Are Latin-American Households Neutral to Increases In Government Spending?

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Abstract

Using a dynamic optimization model, the Ricardian Equivalence Proposition is empirically tested for Argentina, Brazil, Chile and Mexico. The system of equations obtained in the theoretical model is solved using Ordinary Least Squares, Generalized Method of Moments and Full Information Maximum Likelihood. Results indicate that null hypothesis concerning the Ricardian equivalence proposition cannot be rejected for Brazil, but is strongly rejected for Mexico. For Argentina and Chile the results are ambiguous. Therefore, when the fiscal authority seeks to stimulate economic activity by mean of tax reduction and increase in government spending, the outstanding effect might be only raising private savings.

Keywords: Fiscal Policy, Ricardian Equivalence, Public Debt

JEL Classification: E62, H30, H60

Resumo

Utilizando um modelo de otimização dinâmica, a Proposição da Equivalência Ricardiana é testada empiricamente para Argentina, Brasil, Chile e México. O sistema de equações obtido no modelo teórico é resolvido utilizando Mínimos Quadrados Ordinários, Método dos Momentos Generalizados e Full Information Maximum Likelihood. Os resultados indicam que a Equivalência Ricardiana não pode ser rejeitada para o Brasil, é fortemente rejeitada para o México e para Argentina e Chile os resultados são controversos. Assim, quando a Autoridade Fiscal formula políticas utilizando redução de tributos ou aumento nos gastos do governo, o efeito predominante pode ser apenas aumento na poupança privada.

Palavras-chave: Política Fiscal, Equivalência Ricardiana, Dívida Pública

Classificação JEL: E62, H30, H60

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1. Introduction

In an environment of recurrent economic instability, due to currency crisis, changes in exchange rate regime, confidence crisis, sudden stops, and other events with serious impacts on economic activity, a major concern of Latin-American policy makers is the relationship between fiscal policy and aggregate demand. Stabilization plans edited during the recent period have attributed an important role for the fiscal policy. However, this role might not be as effective as desired if the Ricardian Equivalence proposition (REP) is empirically observed. Under the REP, a temporary tax cut, for instance, would not affect personal consumption, since the increase in disposable income would be compensated by a raise in personal savings to neutralize expected increase in future taxes in order to keep a balanced government budget.

Another implication of the REP is associated to the interaction between fiscal and monetary policies. The regime of monetary policy dominance, under which the fiscal policy is passive, is essentially Ricardian. In this case, the monetary authority is not forced to monetize the public debt, and is free to pursue inflation stabilization as the major policy objective. In fact, existence of the Ricardian Equivalence is taken for grant in most models which seek to derivate optimal monetary policy rules.

The landmark on the Ricardian Equivalence literature is Barro (1974), who was the first author to model REP and to clearly state hypothesis needed to its validity. The relation between debt issuance and taxation was first called Ricardian Equivalence by Buchanan (1976). David Ricardo believed that the government choice to issue debt or to tax is irrelevant, since debt can be viewed as a postponement of taxes. Elmendorf and Mankiw (1998) address the issue of public debt and its macroeconomic effects, comparing the REP to the Modigliani and Miller (1958) theorem. Accordingly, corporate financing decisions in corporate finance are similar to government financing decisions in public sector economics. In theory, none of them matters.

Theoretically, the REP comes along with restrictive assumptions. Traditionally, it requires that individuals behave as if they had infinite horizon; capital markets are complete; consumers are rational and farsighted; taxes are non-distortionary or lump-sum; there is no uncertainty regarding to income and future taxes; and, the government will balance its budget.

Some of those hypotheses have been relaxed in the theoretical literature, yielding restricted versions of the REP. For instance, Divino and Orrillo (2008) demonstrate the validity of REP in a general equilibrium model with incomplete markets, provided that the risk-free payoff is in the asset span. Hayford (1989) shows the REP in the presence of liquidity restrictions when default implicates in partial payment of debt (positive recovery value). Bassetto and Kocherlakota (2003) demonstrate that REP holds with distortionary taxes conditioned to the government being able to decide when to collect taxes.

The first empirical works on REP were based on regressions of personal consumption against fiscal variables, such as public debt and tax revenues. Rejection of the REP would depend on finding statistically significant coefficients for the fiscal variables. The results, however, are contradictory, usually depending on econometric techniques, methodology of collection of fiscal variables, and sample periods. Ricciuti (2003) argues that when REP is tested using life cycle models, it is usually rejected. On the other hand, dynamic optimization models tend to validate REP. Leiderman and Razin (1988) developed an intertemporal stochastic model based on Blanchard (1985) that allows to jointly testing hypotheses for the REP. More specifically, they test finite horizons and liquidity constraints for Israel from 1980 to 1985 with monthly data and do not reject REP.

For Latin-American countries, tests on the REP are still incipient. Khalid (1996) introduced some changes in Leiderman and Razin's model and focused the analysis on 21 developing countries, including Argentina, Brazil, and Mexico. They used annual data from 1960 to 1988 and Gross National Income as a proxy for disposable income. They do not reject the REP for 12 countries, including Brazil and Peru. Cuaresma and Reitschuler (2006) test the same model for 15 OECD countries with annual data from 1960 to 2002. Their results show deviations from REP for Finland, United Kingdom, Ireland, Luxembourg, Netherlands, Portugal and Sweden. For the other OECD countries, the REP holds empirically.

The goal of this paper is to test the REP for the major Latin-American countries, namely Argentina, Brazil, Chile, and Mexico in the recent period. Those countries were chosen for their economic and political influences in the region. In addition, they have experienced distinct fiscal arrangements for fiscal policy during the recent period and, to avoid negative effects of the current financial crises, followed the rest of the world in adopting expansionary fiscal policies. Such measures might not have the expected effects if the REP is found to hold in the respective country.

The empirical evidence is based in the model by Khalid (1996). Our results indicate that the REP is not rejected for Brazil, is rejected for Mexico, and the evidence is inconclusive for Argentina and Mexico. Estimated parameters resulted in survival probabilities statistically equal to one, meaning that individuals behave as if they had infinite horizons. Tests for the liquidity restriction indicate that the percentage of individuals facing liquidity restrictions is not significantly different from zero in all countries but Mexico. Yet, we found distinct rules for public and private consumption across the select Latin-America countries, meaning that it is not clear whether increasing public expenditure will crowd-out private investment.

The main contribution of the paper is to provide empirical evidence on the existence of different consumption behaviors across the major Latin-American countries. Thus, there is no space for application of a single fiscal policy rule in the region. Under the current financial crisis, fiscal authorities are increasing expenditure as a way to stimulate the economic activity. Our results suggest that this measure might not be effective for Brazil but might be for Mexico. As for Argentina and Chile, the results are ambiguous.

The paper is organized as follows. In the following section we describe the theoretical model used in the empirical evidence. The econometric procedures are presented in section 3. In sequence, section 4 reports the results. Finally, section 5 is dedicated to the concluding remarks.

2. The Model

The theoretical model follows Khalid (1996), who modifies the framework proposed by Leiderman and Razin (1988) to yield testable restrictions for the REP. It is an overlapping generations model with rational agents and finite horizon. There is a survival probability, γ, that does not depend on age. The probability of living for τ periods is γ^{τ}.

The consumption of an individual with no liquidity constraints, c_t^u, is given by a linear combination between public, g_t, and private, c_t, consumptions. Thus,

$$c_t^u = c_t + \sigma g_t \Rightarrow c_t = c_t^u - \sigma g_t \qquad (1)$$

where σ indicates how individuals weight public consumption relatively to private consumption, being also understood as the degree of substitutability between public and private consumption. If σ is close to zero, then public consumption cannot substitute private consumption.
The expected utility of a consumer with no liquidity constraint is represented by:

$$E_t \sum_{\tau=0}^{\infty} (\gamma\delta)^{\tau} U(c_{t+\tau}^{u*}) \qquad (2)$$

where E_t is the expectation operator conditional on time t information set, $c_{t+\tau}^{u*}$ is the consumption of an individual with no liquidity constraint, and δ is the discount factor.

The individual will maximize (2) subject to the following budget restriction:

$$c_t^{u*} = b_t^u + y_t^u - \left(\frac{R}{\gamma}\right) b_{t-1}^u + \sigma g_t \qquad (3)$$

where b_t^u is a bond issued to an individual with no liquidity restriction at time t, y_t^u is the disposable income and R is the risk-free interest rate, assumed to be constant. Individuals are also subject to a no Ponzi scheme rule:

$$E_t \lim_{t\to\infty} \left(\frac{\gamma}{R}\right)^t b_t^u = 0 \qquad (4)$$

The Bellman's equation can be written as:

$$V\left(y_t^u, b_{t-1}^u\right) = \underset{b_t}{Max}\, U\left[y_t^u + b_t^u - \left(\frac{R}{\gamma}\right) b_{t-1}^u + \sigma g_t \right] + \gamma\,\delta\, E_t\left[V\left(y_{t+1}^u, b_t^u\right)\right] \qquad (5)$$

subject to (3).
The solution yield the following Euler equation:

$$U'\left(c_t^{u*}\right) = \delta\, R\, E_t U'\left(c_{t+1}^{u*}\right) \qquad (6)$$

As Khalid (1996), it is used a quadratic utility function, implying the certain equivalence principle. This assumption allows finding a linear solution for the Euler equation such as:

$$c_t^{u*} = \beta_0 + \beta_1 E_t w_t^{u*} \qquad (7)$$

After aggregating variables and distinguishing that there is a percentage θ of individuals with and (1-θ) without liquidity constraint, one find:

$$\begin{aligned} C_t &= (1-R)\beta_0 + (1-\beta_1)RC_{t-1} + (1-\gamma)(1-\theta)\beta_1 E_{t-1} H_t + (1-\gamma)\beta_1 \sigma E_{t-1} S_t + \\ &\quad + \theta Y_t - \sigma G_t - (1-\beta_1)R\left[\theta Y_{t-1} - \sigma G_{t-1}\right]\mu_t^* \end{aligned} \qquad (8)$$

As equation (8) depends on Human wealth, H_t, which is not directly observed, it is not possible to directly test its validity. In addition, one could argue that the residuals are probably correlated with Y_t. Leiderman e Razin (1988) suggest modeling a ARIMA (1,1,0) for Y_t and G_t as a way to address this issue.

Using (8) and the estimated ARIMA(1,1,0), one finds an equation that can be empirically tested:

$$C_t = \lambda_0 + \lambda_1 C_{t-1} + \lambda_2 Y_{t-1} + \lambda_3 Y_{t-2} + \lambda_4 G_{t-1} + \lambda_5 G_{t-2} + \nu_t \qquad (9)$$

where:

$$\lambda_0 = \frac{\alpha\gamma(1-R)(1-\delta R)}{\delta R(R-\gamma)} \qquad (10)$$

$$\lambda_1 = \frac{\gamma}{\delta R} \qquad (11)$$

$$\lambda_2 = \left[\theta\left(1+\rho_1-\frac{\gamma}{\delta R}\right)+(1-\theta)(1-\gamma)\left(1-\frac{\gamma}{\delta R^2}\right)\left(\frac{R^2(1+\rho_1)-R\gamma\rho_1}{(R-\gamma)(R-\gamma\rho_1)}\right)\right] \qquad (12)$$

$$\lambda_3 = \left[(1-\theta)(\gamma-1)\left(1-\frac{\gamma}{\delta R^2}\right)\left(\frac{R^2\rho_1}{(R-\gamma)(R-\gamma\rho_1)}\right)-\theta\rho_1\right] \qquad (13)$$

$$\lambda_4 = \left[\left(\frac{\gamma}{\delta R}-1-\rho_2\right)+(1-\gamma)\left(1-\frac{\gamma}{\delta R^2}\right)\left(\frac{R^2(1+\rho_2)-R\gamma\rho_2}{(R-\gamma)(R-\gamma\rho_2)}\right)\right]\sigma \qquad (14)$$

$$\lambda_5 = \left[\rho_2+(\gamma-1)\left(1-\frac{\gamma}{\delta R^2}\right)\left(\frac{R^2(1+\rho_2)-R\gamma\rho_2}{(R-\gamma)(R-\gamma\rho_2)}\right)\right]\sigma \qquad (15)$$

In case the time series are non-stationary, it is possible to rewrite (9) as an error correction model:

$$\Delta C_t = -\phi(C_{t-1} - \theta_0 - \theta_1 Y_{t-1} - \theta_2 G_{t-1}) + \xi\Delta Y_{t-1} + \kappa\Delta G_{t-1} + \nu_t \qquad (16)$$

The system of equations (10) to (15) can be solved for the structural parameters from the estimation of the reduced form equations (9) or (16). It allows to directly testing restrictions implied by the REP. The proposition is found to hold empirically if it is not possible to jointly reject the assumptions that survival probability equal to one $(\gamma = 1)$ and percentage of individuals facing liquidity constraints is equal to zero $(\theta = 0)$. For this purpose, it was used the Log-likelihood ratio (LRT) and the Wald tests. According to Greene (2003), those tests are asymptotically equivalent to the Lagrange Multiplier (LM) test. However, for small samples, LRT is shown to be more restrictive while the Wald test is less restrictive and the LM has the lowest power to reject the null hypothesis. Thus, it was applied the LRT and Wald tests.

The model's solution generates an overidentified system of equations in C_t, Y_t, and G_t. It should not be estimated by OLS as this would result in non-consistent estimators. The assumption that explanatory variables are non-stochastic is violated. Therefore, it is necessary to use alternative estimation procedures.

In the estimation, it was used both Full Information Maximum Likelihood (FIML) and Generalized Method of Moments (GMM). We also considered the OLS estimation for comparison purposes. One should be aware that FIML estimation is based on the normality assumption for the residuals, and this might be a restrictive hypothesis. The GMM estimator does not make any assumption on the residuals behavior. In case there is more moment conditions than parameters to be estimated, overidentification can be tested by the Hansen (1982) test.

3. Econometric Procedure

3.1 Data

The data set is quarterly from the first quarter of 1996 to the fourth quarter of 2007 for Argentina, Brazil, Chile and Mexico. The seasonally adjusted time series are expressed in local currency and deflated by each country's CPI. The series along with respective sources are described below.

i) Disposable income (Y_t) represents labor income, excluding taxes. For Brazil, this series is calculated by the Brazilian Institute of Geography and Statistics (IBGE) and is available at the Ipeadata[1] web site. For the other countries, it was used the Gross National Income obtained from the IMF Statistics[2] as a proxy for disposable income, as in Khalid (1996).

ii) Private consumption (C_t) should exclude the consumption of durable goods. However, there is no such time series available. So, it was used, for Brazil, the series of final consumption of the families computed by IBGE and available at Ipeadata and, for the other countries, the series of household consumption extracted from the IMF Statistics.

iii) Government expenditure (G_t), for Brazil, was represented by the final consumption of the public administration, computed by IBGE. For the other countries, it was given by the government consumption expenditure obtained from the IMF Statistics.

iv) Real interest rate (R) was given by the quarterly factor of average real interest rates from the first quarter of 1996 to the fourth quarter of 2007. For Brazil, this information is available at the Central Bank of Brazil web site, under the link Sistema Gerenciador de Séries (SGS[3]). The real rate is the difference between nominal interest rate, represented by the Over Selic, and the inflation rate measured by the wide consumer price index, IPCA, calculated by IBGE. For Argentina, Chile and Mexico it was used the equivalent Money Market interest rate and Consumer Price Index, both available in the IMF Statistics.

3.2 Unit root tests

It is well known that traditional unit root tests, primarily those based on the classic methods of Dickey and Fuller (1979, 1981) and Phillips and Perron (1988), suffer from low power and size distortions. However, these shortcomings have been overcome by modifications to the testing procedures, such as the methods proposed by Perron and Ng (1996), Elliott, Rothenberg and Stock (1996), and Ng and Perron (2001).

[1] Available in www.ipeadata.gov.br , accessed on December 1st , 2008.
[2] Available in www.imfstatistics.org , accessed on December 1st, 2008.
[3] Available in www.bcb.gov.br , accessed on December 1st , 2008.

It was applied the modified unit root tests, labeled $MADF^{GLS}$ and MPP^{GLS}, to the time series of each country. In essence, these tests use GLS de-trended data and the modified Akaike information criterion (MAIC) to select the optimal truncation lag. The asymptotic critical values for both tests are given in Ng and Perron (2001). In addition, it was performed the test by Kwiatkowski, Phillips, Schimidt and Shin (1992), labeled KPSS, which differs from the previous ones by testing the null hypothesis of stationarity instead of unit root. Critical values are provided by Kwiatkowski, Phillips, Schimidt and Shin (1992).

The results of the unit root tests are summarized in Table 1. The tests included both constant and constant and trend. The optimal number of lags was chosen by the Modified Akaike information criteria, starting with a maximum of 10 lags. In general, the results support the conclusion that all series have a unit root, or are integrated of first order [I(1)]. At least two of the three tests performed indicated that the time series is I(1). The cointegration analysis of the next section shall confirm the conclusion of integrated series.

Table 1 – Summary of the unit root tests

Variable	$MADF^{GLS}$	MPP^{GLS}	KPSS
Argentina			
Personal Consumption SA	I(1)	I(1)	I(1)
Government Expenditure SA	I(1)	I(0)	I(1)
Disposable Income SA	I(1)	I(0)	I(1)
Brazil			
Personal Consumption SA	I(0)	I(1)	I(1)
Government Expenditure SA	I(1)	I(1)	I(1)
Disposable Income SA	I(1)	I(1)	I(1)
Chile			
Personal Consumption SA	I(1)	I(1)	I(1)
Government Expenditure SA	I(1)	I(1)	I(1)
Disposable Income SA	I(1)	I(1)	I(1)
Mexico			
Personal Consumption SA	I(1)	I(1)	I(1)
Government Expenditure SA	I(1)	I(1)	I(1)
Disposable Income SA	I(1)	I(1)	I(1)

Note: I(1) means that the time series has a unit root while I(0) that it is stationary according to the respective test at the standard 5% significance level. SA means that the time series was seasonally adjusted.

3.3 Cointegration analysis

Based on the results of the previous section, where it was found that the time series have a unit root, it was applied tests for cointegration. The goal is to find a linear combination of the series within the model, say $a'y_t$, where a is not null, that is stationary. It was applied both the Engle and Granger (1987) and Johansen (1988) tests. The results are reported in Tables 2 and 3.

One can see that there is evidence of cointegration for all countries. From Table 2, the results of the Engle-Granger procedure indicated that the time series are cointegrated for all countries but Argentina. On the other hand, from Table 3, the Johansen's test showed evidence of cointegration for all countries. For Brazil, the test indicated the existence of 2 cointegration vectors while there is just one for the other countries. Based on the cointegration results, one should estimate and test restrictions imposed by the REP on equation (16), which is an error correction model. The next section takes care of the estimation and analysis.

Table 2 – Engle-Granger cointegration test

Variable	ADF Statistic	Number of Lags
Argentina	-2,25	10
Brazil	-3,37*	0
Chile	-3,91**	2
Mexico	-3,58*	7

Note: ** and * the null hypothesis of no cointegration is rejected at the 5 and 10% significance level, respectively.

Table 3 – Johansen cointegration test

	Null Hypothesis	Statistics	Critical Value		Null Hypothesis	Statistics	Critical Value
Argentina				Brazil			
λ_{trace}	r=0	41,08*	24,28	λ_{trace}	r=0	39,68*	24,28
λ_{trace}	r=1	7,68	12,32	λ_{trace}	r=1	15,04*	12,32
λ_{trace}	r=2	0,52	4,13	λ_{trace}	r=2	2,58	4,13
λ_{max}	r=0	33,40*	17,80	λ_{max}	r=0	24,63*	17,80
λ_{max}	r<=1	7,16	11,22	λ_{max}	r<=1	12,46*	11,22
λ_{max}	r<=2	0,52	4,13	λ_{max}	R<=2	2,58	4,13
Chile				Mexico			
λ_{trace}	r=0	80,92**	24,28	λ_{trace}	r=0	52,21*	24,28
λ_{trace}	r=1	6,41	12,32	λ_{trace}	r=1	12,95*	12,32
λ_{trace}	r=2	1,78	4,13	λ_{trace}	r=2	2,29	4,13
λ_{max}	r=0	74,51**	17,80	λ_{max}	r=0	39,26*	17,80
λ_{max}	r<=1	4,63	11,22	λ_{max}	R<=1	10,67	11,22
λ_{max}	r<=2	1,78	4,13	λ_{max}	R<=2	2,28	4,13

Note: * the null hypothesis is rejected at the 5% significance level.

3.4 Model estimation

Theoretically, it is expected that the subjective discount factor (δ) has a value between 0 and 1. The survival probability (γ) also should be in the interval between 0 and 1, with 1 corresponding to the case where individuals act as if they lived forever (infinite horizon). For the substitutability between private and public consumption (σ), a negative value suggests complementarity while a positive value indicates substitutability between those consumptions. In case σ is found to be 0, one could conclude that public consumption does not crowd-out private consumption.

Equation (16) is estimated by OLS, FIML, and GMM for comparison purposes. Among the three methods, system GMM is considered the more robust because it is not subject to endogeneity problem, as OLS, nor imposes the restrictive assumption of normal disturbances, as the FIML. It is however, subject to the week instrument problem and to moment condition overidentification.

The results for the OLS estimation are presented in Table 4. Estimated coefficients for γ and δ are statistically significant at the 10% confidence level. In addition, they present positive signs and values close to 1, as expected. One should note that there are estimated values greater than one. However, statistically, they are all equal to one according to the Wald Test. The percentage of individuals with liquidity constraint, θ, is statistically significant only for Mexico, indicating that around 61% of the population has some sort of credit restriction. Substitutability between private and public consumption, σ, is also statistically significant only for Mexico, showing that there is a complementary relation between those consumptions.

Table 4 – Estimation by OLS

Country	γ	δ	θ	ρ_1	ρ_2	σ
Argentina	1,051**	1,125**	-0,429	0,584**	0,416	6,964
	(0,090)	(0,147)	(0,314)	(0,093)	(0,374)	(6,680)
Brazil	0,960**	1,012**	-0,770	0,278	-0,148	-0,466
	(0,044)	(0,075)	(0,977)	(0,187)	(0,104)	(0,480)
Chile	0,976**	0,989**	-0,149	0,068	0,804	0,712
	(0,128)	(0,179)	(1,636)	(0,089)	(1,970)	(5,567)
Mexico	1,002**	2,253**	0,610**	0,435**	-0,213	-1,663**
	(0,008)	(0,749)	(0,301)	(0,093)	(0,350)	(0,525)

Note: * and ** indicate rejection of H0 with 10% and 5% levels, respectively.

The results for the FIML estimation are presented in Table 5. Initial values of the parameters were set according to theoretical expectations and also to achieve convergence of the solution. Thus, the vector of initial values vector was given by $\gamma = 0.99$, $\delta = 1$, $\sigma = 1$, $\theta = 0$, $\rho_1 = 1.1$ and $\rho_2 = 1.1$.

The FIML also produced estimated coefficients for the survival probability, γ, and the subjective discount factor, δ, in line with what is expected. Again, greater than 1 coefficient is not so according to the Wald test. It was not found statistically significant coefficient for the percentage of individuals with liquidity restrictions. Regarding to the substitutability between private and public consumption, only Mexico presented a significant and equals to 1 estimated coefficient. This means that there is a perfect complementary relation between public and private consumptions in that country. Khalid (1996) found similar values for γ and δ using annual data in the period from 1960 to 1990 for Argentina, Brazil, and Mexico. For θ, however, the two estimations are considerably different. That might be because Latin-American countries were under strong credit restrictions during the heterogeneous period used in Khalid’s estimation. In the recent period, considered in this study, there has been achieved a relative economic stability in the regions which might have reduced credit constraints for the consumers.

Table 5 – Estimation by FIML

Country	γ	δ	θ	ρ_1	ρ_2	σ
Argentina	1,000**	1,022**	0,901	1,010**	0,543**	2,567
	(0,136)	(0,157)	(1,179)	(0,186)	(0,186)	(5,585)
Brazil	0,978**	1,059**	-0,759	0,265	-0,058	-0,854
	(0,024)	(0,116)	(0,560)	(0,272)	(0,136)	(0,500)
Chile	0,932**	0,995**	578,700	1,005**	0,808**	-3,331*
	(0,184)	(0,186)	(61850,94)	(0,194)	(0,111)	(2,017)
Mexico	0,972**	1,432**	-0,508	0,407**	-0,243	-1,041**
	(0,034)	(0,236)	(1,407)	(0,129)	(0,151)	(0,467)

Note: * and ** indicate rejection of H0 with 10% and 5% levels, respectively.

Finally the system of equations was estimated by GMM. The vector of initial values for the parameters was the same one used in the FIML estimation. The instrument set included lags of the model´s covariates, yielding an overidentified system. The Hansen´s test, however, did not reject the overidentifying restriction. The results are reported in Table 6.

In general, the estimated coefficients are close to the ones found from OLS and FIML estimations. The exceptions are δ statistically greater than 1 for Mexico and θ negative for Argentina. The latter result might be due to a structural break in the Argentine time series in the year of 2001 caused by a currency crisis. This structural break was modeled by including level and trend dummies in the regression, but the results did not change. For Mexico, it was confirmed the complementary relation between public and private consumption.

Table 6 – Estimation by GMM

Country	γ	δ	θ	ρ_1	ρ_2	σ
Argentina	1,070**	1,128**	-0,373**	0,543**	0,396**	6,216**
	(0,054)	(0,057)	(0,109)	(0,094)	(0,085)	(1,519)
Brazil	0,956**	1,038**	-0,450	0,451**	-0,093	-0,406
	(0,025)	(0,051)	(0,386)	(0,097)	(0,080)	(0,258)
Chile	0,987**	1,010**	-0,115	0,109	0,802**	0,156
	(0,005)	(0,013)	(0,087)	(0,070)	(0,046)	(0,520)
Mexico	1,003**	2,118**	0,636**	0,470**	-0,332**	-1,774**
	(0,003)	(0,254)	(0,115)	(0,094)	(0,090)	(0,257)

Note: * and ** indicate rejection of H0 with 10% and 5% levels, respectively.

3.5 Testing REP restrictions

As discussed earlier, the theoretical model generates testable restrictions for the REP in the estimated parameters. If the holds, then the estimated survival probability is statically equal to one and the fraction of individuals facing liquidity constraints is statically equals to zero. In terms of the estimated parameters, this restriction implies that $\gamma = 1$ and $\theta = 0$ jointly.

The hypothesis was tested by the Wald test applied to the three versions of the estimated model, i. e., OLS, FIML, and GMM. The Likelihood Ratio test was applied to the FIML, as this is the only method that estimates a likelihood function. Results are presented in Tables 7 and 8.

Table 7 - Results for Wald Test

	OLS	GMM	FIML
	H0: γ=1 e θ=0	H0: γ=1 e θ=0	H0: γ=1 e θ=0
Argentina	1,915	11,780**	16,461**
Brazil	1,096	3,986	1,994
Chile	0,059	8,200**	2,458
Mexico	142,735**	614,049**	12,236**

Note: ** indicates rejection of the null at the 5% significance level.

The Wald test rejects the null hypothesis of infinite horizon and no liquidity constraint for Mexico in all estimated models. For Brazil, on the other hand, it does not reject that hypothesis in none of the estimated models. In the Chilean case, there is rejection under the GMM estimation. For Argentine, rejection of the REP happens under both GMM and FIML estimations. Thus, according to the Wald test, there is strong evidence of the REP for Brazil, no evidence for Mexico, and mixed results for Argentina and Chile.

Table 8 - Results for Likelihood Ratio Test

	H0: γ=1 e θ=0
Argentina	4,656*
Brazil	5,929*
Chile	21,554**
Mexico	9,416**

Note: ** indicates rejection of the null at the 5% significance level.

The LR test confirms the previous results. At the 5% significance level, it rejects the restrictions imposed by the REP for Chile and Mexico. However, it does not reject them for Argentina and Brazil. Thus, there is unambiguous evidence that the REP holds only for Brazil during the period of the analysis.

4. Concluding Remarks

This paper provided empirical evidence on the validity of the Ricardian Equivalence Proposition (REP) for Argentina, Brazil, Mexico and Chile in the recent period of relative economic satiability in Latin America. Those countries were chosen for their representativeness in the region. The theoretical model, proposed by Khalid (1996), provides testable restrictions implied by the REP. It was applied alternative estimation procedures, represented by OLS, FIML, and GMM, and the restrictions were tested by the Wald and LR tests.

The results show that the REP cannot be rejected only for Brasil while it is strongly rejected for Mexico. For Chile and Argentina, the results are ambiguous. Estimated parameters indicated that the survival probability, γ, and fraction of individuals with no liquidity constraints, θ, are statistically equals to 1 and 0, respectively in the Brazilian case. For Mexico, about 60% of the individuals are affected by liquidity constraint.

The favorable evidence of the REP for Brazil is in line with recent studies on the issue of fiscal versus monetary dominance. Fialho and Portugal (2005) and Gadelha and Divino (2008) conclude that the Brazilian economy is under monetary dominance in the post 1994 period. Thus, there is an active monetary policy in the country seeking price stabilization which is backed by a passive fiscal policy.

In the context of the current financial crises, empirical evidences of the REP are extremely relevant for policy making. The fiscal authority is tempted to adopt expansionary policies following a Keynesian orientation. Usually, the measures involve tax reduction and increase in government expenditure. Those were the guidelines followed by many countries seeking to avoid negative impacts of the financial crisis on domestic economic activity and level of employment. In case the REP is found to hold, an expansionary fiscal policy might have no impact on the consumption path and, as a result, on the real side of the economy.

References

Barro, Robert. J. “Are government bonds net wealth?”. Journal of Political Economy, v. 82, p.1095-1117, nov. 1974.

Bassetto, M.; Kocherlakota, N. “On the irrelevance of government when taxes are distortionary”. Journal of Monetary Economics, v.51, p.299-304, 2003.

Blanchard, O. J. “Debt deficits and finite horizons”. Journal of Political Economy, v.93, p.223-247, 1985.

Buchanan, J. M. “Barro on the Ricardian Equivalence Theorem”. Journal of Political Economy, v.84, p.373-381, 1976

Cuaresma, J. C.; Reithschuller, G. “Is the Ricardian Equivalence Proposition an Aerie Faerie Theory for Europe?”. Economica, v.74, p.682-694, 2006.

Dickey, D. A.; Fuller, W. A. “Distribution of the estimators for autoregressive time series with unit root”. Journal of the American Statistical Association, v. 74, 1979.

Dickey, D. A.; Fuller, W.A. “Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root”. Econometrica 49, 1981.

Divino, J. A.; Orrillo, J. “Ricardian Equivalence Theorem in ‘a few lines’”. In: LACEA LAMES 2008, Parallel Meetings, 2008, Rio de Janeiro, p.1-14, 2008.

Elemendorf, D.; Mankiw, N. G. “Government Debt”. In J. B. Taylor e M. Woodford, (eds), Handbook of Macroeconomics. Amsterdam: North Holland, 1998.

Elliot, G.; Rothenberg, T. J.; Stock, J. H. “Efficient tests for an autoregressive unit root”. Econometrica, v.64, n.4, p.813-836, 1996.

Engle, R. F.; Granger, C. W. J. “Co-integration and error correction: Representation, Estimation and Testing”. Econometrica, v.55, p.251-276, 1987.

Fialho, M. L.; Portugal, M. S. “Monetary and Fiscal Policy Interactions in Brazil: an Application to the Fiscal Theory of the Price Level”. Estudos Econômicos, v.35 p.657-685, 2005.

Gadelha, S. R. B.; Divino, J. A.. “Dominância Fiscal ou Dominância Monetária no Brasil? Uma Análise de Causalidade”. Economia Aplicada, v. 12, no. 4, Out-Dez 2008.

Greene, W. H. “Econometric Analysis”. New Jersey, Prentice Hall 2003.

Hansen, L. P. “Generalized Instrumental Variables Estimation of Nonlinear Expectations Models”. Econometrica, v.50, Sep 1982.

Hayford, M. “Liquidity Constraints and The Ricardian Equivalence Theorem”. Journal of Money, Credit and Banking, Aug 1989.

Johansen, S. “Statistical analysis of cointegration vectors”. Journal of Economic Dynamics and Control, v.12, p.231-254,1988.

Khalid, A. M. “Ricardian Equivalence: empirical evidence from developing countries”. Journal of Development Economics, v.51, p.413-432, 1996.

Kwiatkowski, D., Phillips, P. C. B., Schimidt, S. e Shin, Y. “Testing the null hypothesis of stationary against the alternative of a unit root”. Journal of Econometrics, v. 54, p. 159-178, 1992.

Leiderman, L.; Razin, A. “Testing Ricardian neutrality with an intertemporal stochastic model”. Journal of Money, Credit and Banking, v.20, p.1-21, 1988.

Modigliani, Franco; Miller, Merton. “The cost of capital, Corporation Finance and the Theory of Investment”. American Economic Review, v.48, p.261-297, 1958.

Ng, S.; Perron, P. “Lag length selection and the construction of unit root tests with good size and power”. Econometrica, v.69, n.6, 2001.

Perron, P.; Ng, S. “Useful Modifications to Some Unit Root Tests with Dependent Errors and their Local Asymptotic Properties”. Review of Economic Studies, 9, 1996.

Philips, P. C. B.; Perrron, P. “Testing for unit root in time series regression”. Biometrika, v.75, p. 335-346, 1988.

Ricciuti, R. “Assessing Ricardian Equivalence”. Journal of Economic Surveys, v.17, p.55-78, 2003.