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A Cross-Country Test of Ricardian Equivalence and the Twin Deficits Hypothesis

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Abstract: This paper examines the validity of the Ricardian equivalence proposition by focusing on the long-run differences in government budget and trade deficits in fifty countries. A theoretical model is developed which nests both Ricardian and non-Ricardian behavior, allowing for direct testing of the Ricardian equivalence and twin deficits hypotheses. The implications of the Ricardian equivalence proposition generated by the model are rejected, resulting in support for the twin deficits hypothesis. Countries with persistent government budget deficits have generally experienced persistent trade deficits. The results, which are found to hold for alternate country samples and time periods, have important policy implications concerning the potential consequences of using borrowing as a means to finance government spending.

Keywords: Ricardian Equivalence, Twin Deficits

JEL Classifications: E62, F32, H30, H62

1. Introduction

The validity of the twin deficits hypothesis, that a government budget deficit could cause a trade deficit, has been long debated in the economic literature. Recent events, particularly the significant deterioration of fiscal and trade balances in several European countries, have sparked renewed interest in this discussion. Central to the question of whether budget deficits impose a cost on society is whether or not the Ricardian equivalence proposition is a reasonable approximation of reality. Under Ricardian equivalence, individuals incorporate the government's budget constraint in their decision-making process and any increase in government borrowing is offset by an increase in private savings. In this manner, the real economy is unaffected by the method used to finance government spending. If Ricardian equivalent behavior is not exhibited, an increase in government borrowing may be associated with increases in interest rates, consumption, and current account deficits.

Previous researchers have tested the validity of the Ricardian equivalence proposition by examining the effects of government deficits on interest rates and private consumption. Standard analysis indicates that an increase in government debt that is not offset by an increase in private savings should cause interest rates to rise. However, very little evidence has been found to link government budget deficits to either real or nominal interest rates (Plosser, 1987; Evans, 1987; Barro, 1987; Lee, 1991; Calomaris *et. al.* 2003; Engel and Hubbard, 2004). Ricardian equivalence also implies that government budget deficits will not affect private consumption. Examination of the relationship between budget deficits and private consumption has led to very mixed results, often with different conclusions drawn from the same basic data.[1]

Other researchers have examined the link between government deficits and net export deficits, or the twin deficits hypothesis. Reduced form analysis of the twin deficits hypothesis has found only weak evidence that government deficits cause trade deficits (Ahmed, 1987; Darrat, 1988; Abell, 1990a, 1990b; Miller and Russek, 1996). Mohammadi and Skaggs (1996) summarize these results and examine their sensitivity to different filtering methods and econometric procedures. They find that U.S. government budget deficits have only a very modest effect on the trade balance and that this effect is extremely sensitive to the variable definitions and the econometric techniques employed. More recent examination of the twin deficits hypothesis has focused on using vector error correction models to examine the possibility of structural breaks and to test causation between fiscal and trade deficits.[2]

Most of the prior examinations of the Ricardian equivalence and twin deficit hypotheses have used time-series data to isolate the effects of government deficits on other economic variables. In such examinations, the data must be filtered in order to remove any nonstationary components. However, at the medium to high frequencies emphasized by most filtering techniques, exogenous changes in government deficits may be small in comparison to any changes associated with the business cycle. During a recession, for example, government deficits generally increase due to lower revenues and automatic spending increases while the trade balance often improves due to low import demand. As discussed in Kim and Roubini (2008), if part of the endogenous movement in government deficits caused by changes in output is misidentified as representing exogenous innovations in such deficits, significant misinterpretation of the effects of government deficits is a distinct possibility. Any conclusions drawn may be sensitive to not only the method of filtering, but also the econometric method employed to identify exogenous innovations in government deficits.

In order to avoid some of the problems found in previous work, the empirical analysis performed in this paper focuses on long-run differences between countries. Data are collected over a forty-four year period for fifty countries. Differences between the countries that have persisted for many years are then examined in order to test the Ricardian equivalence and twin deficit hypotheses. In particular, the analysis focuses on the relationship between persistent government deficits and other economic variables. The main advantage of this long-term examination is that it avoids much of the short-term noise associated with the business cycle and temporary economic disturbances. Also, this methodology permits the inclusion of many countries whose data are not complete enough to permit a more traditional time-series analysis.

In order to formally test the Ricardian equivalence hypothesis, a theoretical model is described in which households have either infinite or finite horizons. If households have infinite horizons, they are perfectly connected to future generations and will be indifferent between taxation and borrowing as methods of financing government spending. If, however, households have finite horizons, government deficits represent an increase in the wealth of current households and will affect both consumption and the balance of trade. Using the cross-country data, the Ricardian equivalence proposition is rejected and support is found for the twin deficits hypothesis. As predicted under the finite-horizon model specification, countries with persistent government budget deficits have also generally experienced persistent trade deficits and high levels of private consumption. Other differences between countries, such as government expenditures, investment levels or output growth rates, are found to be much less important than government budget deficits in explaining long-term differences in net exports between countries.

2. Theoretical Model

This section describes a model that nests both Ricardian equivalence and a non-Ricardian alternative. The model is similar to those described in Evans (1993) and Kasa (1994) who build upon the earlier work of Blanchard (1985). Because Ricardian behavior is nested within a more general model, the implications of Ricardian equivalence can ultimately be directly tested against the alternative hypothesis of finite planning horizons.

In this model, the economy is inhabited by households that have a finite probability of dying in each period. In each period, a new generation of households is born to replace those that have not survived, allowing the aggregate population to remain constant over time. Each household is assumed to have a chance equal to $(1-\theta)$ of dying in each period. Rather than being simply related to the rate of birth and death in the economy, the survival parameter, θ, could also represent a general measure of how connected each household feels to future generations. As pointed out by Evans (1993), if households feel perfectly connected to future generations, the survival parameter is effectively equal to one and the model collapses to an infinite-horizons model. If households are less than perfectly connected to future generations, the survival parameter will be less than one, causing a divergence of the household and social discount rates.

Each household born in period *t-k* and still alive in period *t* chooses a consumption stream, $\{c_{k,t}\}$, to maximize expected lifetime utility,

$$\sum_{j=0}^{\infty}\beta^{j}\theta^{j}E_{t}U\left(c_{k,t+j}\right), \qquad (1)$$

where β is the time preference parameter. The momentary utility function for period *t+j* is multiplied by the probability that a household will survive at least *j* more periods, θ^{j}.

Households receive an exogenous labor income stream, $\{y_t\}$, and pay a lump-sum tax, τ_t, in period *t*. Regardless of the period in which they were born, all households alive in period *t* are assumed to have identical current and future labor income and tax liabilities. The budget constraint of a household originating in period *t-k* is given by

$$c_{k,t} = y_t - \tau_t + \left(\theta^{-1}R\right)a_{k,t-1} - a_{k,t}, \quad k = 0, 1, 2, \dots \qquad (2)$$

where *R* is the constant gross real interest rate and $a_{t,k}$ represents the time *t* asset holdings of a household originating in period *t-k*. A household can earn a return that is higher than the risk-free rate by making an actuarially fair bet whether it will survive to the next period. If the household is alive in the next period, it will receive θ^{-1} times its bet and if the household does not survive it will receive nothing. Surviving households receive a return on their wealth of $\theta^{-1}R$ while households that do not survive receive a return of zero. Similarly, the competitive interest rate on household debt is equal to $\theta^{-1}R$. In order to compensate a lender for the possibility that the household will not survive to honor its debt, a risk premium must be offered on personal loans that allows the expected return on household debt to equal the risk-free rate.

Under the assumption that $\beta = R^{-1}$, the household's maximization problem yields a consumption function dependent on expected lifetime after-tax labor income and the current level of household assets,

$$c_{k,t} = \left(\frac{R-\theta}{R}\right)\left[E_t \sum_{j=0}^{\infty}\left(\frac{\theta}{R}\right)^j \left(y_{t+j} - \tau_{t+j}\right) + \left(\frac{R}{\theta}\right)a_{k,t-1}\right]. \qquad (3)$$

The government is assumed to pay for any purchases by collecting lump-sum taxes or by issuing debt. The government budget constraint is given by

$$D_t = RD_{t-1} + G_t - T_t \qquad (4)$$

where D_t is the amount of government debt, G_t is the level of government consumption and T_t is aggregate revenues collected through taxation. For simplicity, changes in the total level of government debt are assumed to be permanent. In the future, a tax rate will be chosen such that revenues are equal to government consumption plus interest payments on the debt.

Substituting the government budget constraint into the aggregated consumption function yields,

$$C_t = \left(\frac{R-\theta}{R}\right)\left[RA_{t-1} + (R-1)D_{t-1} + E_t \sum_{j=0}^{\infty}\left(\frac{\theta}{R}\right)^j \left(Y_{t+j} - G_{t+j}\right)\right] + (1-\theta)DEF_t \qquad (5)$$

where the time *t* government deficit is given by $DEF_t = D_t - D_{t-1}$ and aggregate variables are denoted by capitalized letters. It is assumed that initial aggregate household assets, A_{t-1}, and government debt, D_{t-1}, are approximately zero and that any expected future changes in labor income or government consumption are expected to be permanent, $E_t\left(Y_{t+j}\right) = E_t\left(Y_{t+1}\right)$, *j*=1, 2, … and $E_t\left(G_{t+j}\right) = E_t\left(G_{t+1}\right)$, *j*=1, 2, … . With these simplifications, substituting aggregate consumption into the definition of net exports, $NX_t = Y_t - G_t - C_t$, and dividing by the current income level yields

$$\left(\frac{NX_t}{Y_t}\right) = -\left(\frac{\theta}{R}\right)\left(\frac{E_t\left(Y_{t+1}\right) - Y_t}{Y_t}\right) + \left(\frac{\theta}{R}\right)\left(\frac{E_t\left(G_{t+1}\right)}{Y_t} - \frac{G_t}{Y_t}\right) - (1-\theta)\left(\frac{DEF_t}{Y_t}\right). \qquad (6)$$

The first term on the right hand side of (6) captures expectations about future income levels. If households expect labor income to increase, they will borrow to increase current consumption, generating a net export deficit. The second term captures the effect of an expected change in government consumption. If the amount of income available for private consumption is expected to decrease in the future due to an increase in government consumption, households will smooth their consumption intertemporally, causing a trade surplus. The final term on the right hand side of equation (6) represents the degree to which households internalize government deficits. For $\theta < 1$, households have a finite chance of dying in each period. Because any individual household does not expect to survive to fully repay any government debt, a government deficit represents an increase in the expected lifetime after-tax income of the household. In this case, a government deficit will cause an increase in private consumption, leading to a net export deficit. If, on the other hand, households feel perfectly connected to future generations, they will internalize this deficit and increase their savings to offset the increased expected future tax payments. In this case, the model collapses to a simple infinite horizons situation and Ricardian equivalence will hold.

3. Empirical Analysis

The empirical analysis involves using cross-country data to estimate the relationships implied by equation (6) from the theoretical model. Annual data from 1970 through 2013 are collected from the International Monetary Fund's International Financial Statistics data library as well as the World Bank and OECD national accounts data.[3] Data on private consumption, government consumption, net exports and investment are taken from the national accounts. Government budget deficits are defined as expenditures minus revenues from the government finance section. Each of these variables is divided by nominal gross domestic product to be converted into a share of output. Output is defined as the log of real gross domestic product and the real exchange rate is defined in terms of foreign goods per U.S. good. In order to generate statistics to be used in the empirical analysis, the time-series data is divided into two sub-periods, 1970-1991 and 1992-2013. For each country, the mean value of each of the variables is computed for both of the sub-periods. This allows the estimation using data over two time periods to capture the potential effects of expected future values of output and government consumption on the current trade balance. Following the relationships outlined in equation (6), the specific equation estimated in the main regression analysis is given by:

$$\left(\frac{NX_t}{Y_t}\right) = \beta_0 + \beta_1\left[\log\left(Y_{t+1}\right) - \log\left(Y_t\right)\right] + \beta_2\left(\frac{G_{t+1}}{Y_{t+1}} - \frac{G_t}{Y_t}\right) + \beta_3\left(\frac{DEF_t}{Y_t}\right) + \varepsilon_t. \qquad (7)$$

Equation (7) is estimated using the means from the sub-period 1970-1991 to represent time period *t* and the means from 1992-2013 to represent time period *t+1*. This specification involves using the actual values of output and government consumption in the second period to represent the expected future values of these variables found in equation (6).

The main estimation results are reported in the first column of Table 1. The results indicate that countries that have run persistent government deficits have also tended to experience sustained trade deficits with the coefficient on the government budget deficit significant at the 1% level. Additionally, the results indicate that differences in the growth rate of output also explain some of the variation in net exports between countries. The coefficient on the growth rate of output is negative which supports the theoretical proposition that high expected future output should lead to increased current private consumption levels and borrowing, leading to trade deficits.

The robustness of the empirical results is examined by including additional variables that could theoretically affect the balance of trade. The results generated from estimating equation (7) with the inclusion of additional explanatory variables are reported in columns two through five of Table 1. Temporary increases in government consumption or private investment could cause net export deficits as individuals attempt to smooth their consumption over time. Also, changes in the real exchange rate could capture shifts in relative demand or productivity between countries which could lead to trade deficits or surpluses. However, none of the estimated coefficients on these additional variables are found to be significant. Neither variation in government consumption, investment or real exchange rate movements appear to explain the long run differences in the balance of trade.

One area of concern with the estimation involves the possibility that the empirical results are being driven by a few developing countries with extremely large trade or budget deficits or generally less reliable data. To answer this concern, the main regression is also estimated using a sub-sample containing twenty-three industrialized countries, including Western Europe, the United States, Canada, Japan, Australia, and New Zealand.[4] These results, reported in the first column of Table 2, suggest that the relationship between trade and budget deficits is robust rather than being driven by a few outliers with the coefficient on government budget deficits remaining significant at the 1% level.

One of the limiting factors in the main analysis is that data for many countries is not available over the entire period from 1970-2013. In particular, many eastern European and newly industrialized countries have reliable data available only over the past fifteen to twenty years. To test the relationship between trade and budget deficits for a wider range of countries, the main regression is run using a more recent time period of 2000-2013. The analysis allows for the inclusion of ninety-five countries where data are available for at least 75% of the observations.[5] The regression analysis uses the mean budget deficit and trade balance from 2000-2013 period for each country. Also, the change in output and the change in government consumption is taken as the difference between 2013 and 2000. The results, found in the second column of Table 2, are consistent with the earlier estimation results. The coefficient on government budget deficits is again found to be significant at the 1% level. Regression analysis results with additional possible explanatory variables, found in column three of Table 2, are also supportive of the twin deficit hypothesis.

To examine the possibility that the findings are being driven by data from smaller developing economies, a forty-two country subsample of European and other industrial economies is also tested.[6] Results of additional testing with the forty-two country subsample using the data from 2000-2013 are found in columns four and five of Table 2. The results are also consistent with the earlier findings that government budget deficits are correlated with net export deficits.

4. Conclusions

The long-term differences between fifty countries are examined in order to evaluate the consequences of persistent government budget deficits. Using the cross-country data, the Ricardian equivalence proposition is strongly rejected. The null hypothesis of infinite horizons is statistically rejected against the alternative that consumers behave as if they have a finite planning horizon. As predicted by the model, countries with higher than average government budget deficits have also generally experienced higher than average trade deficits, potentially leading to a redistribution of wealth across generations. These results are consistent with the twin deficits hypothesis and have important policy implications concerning the consequences of using borrowing as a means to finance public spending.

Endnotes

1. Examining U.S. data, Kormendi (1983) and Kormendi and Meguire (1990) find that budget deficits do not affect private consumption. However, using almost identical data, Feldstein and Elmendorf (1990) and Modigliani and Sterling (1986) come to the opposite conclusion. Looking at other countries, Reid (1989) finds evidence against Ricardian equivalence in Canada while Evans (1993) can only statistically reject the Ricardian equivalence hypothesis in one out of nineteen countries.

2. See Salvatore (2006), Kalou and Paleologou (2012), Trachanas and Katrakilidis (2013) for examples of recent work in this area generally finding evidence supporting the twin deficits hypothesis in a variety of G-7 and EMU countries.

3. All countries for which reliable data are available for at least seventy-five percent of the observations for each of the variables between 1970 and 2013 are included in the sample. The countries included are: Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Cyprus, Denmark, Ecuador, El Salvador, Fiji, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Kenya, Korea, Luxembourg, Mauritius, Mexico, Morocco, Nepal, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Philippines, Portugal, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, United Kingdom, United States, Venezuela.

4. The twenty-three industrial country subsample includes: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

5. The 2000-2013 main sample includes: Antigua and Barbuda, Armenia, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Belize, Benin, Bhutan, Bosnia and Herzegovina, Brazil, Bulgaria, Burkina Faso, Cambodia, Canada, Chile, Congo, Dem. Rep., Cote d'Ivoire, Croatia, Czech Republic, Denmark, Dominica, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Honduras, Hungary, Iceland, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Kuwait, Latvia, Lebanon, Lithuania, Luxembourg, Macao, China, Madagascar, Malaysia, Mali, Malta, Mongolia, Morocco, Namibia, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St.

Vincent and the Grenadines, Sweden, Switzerland, Thailand, Tunisia, Uganda, Ukraine, United Kingdom, United States, Uruguay.

6. The 2000-2013 forty-two country subsample includes: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Chile, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Ukraine, United Kingdom, United States.

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Table 1. Regression Results

	(1)	(2)	(3)	(4)	(5)
$(Y_{t+1} - Y_t)$	-0.0446 (-2.15)**	-0.0405 (-1.76)**	-0.0469 (-2.24)**	-0.0424 (-1.97)**	-0.0341 (-1.43)
$(G_{+1} - G_t)$	0.0021 (1.07)	0.0026 (1.14)	0.0025 (1.23)	0.0019 (0.93)	0.0035 (1.42)
(DEF_t)	-1.0679 (-5.318)***	-1.1055 (-5.01)***	-1.0493 (-5.19)***	-1.0621 (-5.23)***	-1.12 (-5.07)***
(G_t)		0.0603 (0.43)			0.0015 (0.970)
(I_t)			-0.0011 (-0.916)		-0.0018 (-1.31)
(ΔRR_t)				0.00015 (0.440)	0.00026 (0.735)
constant	0.05346 (2.933)***	0.0423 (1.33)	0.0812 (2.30)**	0.0532 (2.89)***	0.0698 (1.81)*
R^2	0.459	0.461	0.469	0.461	0.484
Adjusted R^2	0.424	0.413	0.422	0.413	0.394

Notes:

Significance at the ten-percent, five-percent and one-percent level are denoted by *, ** and *** respectively. The dependent variable is net exports divided by output.

Notation: **(*G*)** = government consumption divided by output, **(*I*)** = investment divided by output, **(*DEF*)** = government budget deficit divided by output, **(*Y*)** = real output, **(*ΔRR*)** = growth rate of real exchange rate. The subscript (t) denotes the mean from the first time period from 1970-1991 and the subscript (t+1) denotes the mean from the second time period from 1992-2013.

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Table 2. Additional Regression Results

	(1)[a]	(2)[b]	(3)[b]	(4)[c]	(5)[c]
$(Y_{t+1} - Y_t)$	0.0431 (0.897)	0.2848 (0.958)	0.3476 (1.13)	-0.2399 (0.537)	0.0459 (0.100)
$(G_{t+1} - G_t)$	-0.0020 (-0.553)	-0.5300 (-0.901)	0.2026 (0.295)	-1.344 (-1.56)	-0.7967 (-0.745)
(DEF_t)	-0.9065 (-3.26)***	-1.933 (-6.87)***	-1.840 (-6.75)***	-1.308 (-3.99)***	-1.360 (-4.270***
(G_t)			0.1823 (0.761)		-0.3991 (-1.20)
(I_t)			-0.6131 (-3.27)***		-0.7445 (-2.06)**
(ΔRR_t)			0.0682 (1.33)		0.1073 (0.543)
constant	0.01221 (0.374)	0.9891 (0.414)	10.28 (1.69)	5.701 (2.13)**	29.90 (2.618)**
R^2	0.406	0.346	0.422	0.333	0.425
Adjusted R^2	0.312	0.325	0.383	0.282	0.330

Notes:

[a]Twenty-three industrial country subsample from 1970-2013.
[b]Ninety-five countries using data from 2000-2013.
[c]Forty-two industrial country subsample using data from 2000-2013.

Significance at the ten-percent, five-percent and one-percent level are denoted by *, ** and *** respectively.