ON THE DEGREE OF DEBT NEUTRALITY:
SOME EVIDENCE FOR
THE JAPANESE ECONOMY*

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1. Introduction

This paper is an investigation of the degree of debt neutrality for the Japanese economy. Empirical evidence is brought to bear on the following questions: To what extent is consumption sensitive to the choice of tax versus debt financing of current government expenditure? To what extent is public debt treated as net wealth?

The debt neutrality question has stimulated a considerable amount of research since Barro's (1974) revival of the "Ricardian neutrality" proposition. Most of the literature examined empirically the question of whether or not the neutrality proposition holds for the U.S. economy. Among others Kochin (1974), Tanner (1979), Kormendi (1983) and Aschauer (1985) obtain empirical results favorable to the debt neutrality proposition that to a first approximation, the choice between current taxation and debt issuance to finance a given government expenditure stream is irrelevant to the determination of the level of aggregate demand. On the other hand, Feldstein (1982) rejects some of the assumptions adopted in the empirical specifications of Kochin, Barro, and Tanner and comes to the conclusion that debt neutrality is contradicted by the data. Boskin and Kotlikoff (1985) and Boskin (1986) cast doubt on the contention that government debt policy does not affect consumption and saving. As for the Japanese economy, Ihori (1985), Christ (1986), and Homma, et al. (1986) obtain empirical results favorable to debt neutrality. However, the degree of debt neutrality has been little investigated.1)

As is well known, when inheritance is allowed and each consumer cares the welfare of his descendants, issuance of government debt will have no effect whatsoever to the real aspects of the economy. On the other hand, if no consumer is concerned with the welfare of his descendants at all, debt neutrality does not hold.2) In fact, it is plausible to conjecture that behavior in the real

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1) Seater (1982) examines empirically the degree of debt neutrality by estimating financial asset demand functions. However, he draw no conclusion from the regression concerning the degree of debt neutrality.

2) The conditions for this perfect debt neutrality are quite restrictive—no wealth constraints, equal borrowing and leading rates, no childless families, and so on—and may not be fully met.
world may fall between these extremes. Less extreme behavior by economic agents would produce estimated coefficients that were intermediate between those predicted by the extreme cases. Even if the data cannot reject debt neutrality, it does not necessarily imply that the extreme debt neutrality proposition holds. Therefore, it is useful to investigate the degree of debt neutrality.

The rest of the paper is organized as follows. In section 2 the degree of debt neutrality is theoretically defined within the framework of Blanchard's (1985) “uncertain lifetime” approach. In section 3 the consumption function and the trade balance function are estimated for the Japanese economy, and the degree of debt neutrality is calculated. Section 4 discusses some limitations of the study. Finally, section 5 concludes this paper.

2. Theoretical Considerations

A. Blanchard's (1985) Model

As is well known there are several ways by which a fully rational model can incorporate the feature that debt burden may matter. The overlapping generations model due to Diamond (1965) incorporates the feature that debt matters in a general equilibrium framework. However, the overlapping generations model a priori assumes the perfect substitutability between government debt and real capital. In order to define the index of the degree of debt neutrality, we develop a finite horizon model in which rational behavior may fall between the extreme Barro case and the extreme Keynesian case. In this sense Blanchard's (1985) framework is interesting because his model includes the extreme Barro case and the extreme Keynesian case as special cases, so that we may define the degree of debt neutrality theoretically.

We first develop a finite model of identical individuals that contains the essential of Blanchard's work. Each agent throughout his life faces a constant probability of death, \( p \). At any instant of time a large cohort, whose size is normalized to be \( p \), is born. If the probability of death is constant, the expected remaining life for an agent for any age is given by \( p^{-1} \). As \( p \) goes to zero, \( p^{-1} \) goes to infinity: Agents have infinite horizons.

Under the assumption that instantaneous utility is logarithmic, as shown by Blanchard aggregate consumption is given by

\[
(1) \quad C = (p + \theta)(H + W)
\]

Aggregate consumption \( C \) is a linear function of aggregate human and nonhuman wealth, \( H + W \). \( \theta \) is the rate of time preference.

Human wealth is the present value of future labor income accruing to these currently alive

\[
(2) \quad H = \frac{YW - T}{(r + p)}
\]

where \( YW \) is (permanent) labor income and \( T \) is (permanent) taxes. If agents have finite horizons, if \( p > 0 \), the discount rate on noninterest income \( YW - T \) exceeds the interest rate.

Nonhuman wealth \( W \) is given by

\[
(3) \quad W = K + D + F
\]

where \( K \) is real capital, \( D \) is government debt, and \( F \) is foreign assets.

In period \( t \) the government spends on goods \( G_t \) that do not affect the marginal utility of private consumption and finances spending either by lump sum taxes \( T_t \) or debt issuance \( D_t \). Its dynamic budget constraint is \( \dot{D}_t = rD_t + G_t - T_t \). Under the transversality condition, its
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budget constraint is in the long run

(4) \( rD + G = T \)

(4) is equivalent to the statement that the level of debt \( D \) is equal to the present discounted value of future surpluses \( ((G - T)/r) \). \( G \) and \( T \) may be regarded as permanent levels of government expenditures and taxes, respectively.

We consider the small open economy: namely, in the small open economy the interest rate is the world interest rate \( r \), which is given and at which consumers can freely borrow and lend. For simplicity, we may think that investment is fixed by the exogenous world rate of interest. It has been recognized that focusing on a small open economy is a theoretical strategy with great rewards because it permits partial equilibrium analysis. Here we utilize this strategy in modelling the effects of government fiscal action and illustrate it empirically with an econometric study of Japan.

From (1)–(4) we have

(5) \( C = (p + \theta) \left( \frac{YW - G}{r + p} + \frac{p}{r + p} D + K + F \right) \)

We have

(6) \( \dot{F} = rF + YW - C - G - I \)

where \( I \) is investment. Equation (6) is regarded as the equilibrium condition for the good market. \( \dot{F} \) is a surplus of the current account, and \( \dot{F} - rF \), denoted \( NX \), means the trade balance.

B. Degree of Debt Neutrality

The consumption function (5) has the following policy implication. An increase in taxes and debt \( (dT = rD > 0) \) does not affect permanent income but leads agents feel wealthier by an amount \( \frac{p}{p + r} dD \). This leads then to increase consumption and dissave and to decumulate foreign assets. \( \frac{p}{p + r} \) may be regarded as the wealth effect of debt. If \( p \rightarrow 0 \) (the infinite horizon case), \( \frac{p}{p + r} \) is zero; debt will not be regarded as net wealth. The choice between current taxation and debt issuance to finance a given government expenditure stream is irrelevant to the determination of the level of aggregate demand. We have the extreme debt neutrality case. On the other hand, if \( p \rightarrow 1 \), \( \frac{p}{r + p} \) is approximately equal to one; debt will be regarded as being almost perfect substitutable with foreign assets. We have the extreme Keynesian case.

Therefore it is natural to denote by

(7) \( x = 1 - \frac{p}{r + p} \)

the degree of debt neutrality. If \( p = 0 \) then \( x = 1 \), and if \( p = 1 \) then \( x = r/(1 + r) \). The index \( 1 - x \) means to what extent public debt will be regarded as net wealth. In other words \( x \) means to what extent consumption is insensitive to the choice of tax versus debt financing of government expenditure, and hence \( x \) may be regarded as the degree of debt neutrality.

One could say that the level of \( p \) means the degree of debt neutrality. However, the economic implication of \( p \) is not clear. Although \( p \) lies between 1 and 0, we cannot say that the degree of debt neutrality is 1/2 if \( p = 1/2 \). It is not clear that \( p > (\leq) \) 1/2 means that the reality is closer to the Barro (Keynesian) case. On the contrary, if \( x > 1/2 \), we can say that the reality is closer to the Barro case than the Keynesian case.
3. **Empirical Results**

This section presents time-series evidence for the Japanese economy on the degree of debt neutrality. First we estimate the private sector consumption function based on the uncertain lifetime approach. Then we undertake an estimation of the trade balance function. By doing so we present some evidence of the degree of debt neutrality for the Japanese economy.

### A. Consumption Function Approach

Consider as an empirical specification of the private sector consumption function the following modified version of equation (5).

\[
\begin{align*}
C_t &= a_0 + a_1(Y_t - G_t) + a_2D_t + a_3F_t + u_t
\end{align*}
\]

where \( Y \) is NNP, \( G \) is government spending on goods and services, \( D \) is government debt, and \( F \) is net foreign assets.

There is a difference between (5) and (8). Substituting \( Y = Y_W + rK \) into (5), we have

\[
(5') C = (p + \theta)|((Y - G)/(r + p) + p/(r + p)(D + K) + F|
\]

Because of the unavailability of the quarterly data on real capital, we use (8) in place of (5'). In this paper we use a simple version of the permanent income hypothesis in order to focus on the issues of how the household sector responds to government fiscal policy. Our specification (8) will be useful as a first step.\(^3\)

Theoretical considerations imply positive coefficients for \( Y - G, D, \) and \( F (a_1, a_2, a_3 > 0) \) and the coefficient for \( F \) is greater than the coefficient for \( D (a_3 > a_2) \). The index of the degree of debt neutrality \( x \) is given by \( 1 - a_2/a_3 \). Theoretical considerations also imply the following relation

\[
(\varrho = a_2/a_1, \quad \theta = a_3 - a_2/a_1, \quad \text{and} \quad r = (a_3 - a_2)/a_1)
\]

In Table 1 equations (i)–(iii) report the results of estimating (8) over the years 1970I–1983IV in three forms; ordinary least squares (OLS) in levels, OLS in the first differences, and OLS in the ratios divided by \( Y \). A quick inspection of equations (i)–(iii) reveals that the coefficient estimates are similar across the three forms of equations, which indicates that the results do not suffer from spurious regression problems. The results on the individual coefficients in equations (i)–(iii) conform to the implications of the uncertain lifetime approach quite well. The coefficient on \( Y - G \) is of reasonable magnitude and \( t \)-statistics is significantly large. The coefficient on \( D \) is positive and smaller than the coefficient on \( F \). The index of the degree of debt neutrality \( x \) is calculated as 99%, 82%, and 73%, respectively. As \( a_2 \) in the estimation equation (i) is not significant, the calculated value of \( x \) in (i) is not reliable. Therefore, equations (ii) and (iii) suggest

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\(^3\) The long-run government budget constraint (4) does not hold in Japan in recent years. If, however, the private sector recognizes the long-run government budget constraint (4), private consumption will be determined by (5). Put it in another way, if the government satisfies the transversality condition, the level of debt is equal to the present value of future surpluses. (4) may be regarded as the dynamic budget constraint together with the transversality condition.
It is desirable to use permanent levels of $Y$ and $G$ instead of actual levels of $Y$ and $G$ when estimating (8). Recently Seater and Mariano (1985) estimate a version of the permanent income consumption function by using Beveridge and Nelson (1981)'s method to conduct series on permanent income. The procedure is to estimate an ARIMA model for $Y$ and then compute the stochastic steady state values of $Y$ for each period. These steady state values are the normal levels, denoted $Y^*$. Normal government spending $G^*$ is estimated by using the Beveridge-Nelson method as well.

Equations (iv) and (v) in Table 1 reports the results of estimating (8) where $Y^* - G^*$ place of $Y - G$. Comparing the estimates in equations (iv) and (v) with those in equations (ii) and (iii) reveals the coefficients to be stable. Equations (iv) and (v) suggest that the degree of debt neutrality would be 72% to 76%.

Recently Boskin (1986) reports new empirical results on the effects of government deficits that $x$ would be from 70% to 80%.\(^4\)

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Equations (iv) and (v) in Table 1 reports the results of estimating (8) where $Y^* - G^*$ place of $Y - G$ is used in two forms; OLS in the first differences and OLS in the ratios divided by $Y$. (iv) and (v) use $Y^* - G^*$ place of $Y - G$. (vii) and (viii) use $Y - government consumption$ in place of $Y - G$. DEF is the deficit of general government.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>$Y - G$</th>
<th>$D$</th>
<th>$F$</th>
<th>$DEF$</th>
<th>$R^2$</th>
<th>$D.W.$</th>
<th>$x$</th>
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<td>(i)</td>
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<td>0.60</td>
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<td>(6.73)</td>
<td>(26.2)</td>
<td>(0.71)</td>
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<td>(ii)</td>
<td>2582</td>
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<td>0.03</td>
<td>0.17</td>
<td>0.63</td>
<td>1.25</td>
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<td>(3.27)</td>
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<td>(iii)</td>
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<td>0.66</td>
<td>0.03</td>
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<td>(1.81)</td>
<td>(2.76)</td>
<td>(6.58)</td>
<td>(2.94)</td>
<td>(3.29)</td>
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<td>(vii)</td>
<td>−1.12</td>
<td>1.65</td>
<td>0.039</td>
<td>0.12</td>
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<td></td>
<td>(−8.92)</td>
<td>(14.7)</td>
<td>(10.6)</td>
<td>(3.84)</td>
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<tr>
<td>(viii)</td>
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<td>0.85</td>
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<td>(−7.81)</td>
<td>(13.1)</td>
<td>(10.4)</td>
<td>(3.92)</td>
<td>(0.74)</td>
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Notes: $t$-statistics are shown in parentheses. All variables are stated as real per capita amounts. $D.W.$ is the Durbin-Watson statistic. (i) reports OLS in levels, (ii) OLS in the first differences, and (iii) OLS in the ratios divided by $Y$. (iv) and (v) use $Y^* - G^*$ place of $Y - G$. (vi) reports OLS in the first differences and (v) OLS in the ratios divided by $Y^*$. (vi)-(viii) report OLS in the first differences. (vii) and (viii) use $Y - government$ consumption in place of $Y - G$. DEF is the deficit of general government.

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4) We may calculate the values of $p$, $\theta$, and $r$ from the estimated values of $a_1$, $a_2$, and $a_3$ based on theoretical considerations. From equations (ii), (iii), and (v) in Table 1 we have $p = 0.044 - 0.067$, $\theta = 0.07 - 0.1$ and $r = 0.11 - 0.31$. As our theoretical framework is aimed at estimating the degree of debt neutrality $x$, not estimating parameters $p$, $\theta$, and $r$, we should not overstate the explanatory power of these values. $p$ may be regarded as the probability that either the family ends or the current members of the family have no concern with the future. There is scant evidence of the appropriate value of $\theta$. It seems that this paper may overestimate $p$ and $r$. 

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and debt on real economic activity for the U.S. economy. He estimates similar consumption equations as (8) but includes current government deficits as an additional explanatory variable. He also subtracts government consumption, rather than subtracting government expenditures from income as a measure of permanent income. According to his results for the U.S. economy, the tax cut, holding government consumption constant unambiguously increases consumption substantially, about 30 to 40 cents on the dollar. Boskin concludes that the size, statistical significance and robustness to alternative specifications of the deficits are a strong rejection of the perfect debt neutrality proposition.

Equations (vi) and (viii) in Table 1 report the results of estimating a modified version of (8) where the government deficits are also included following Boskin over years 1973I–1983IV. Equations (vii) and (viii) report the results of estimating a modified version of (8) where government consumption is subtracted from income as a measure of permanent income. Equations (vi)–(viii) suggest that the tax cut, holding government spending constant increases consumption rather moderately about 10 to 15 cents on the dollar for the Japanese economy. The results are consistent with the finding that the degree of debt neutrality is about 70%.

B. Trade Balance Function Approach

The index of the degree of debt neutrality $x$ may be calculated by estimating a trade balance function. From (5) and (6) the trade balance $NX$ may be described by

$$\tag{9} NX = \frac{r - \theta}{r + p}(YW - G) - \frac{(p + \theta)p}{r + p}D - (p + \theta)(F + K) - I$$

Therefore, an empirical specification of the trade balance equation will be

$$\tag{10} NX_t = b_0 + b_1(Y_t - G_t) + b_2D_t + b_3F_t + u_t$$

Theoretical considerations imply negative coefficients for $D$ and $F$ ($b_2 < 0$, $b_3 < 0$) and the coefficient for $D$ is less than the coefficient for $F$ ($b_2 < b_3$) but the sign of coefficient for $Y - G$ is ambiguous. The index $x$ is then calculated by $1 - b_2/b_3$. Theoretical considerations also imply the following relation

$$p = -b_2/(1 - b_1), \theta = -b_3 - b_2/(1 - b_1), \text{ and } r = (b_2 - b_3)/(1 - b_1).$$

Equations (i) and (ii) in Table 2 represent the results of estimating (10) over the years 1973I–1983IV. The coefficient for $Y - G$ ($b_1$) is insignificantly different from zero, which suggests that $r$ is very close to $\theta$. The coefficient for $D(b_2)$ is negative and greater than $b_3$ which is consistent with theoretical considerations. The estimates for $x$ are 0.71–0.78 and virtually the same as those estimated in Table 1. The degree of debt neutrality would be about 70%–80%.

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5) As the government budget constraint (4) is the long-run constraint, not the dynamic one, it does not seem to make much sense to include current deficits as well as government debt in Blanchard’s framework.

6) Here we ignore real capital as in (8). $b_0$ includes the effect of investment which has been assumed to be exogenous.
Equations (iii)-(v) in Table 2 report the results of estimating (10) where \( Y^* - G^* \) in place of \( Y - G \) is used in OLS in the ratios. Regression results for (10) over the period 1970I-1983IV are reported in equation (iii) of Table 2. We also ran regressions over periods (1970I-1974IV) and (1975I-1983IV), and the results are reported in equations (vi) and (v). For the period (1970-1983) the estimate for \( x \) is 70% and virtually the same as those estimated before. For the period (1970-1974) \( x \) is calculated as 0.21, and for the period (1975-1983) \( x \) is calculated as 0.68. The results suggest that the degree of debt neutrality is at a higher level in recent years.  

4. Some Further Issues

No empirical study is without its caveats and this paper is no exception. We suggest that the following possible departures from the assumption of this study should be borne in mind when interpreting the empirical results.

(1) Imperfect capital market: With the existence of the imperfect capital market the perfect debt neutrality will not be valid. Clearly, at least the present disposable income has an impact on consumption.

(2) Endogenous real rate: Endogenous real rate is potentially a serious problem for a study of this type. There are three possible reasons for the endogeneity of the real rate. First, Japan may be a large country. Second, even if it is small, the existence of non-traded goods will imply that the relevant real rate is endogenous. Third, exchange controls may be in existence. As long as the economy considered is substantially open (not necessarily small), there is a component of the real rate that is determined by world conditions and the model may be identified.

(3) Direct test of altruism: Since concepts such as deficits, public debt and foreign assets are subject to vagaries of accounting procedures, more direct tests of the intergenerational altruism model are desirable. In the intergenerational altruism model aggregate consumption depends

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7) These results are compatible with Homma, et al. (1986).
only on aggregate resources, not on their age distribution. This forms the basis for the test
developed by Boskin and Kotlikoff (1985).

In the light of these various points, the estimated values should be regarded as illustrating a first
step of a general empirical methodology, and giving a rough idea about the empirical magnitude
of the degree of debt neutrality, rather than as exact values.

5. Conclusion

It is well known that the general government's budgets in Japan were generally in balance or in
surplus until 1974. From 1975 the deficit/GNP ratio continued to rise to 5.5% in 1978. In 1979
an introduction of general consumption taxation became a big political issue. It may be plausible
to think that individuals recognize the future tax obligations implicit in current debt issuance
more fully when the government deficits are at higher levels since 1970's.

Homma, et al. (1986) suggest that it is more likely in recent years that the data are incapable of
rejecting debt neutrality. However, the degree of debt neutrality has not been estimated. The
present results suggest that the degree of debt neutrality would be in the range of 70 to 80
percent.

In the standard Keynesian approach to modeling private consumption behavior, perceptions of
the private sector with respect to the current and future consequences of government fiscal
policy are not fully rational. On the other hand, the new-classical school of macroeconomic
policy stresses the real effects of government spending rather than the method by which such
spending is financed. Our empirical results, taken as a whole, are inconsistent with both the
perfect debt neutrality hypothesis and the more traditional Keynesian hypothesis. The results
suggest that reality lies between these extremes.

The empirical results of this paper suggest that the debt neutrality view of the effects of fiscal
policy actions on the economy deserves at least some credibility for the Japanese economy. It is
hoped that this study and further work in this area will help to answer questions about the magni-
tude of the degree of debt neutrality as well as about the size of debt substitutability. These ques-
tions are important for the relevance of fiscal policy in the real economy.

DATA APPENDIX

\[ C = \text{private consumer expenditure} \]
\[ Y = \text{net national product} \]
\[ Y^* = \text{normal values for } Y \text{ computed according to the Beveridge-Nelson method.} \]
\[ G = \text{expenditures of general government} \]
\[ G^* = \text{normal values of } G \text{ computed according to the Beveridge-Nelson method.} \]
\[ D = \text{cumulative deficits of general government} \]
\[ F = \text{net holdings of foreign assets} \]
\[ DEF = \text{actual deficits of general government} \]
\[ NX = \text{trade balance} \]
All variables are stated as real per capita amounts and taken from Annual Report of National Account (Economic Planning Agency).

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REFERENCES


