Referee Report on

Unexpected Consequences of Ricardian Expectations

I

This is the revised and considerably extended (18 versus 8 pages) version of a paper entitled "A Case Where Barro Expectations Are Not Rational".

The paper is about Ricardian equivalence, which states

- that given the time path of government spending on goods,
- the time path of government borrowing and taxation does not influence the equilibrium allocation of the economy.

However, to me it is not clear

- whether the paper wants to disprove this result
- or wants to point out that Barro's (1989) intuitive explanation of the result is unconvincing.

The paper provides a lengthy quote from Barro's (1989) survey of the Ricardian proposition and concludes that Barro's argument relies on assuming that economic agents believe a change in the time path of government borrowing would not alter the present value of their disposable income. A simple example invalidates this assumption: Assume that income from wages and private equity is X_t so that disposable income Y_t is given by

$$Y_t = X_t - T_t + rD_t, \tag{Y}$$

where T_t are taxes and rD_t are interest payments on government debt D_t. Suppose that the government maintains a deficit of size $D_{t+1} - D_t = \alpha G_t$, $\alpha \in (0,1)$, where G_t is government spending on goods. In this case, the government's budget constraint

$$D_{t+1} - D_t = rD_t + G_t - T_t$$

implies

$$T_t = (1-\alpha)G_t + rD_t$$

so that (Y) yields

$$Y_t = X_t - (1-\alpha)G_t > X_t - G_t.$$

The last term on the right-hand side is the household's disposable income in the case of pure tax financing, $T_t = G_t$ and $D_t = 0$. On the balanced growth path, all variables grow at the same rate $g > r$ so that the present value of disposable income is higher with debt than with pure tax financing, disproving the household's assumption.

II

Does this establish the case against Ricardian equivalence? Definitely not! The argument just demonstrates that intuition may lead us astray and is no substitute for a formal proof. These proofs exist (see, e.g., Blanchard and Fischer, 1989, p. 56) and I provided one in my report on the first version of the present paper. The proof rests on showing that the intertemporal budget constraints of the household and the government imply the same set of opportunities irrespective of the time path of government debt. In his reply to my comment, the author argued,

> *So the problem relates to interpreting equation (5r) as a budget constraint describing the choice set of the household sector. Strictly speaking it is not a budget constraint, but rather a result obtained from combining the households' budget constraint and the government's budget constraint.*

Let me remind us that the allocation achieved by the Ramsey model can be attained in two ways: by a sequence economy with the budget constraints (1) and (3) (referring to the equation numbers in my first report) and by time zero trading, in which case the intertemporal budget constraints (2) and (4) apply (see, e.g., Ljungqvist and Sargent, 2004, Chapter 12). Therefore, my equation (5) is a valid description of the restrictions placed on any feasible allocation.

The problem with the author's argument is that he just considers the right-hand side of the household's budget constraint, i.e, the definition of disposable income. In a Solow type of model this would be correct, since the left-hand side (consumption plus investment) is obtained from splitting up disposable income by a rule of thumb. Yet, in the Ramsey model with forward looking households, both sides of the budget equation must be considered.

In order to make this very obvious, let's take a simple example with an analytic solution of the household's choice problem. Assume output Y_t at time t is produced from labor N_t and physical capital K_t according to

$$Y_t = AN_t^{1-\gamma} K_t^{\gamma} \bar{K}_t^{1-\gamma}, \quad \gamma \in (0,1), A > 0, \tag{1}$$

where $\bar{K}_t$ is the aggregate capital stock. In the equilibrium of the factor markets (where $\bar{K}_t = K_t$) wages w_t and the rental rate of capital r_t are determined from

$$w_t = (1-\gamma)\frac{Y_t}{N_t}, \tag{2a}$$

$$r_t = \gamma A N_t^{1-\gamma}. \tag{2b}$$

The household solves

$$\max \sum_{s=0}^{\infty} \beta^s \ln C_{t+s}, \quad \beta \in (0,1)$$

subject to

$$K_{t+1} - K_t + D_{t+1} - D_t \leq w_t N_t + (r_t - \delta)(K_t + D_t) - T_t - C_t, \tag{3a}$$

$$N_t \leq 1. \tag{3b}$$

The first-order conditions imply

$$C_{t+1} = C_t \beta (1 - \delta + r_{t+1}), \tag{4a}$$

$$N_t = 1 \tag{4b}$$

Thus, from (2b), $r_t = r \equiv \gamma A$ and $1 + g = C_{t+1}/C_t = \beta(1-\delta+\gamma A) < 1 + \gamma A = 1 + r$. By using (4a) and the household's intertemporal budget constraint (where $A_t \equiv K_t + D_t$)),

$$0 = A_t + H_t - \sum_{s=0}^{\infty} \frac{C_{t+s}}{(1-\delta+r)^s}, \quad H_t = \sum_{s=0}^{\infty} \frac{w_{t+s}N_{t+s} - T_{t+s}}{(1-\delta+r)^s},$$

it can be shown that consumption at time t equals

$$C_t = \theta[A_t + H_t], \quad \theta \equiv \frac{(1+r)(1-\beta) + \beta\delta}{1+r}.$$

Consider the two cases from the paper:

i. $G_{t+s} = T_{t+s}$ for all $s = 0, 1, \ldots,$

ii. $D_{t+s+1} - D_{t+s} = \alpha G_{t+s} \Rightarrow T_{t+s} = (1-\alpha)G_{t+s} + (r-\delta)D_{t+s}, D_t = 0.$

Obviously, in case i. the present value of net wage income equals

$$H_t = \sum_{s=0}^{\infty} \frac{w_{t+s}N_{t+s} - G_{t+s}}{(1-\delta+r)^s}. \tag{5}$$

In case ii., the intertemporal budget constraint of the government requires (since $D_t = 0$)

$$\sum_{s=0}^{\infty} \frac{(1-\alpha)G_{t+s} + (r-\delta)D_{t+s}}{(1-\delta+r)^s} = \sum_{s=0}^{\infty} \frac{G_{t+s}}{(1-\delta+r)^s},$$

implying

$$\sum_{s=0}^{\infty} \frac{\alpha G_{t+s}}{(1-\delta+r)^s} = \sum_{s=0}^{\infty} \frac{(r-\delta)D_{t+s}}{(1-\delta+r)^s}$$

so that

$$\sum_{s=0}^{\infty} \frac{T_{t+s}}{(1-\delta+r)^s} = \sum_{s=0}^{\infty} \frac{(1-\alpha)G_{t+s}+(r-\delta)D_{t+s}}{(1-\delta+r)^s} = \sum_{s=0}^{\infty} \frac{G_{t+s}}{(1-\delta+r)^s}.$$

As a consequence, H_t, is still given by (5), and consumption is unchanged by this switch in government policy.

III

Concluding, the revised paper perhaps highlights the pitfall of intuitiv reasoning in proving economic theorems, yet it has not disproved the Ricardian equivalence theorem.

References (not cited in the paper)

Blanchard, Oliver and Stanley Fischer. 1989. Lectures on Macroeconomics. The MIT Press. Cambridge, MA and London.

Ljungqvist, Lars and Thomas J. Sargent. 2004. Recursive Macroeconomic Theory. Second Edition. MIT Press: Cambridge, MA, London.