{(5.61)}{0.349}\, Y_{d,t} + \underset{(0.89)}{0.009}\, W_t - \underset{(4.45)}{0.385}\, DEF_t + \underset{(1.81)}{0.101}\, D_t + \\
& - \underset{(1.34)}{0.137}\, Y_{d,t-1} - \underset{(1.67)}{0.015}\, W_{t-1} + \underset{(0.81)}{0.066}\, DEF_{t-1} - \underset{(0.68)}{0.049}\, D_{t-1} + \\
& + \underset{(5.50)}{0.757}\, C_{p,t-1}
\end{aligned}
$$

$\hat{\sigma} = 0.0055.$

[8] Of course, a degrees of freedom correction does not help much in this case.

[9] Interestingly, among the other rejected models we find HALL's (1978) "first order autoregressive" with $F(8, 20) = 25.578$.

[10] Exact references for these statistics can be found in SPANOS (1986).

a small sample version of Godfrey's test for residual autocorrelation up to the p-th order. With the (after all unsurprising) exception of the RESET test for linearity, these tests indicate no misspecification at a significance level of 0.05.[11]

As far as the estimated parameters are concerned, a number of points can be made. First, the constant term whose significance could hardly be explained in the MJP framework is now entirely negligible. Second, the long run marginal propensity to consume out of (labour and property) disposable income equals 0.783 in the long run, entailing a long run income elasticity very much near unity. Third, in accordance with the debt neutrality proposition, the coefficient of government deficit is negative and very close, in absolute value, to the coefficient of disposable income. Fourth, the value taken by the coefficients of private wealth and government debt conflict with both the debt neutrality proposition and the standard life-cycle model. This, again, is not entirely unsurprising given that disposable income includes property income.

Under the null hypothesis of correct specification, $F(2, 24)$ tests for the restrictions implied by ultrarationality. They appear to be rejected at the 5 percent significance level but not at the 1 percent significance level. The same result obtains if, in view of the definition of disposable income, the restrictions $\alpha_2 = \alpha_4 = 0$ and $\alpha_2 = -\alpha_1$ are jointly imposed, since $F(3, 24) = 4.344$. In other words, the empirical evidence appears to suggest that, if anything, a very old fashion backward-looking permanent income story incorporating the "ultrarationality" hypothesis could provide an adequate representation of the data.

4. Concluding remarks

As this note has tried to show, what MJP regard as "the most reliable description of consumption behavior of the Italian economy and of the impact of fiscal variables on said behavior" (p. 113) is, in fact, a seriously misspecified regression whose implications are bound to be misleading. If a correct estimation strategy is followed, MJP's evidence supports, if anything, the debt neutrality proposition.[12]

[11] Instrumental variable estimation of equation (6) hardly changes the results yielding, in particular, $\alpha_1 = 0.343$ (5.532) and $\alpha_3 = -0.330$ (3.708). Instruments used are $Y_{d,t-1}$, DEF_{t-1}, W_t, D_t, W_{t-1}, D_{t-1} and C_{t-1}. Their validity has been assessed by means of Sargan's test of overidentifying restrictions, asymptotically distributed as a $\chi^2(r)$. In the present case ($r = 2$) the test statistic takes a value of 5.393 and the null hypothesis of validity of instruments cannot be rejected.

[12] Notice that the existence of liquidity constraints (as documented, for Italy, in JAPPELLI and PAGANO (1988) is not inconsistent with Barro's dynastic model. See HAYASHI (1985).

Once more, it should be underlined, however, that the purpose of this note was *not* to present an alternative view of what has driven Italian national saving since 1951 but, more modestly, to underline the danger of testing hypotheses about individual economic behavior on aggregate data inappropriately using the econometric methodology.

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REFERENCES

Hall Robert E., "Stochastic Implications of the Life Cycle - Permanent Income Hypothesis", *Journal of Political Economy*, Vol. 86 (1978), 971-987.

Hayashi F., "Tests for Liquidity Constraints: A Critical Survey", Working Paper no. 1720 (Cambridge: NBER, 1985).

Harvey A.C., *The Econometric Analysis of Time Series* (Oxford: Philip Allan, 1981).

Hendry D.F. and G. Mizon, "Serial Correlation as a Convenient Simplification not a Nuisance: A Comment on the Study of the Demand for Money by the Bank of England", *Economic Journal*, 88 (1978), 549-563.

Hendry D.F., A. Pagan and J.D. Sargan, "Dynamic Specification", in Z. Griliches and M.D. Intriligator, *Handbook of Econometrics*, Vol. II (Amsterdam: North Holland, 1984), 1023-1100.

Jappelli T. and M. Pagano, "Liquidity Constrained Households in an Italian Cross-section", Discussion Paper no. 257 (London: CEPR, 1988).

Modigliani F. and T. Jappelli, "Fiscal Policy and Saving in Italy since 1860", in M. Boskin, J.S. Flemming and S. Gorini (eds.), *Private Saving and Public Debt* (Oxford: Basil Blackwell, 1987), 126-170.

Modigliani F., T. Jappelli and M. Pagano, "The Impact of Fiscal Policy and Inflation on National Saving: the Italian Case", in this *Review* (1985), 91-126.

Modigliani F., T. Jappelli and M. Pagano, "Errata Corrige", in this *Review* (1986), 129.

Modigliani F. and A. Sterling, "Government Debt, Government Spending and Private Sector Behavior: Comment", *American Economic Review*, 76 (1986), 1168-1179.

Nicoletti G., "Private Consumption, Inflation and Deficit Financing in Eight OECD Countries: 1961-1985", *OECD Economic Papers* (1988).

Onofri P., "Analisi empirica delle relazioni fra consumo e debito pubblico in Italia (1970-1984)", in C. Santini e B. Sitzia (a cura di), *Ricerche quantitative e basi statistiche per la politica economica* (Roma: Banca d'Italia, 1987), 1011-1036.

Sargan J.D., "Wages and Prices in the UK: A Study in Econometric Methodology", in P.E. Hart, G. Mills and J.K. Whitaker (eds.), *Econometric Analysis for National Economic Planning* (London: Butterworths, 1964).

Spanos A., *Statistical Foundations of Econometric Modelling* (Cambridge: Cambridge University Press, 1986).