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martin@utalca.cl

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Pastén C., Roberto

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A Note on Fiscal Deficit Sustainability in Chile: 1833-1999

Una Nota sobre la Sustentabilidad del Déficit Fiscal en Chile: 1833-1999

Roberto Pastén C.¹

¹Ph.D. Escuela de Ingeniería Comercial, Universidad Tecnológica Metropolitana. E-mail: rpasten@cba.ua.edu

ABSTRACT. If fiscal deficit is stationary around a mean, the government's intertemporal budget constraint (GIBC) holds and no adjustment to the debt process is necessary. If fiscal deficit is non-stationary, or if it is stationary around a positive trend, the ability to pay the debt is compromised and a sudden change in the debt process is expected in order for the government to keep the public debt marketable. The former case is called strong sustainability while the latter is called weak sustainability. This paper shows that for the whole period 1833-1999 the Chilean fiscal deficit has been stationary around a mean and for the period 1889-1973 it has been stationary with a structural break in trend around 1940 and therefore only weakly sustainable from 1940 to 1973.

Keywords: Chilean fiscal deficit, structural breaks, public debt sustainability.

RESUMEN. Si el déficit fiscal es estacionario alrededor de una media, la restricción intemporal del presupuesto del gobierno (GIBC) se mantiene y no es necesario un ajuste al proceso de la deuda. Si el déficit fiscal no es estacionario, o si es estacionario alrededor de una tendencia positiva, se compromete la capacidad para pagar la deuda y se anticipa un cambio brusco en el proceso de la deuda a fin de permitir al gobierno de mantener vendible la deuda pública. El primer caso se denomina sustentabilidad fuerte y el segundo caso se denomina sustentabilidad débil. Este artículo muestra que para todo el período 1833-1999 el déficit fiscal chileno ha permanecido estacionario alrededor de una media y que para el período 1889-1973 ha permanecido estacionario con un quiebre estructural de la tendencia alrededor de 1940, y por lo tanto, sólo con sustentabilidad débil desde 1940 a 1973.

Palabras clave: Déficit fiscal chileno, quiebres estructurales, sustentabilidad de la deuda pública.

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1. Introduction

Figure 1 displays both; fiscal spending and fiscal revenue (as GDP share) for Chile in the period 1833-1999. In the figure is possible to observe the fiscal disarray around the middle 1970s, a period that recorded the highest deficits in the history of the country and only followed in intensity by wartime periods such as the War against Spain (1864-1866), the Pacific War (1879-1884) and the civil war of 1891. Also in figure 1, it is evident the increasing trend toward higher and higher deficit emerging by 1940 (at the beginning of the Second World War) and lasting until 1973 (the year of President Allende's deposition). Stabilization and positive fiscal budgets emerged at the beginning of General Augusto Pinochet's rule and remained in place afterward. Historical account of the events surrounding the deposition of President Allende seems to indicate that the Chilean fiscal position was critical at the end of the socialist government in 1973. A debt process that is non sustainable, as we argue in this paper, implies a current fiscal policy that cannot be maintained in the long run without resort to a sudden adjustment, consequently, by 1973, at least at first sight, it seems evident that the Chilean fiscal position was non sustainable at all. Therefore, any consistent indicator of sustainability must highlight the fact that at the end of 1973, the public debt process in Chile cannot be considered sustainable. The main objective of this paper is to see if novel indicators of sustainability that are based on the order of integration of the fiscal series are capable to capture the main insights of the Chilean fiscal process.

According to the literature, if fiscal deficit is I (0) the government intertemporal budget constraint (GIBC) holds and none adjustment to the debt process is necessary. This situation is referred in the literature as "strong sustainability" (Hamilton and Flavin, 1986; Trehan and Walsh 1988, and 1991).

Contrarily, if fiscal deficit is I (1), even though there are cases where the GIBC holds – as in the case where taxes and spending are cointegrated-, the ability to pay the debt is compromised. Therefore, a sudden change in the debt process is expected in order for the government to keep the public debt marketable. This situation has been referred in the literature as weak sustainability (See Quintos, 1995; Hakkio and Rush, 1991; and particularly Jha and Sharma, 2004). If deficit is I (1), public spending consistently surpasses public revenues and therefore there will be an increasing risk of default –the government either actually fails to pay the debt or implements inefficient

measures such as unplanned spending cuts, tax increases or resort to inflation financing-. However, spending that consistently surpasses taxes not are only due to a stochastic trend in the fiscal deficit process but they are also due to a deterministic trend imposed on the fiscal deficit process. Consequently, we may well call weakly sustainable not only the case where deficit is non-stationary but also where deficit is stationary around a trend. Using Chilean fiscal data for the period 1833-1999 we found: a) public debt has been strongly sustainable for the whole period and b) it has been only weakly sustainable for the period 1940-1973.

This paper is organized as follows. Section 2 is a brief revision of the literature on debt sustainability and order of integration. Section 3 analyses the order of integration of the Chilean fiscal deficit for the period 1883-1999. Section 4 looks for structural breaks in trend and identifies a piecewise broken trend in the fiscal deficit. Conclusions and some explanatory political and economic events are confined to section 5.

2. Testing Fiscal Deficit Sustainability

The government's intertemporal budget constraint (GIBC) is the starting point for any fiscal deficit sustainability analysis:

$$D_{t+1} - D_t = rD_t + (G_t - \tau_t Y_t) \quad (1)$$

where D_t is the stock of government debt at the beginning of period t , G_t is the level of government spending (net of interest payments) in period t , Y_t is output level in period t , τ_t is total revenue where τ and Y is the average total revenue. Finally, r is the constant real interest rate. The left hand side of (1) defines the central government fiscal deficit in period t .

Equation (1) can be iterated forward in order to yield:

$$(1+r)D_t = \sum_{s=t}^{\infty} \frac{(\tau_s Y_s - G_s)}{(1+r)^{s-t}} + \lim_{s \rightarrow \infty} \frac{D_{s+1}}{(1+r)^{s-t}} \quad (2)$$

Dividing each variable in (2) by Y_t and assuming a constant rate of growth yields the following expression:

$$(1+r)d_t = \sum_{s=t}^{\infty} \gamma^{s-t} (\tau_s - g_s) + \lim_{s \rightarrow \infty} \gamma^{s-t} d_s \quad (3)$$

where lower-case letters represent the corresponding variables now expressed as output share, where γ is the output growth rate.

Rearranging some terms and multiplying both sides of (3) by γ^{t-1} , yields the following identity;

$$(1-\gamma)\sum_{s=1}^{\infty}\gamma^{s-1}(\tau_s - g_s) + (1-\gamma)\lim_{s\rightarrow\infty}\gamma^{s-1}d_s = (r-n)d_t \tag{4}$$

after some manipulations this expression becomes:

$$g_t + (r-n)d_t = \tau_t + \sum_{s=t+1}^{\infty}\gamma^{s-t}(\Delta\tau_s - \Delta g_s) + (1-\gamma)\lim_{s\rightarrow\infty}\gamma^{s-t}d_s \tag{5}$$

If the government is precluded to run a Ponzi game, the last expression in the right hand side of (5) is equal to zero. In that case the present value of current and future spending plus the initial level of debt must be equal to the stream of current and future tax collection. Consequently, sustainability of the fiscal deficit has been defined everywhere in the literature as the case where the last terms in (5) drops from the equation. Therefore if:

$$\lim_{s\rightarrow\infty}\gamma^{s-t}d_s = 0 \tag{6}$$

we will say that the fiscal deficit - or equivalently, the growth rate of the public debt - is sustainable.

The left hand side in equation (5) represents total expenditures inclusive of real interest payments. If α_t and β_t are assumed non stationary, the difference will be stationary. In particular assuming that both variables follow a random walk with drift;

$$\tau_t = \alpha_1 + \tau_{t-1} + \varepsilon_{1t} \tag{7}$$

$$g_t = \alpha_2 + g_{t-1} + \varepsilon_{2t} \tag{7'}$$

$$\begin{aligned} (1-\gamma)\sum_{s=t+1}^{\infty}\gamma^{s-t}(\tau_s - g_s) &= \sum_{s=t+1}^{\infty}\gamma^{s-t}(\tau_s - g_s) - \gamma\sum_{s=t+1}^{\infty}\gamma^{s-t}(\tau_s - g_s) \\ &= \tau_t - g_t + \gamma(\tau_{t+1} - g_{t+1}) - \gamma \\ &= \tau_t - g_t + \sum_{s=t+1}^{\infty}\gamma^{s-t}(\Delta\tau_s - \Delta g_s) \end{aligned}$$

replacing this expression in (5) will yield (6)

where α and β are two independent random errors. Therefore, expression 5 becomes

$$g_t + (r-n)d_t - \tau_t = \alpha + \varepsilon_t \tag{8}$$

where $\alpha = (1+n/(1+r))(\alpha_1 - \alpha_2)$ and $\varepsilon_t = \sum_{s=t+1}^{\infty}\gamma^{s-t}(\varepsilon_{1s} - \varepsilon_{2s})$

are the constant and the error term respectively.

According to (8) the difference between total expenditures (inclusive of interest payment) and total revenue is stationary. Since the left hand side in (8) is equivalent to the definition of fiscal deficit, henceforth this test reduces to a test of the stationarity of the fiscal deficit.

Now consider a regression of total revenue on total spending (inclusive of interest payments) such as;

$$\tau_t = \alpha + \beta(g_t + (r-n)d_t) + \varepsilon_t \tag{9}$$

Under the standard assumption that total revenue and total spending have a unit root, Hackio and Rush (1991) show that a sufficient (but not necessary) condition for sustainability of the fiscal deficit is $0 < \beta \leq 1$, being $\beta = 1$ the necessary and sufficient condition. Later Quintos (1995) argued correctly that $0 < \beta \leq 1$ is not only necessary but also sufficient for the GIBC to hold. In other words, it is possible to have a non-stationary deficit and still the IBC will hold.

However in the same paper, the author argued that even though under $0 < \beta \leq 1$ still the GIBC holds, it has serious implicancies over the fiscal policies. According to the author "although our results show that $0 < \beta \leq 1$ is sufficient for the deficit to be sustainable, it is inconsistent with the government's ability to market its debt in the long run. In other words, the condition $0 < \beta \leq 1$ has serious policy implications because a government that continues to spend more that it earns has a high risk of default and would have to offer higher interest rates to service its debt" (Quintos, 1995:410). Under condition $\beta < 1$, a stochastic trend is imposed on the fiscal deficit and consequently it is a signal that the government is spending more that it is earning. However, similar assertion can be stated for cases where although the fiscal deficit is stationary, it is stationary around a deterministic trend rather than around a mean. Summing up, a stochastic trend or a deterministic trend in deficit both cases implies weak sustainability. Therefore, even though the GIBC holds,

Roberto Pastén C.

the future marketability of the public debt is compromised and a sudden change in the debt process is expected.

We will now turn to the empirics of the fiscal data in the Chilean case. We will find that even though the fiscal deficit is stationary around a flat trend for the whole sample 1833-1999, it is stationary around a broken trend – and therefore only weakly sustainable – for the sub-sample 1899-1973.

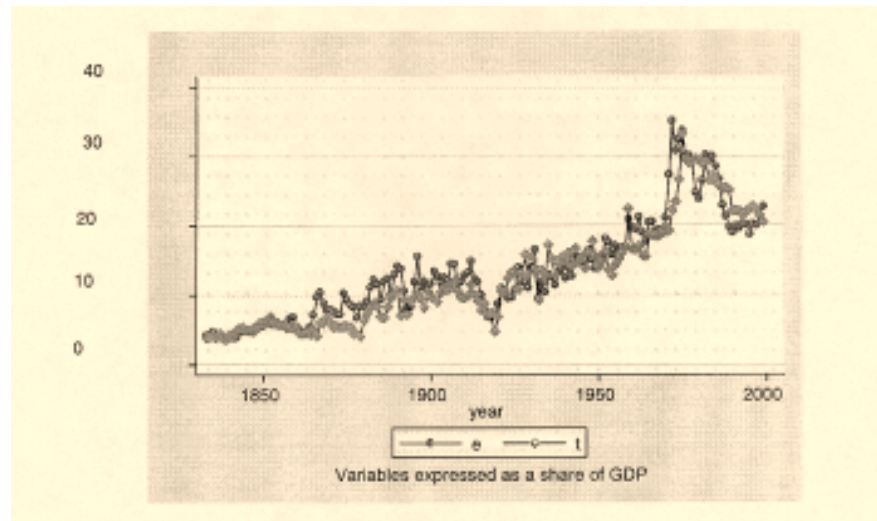
3. Analyzing Chilean Fiscal Budget Sustainability: 1833-1999

This section analyzes the possible stationarity of the

fiscal deficit in order to test the hypothesis that the debt has been sustainable in the long run (1833-1999). The data for total expenditures, total revenue and the overall fiscal deficit for the Chilean consolidated central government (all of them as a share of output) have been taken from a series rigorously constructed by Wagner et al (2000) comprising information for the Chilean fiscal sector from 1833 to 1999.

Figure 1 displays fiscal revenue and fiscal expenditures (as a share of GDP) for the period 1833-1999. As can be seen in the figure both variables tend to meander around a trend. The apparent structural break that seems to emerge around the middle seventies is given by a particular set of structural

Figure 1. Public revenue and public spending Chile: 1833-1999



Source of the data: Wagner, Jofre and Luders (2000)
e :public spending; t: public revenue

reforms implemented by the military government of General Augusto Pinochet.

If fiscal deficit is stationary around a flat trend, the null hypothesis that the fiscal deficit has been (strongly) sustainable cannot be rejected by the data. Column (2), Table 1 presents a set of unit root tests for (fiscal deficit as a share of GDP). As can be seen from entries

in the table, every statistic rejects the null hypothesis of a unit root in the fiscal deficit at conventional levels of confidence. Moreover, in every case the corresponding statistic does reject a trend in the series (not reported). The results presented in Table 1 therefore provide support for the proposition that the fiscal has been stationary around a mean and therefore, strictly sustainable in the long run.

Table 1. Unit root tests for deficit 1833-1999

$$\Delta x_t = \alpha + \beta x_{t-1} + \pi + \sum_{j=1}^p \gamma_j \Delta x_{t-j}$$

Statistic	Deficit	5 % Critical value	10 % Critical Value
ADF	-2.914(6)	-2.886	-2.576
GLS-DF	-2.840(6)	-2.021	-1.712
PP(z(rho))	-41.972(6)	-13.832	-11.088
PP(z(t))	-4.921(6)	-3.441	-3.141

ADF: Augmented Dickie Fuller Test, GLS-DF: GLS Dickie Fuller Test. PP ((z(rho))): z(rho) Phillip Perron Test. PP(z(t)): The z(t) Phillip Perron Test.
 Between Brackets the optimal number of lags (p) selected according to the Ng-Perron (1995) statistic.

4. Fiscal Deficit Sustainability with a Break Point: 1889-1973

In this section, we implemented an endogenous procedure in order to find a structural break in the fiscal process that ended with the crisis of 1973. In doing so, it is possible to suggest some of the underlying causes that triggered the disarray in the fiscal policy and finally caused the break in the democratic system.

Similarly to the previous section, we test the hypothesis of a stationary fiscal deficit. However, this time a shorter period of time -1889-1973- is used in order to highlight one structural break rather than multiple structural breaks. The first three rows in Table 2 provide some conventional unit root statistics. In general they *do not reject the unit root hypothesis* at conventional levels. However, as was pointed out by Perron (1989) and others, standard tests of unit root have low power rejecting the null of unit root in presence of structural breaks. In order to address this issue a set of ZA (Zivot and Andrews, 1992) tests are presented in rows (4), (5) and (6) of table 2. In row (4), the Zivot and Andrews test *fails to reject* the null hypothesis of a unit root against stationarity with a

break in intercept. However in rows (5) and (6) *it rejects* unit root against stationarity with a trend shift and (less conclusively) it rejects unit root against stationarity with shift in trend and intercept simultaneously. The break points endogenously estimated are 1940 and 1935 respectively.

In Table 3 we study the form taken by the structural break using model B (shift in trend). We estimated two models that differ only in the numbers of lags considered. The first considers two lags of the differenced variable and is reflected in column (2) in the table. The second model considers three lags in the differenced variables and is reflected in column (3). Both models are close to each other. In what follows we use the model with two lags in the differenced variable (column (2)).

Where in our context corresponds to the fiscal surplus divided by GDP, is the trend, if, 0 otherwise, with the break point. is an iid random error, and the estimated values of the rest of the parameters are displayed in Table 3. From that table, it seems apparent that the surplus's trend changed from positive to negative trend during 1940. This change in regime is shown in Figure

Table 2. Tests for unit root in deficit with structural shifts 1889-1973

$$\Delta x_t = \alpha + \beta x_{t-1} + \pi + \sum_{j=1}^j \gamma_j \Delta x_{t-j}$$

Statistic	Deficit	1 % Critical value	5 % Critical Value	Breakpoint
ADF	-1.311 (4)	-3.538	-2.906	
GLS-DF	-1.239 (4)	-2.606	-2.115	
PP(z(t))	-3.397(4)	-3.532	-2.903	
ZA(A)	-3.615	-5.43	-4.80	
ZA(B)*	-5.306	-4.93	-4.42	1940
ZA(C)*	-5.349	-5.57	-5.08	1935

AFF: Augmented Dickie Fuller Test, GLS-DF: GLS Dickie Fuller Test, PP(z(t)): The z(t) Phillip Perron Test. ZA(A) is Zivot-Andrews Test with a change in intercept. ZA(B) is Zivot-Andrews Test with change in trend. ZA(C) is Zivot-Andrews Test with a change in both, intercept and trend. Between Brackets the optimal number of lags (j) selected according to the Ng-Perron statistic (1995).

Table 3. AR(2) AND AR(3) regressions 1889-1973D

Dependent Variable	ΔSur_t	2 Lags in Diff.	3 Lags in Diff.
Constant		-200.88 (-4.47)	-225.59 (-4.38)
t		0.104 (4.47)	0.12 (4.38)
DT		-0.287 (-5.19)	-0.31 (-4.93)
Sur_{t-1}		-1.00 (-6.28)	-1.044 (-5.28)
ΔSur_{t-1}		0.75 (3.29)	0.93 (2.50)
ΔSur_{t-2}		-0.25 (1.95)	-0.43 (-1.20)
ΔSur_{t-3}			0.07 (0.54)

Following Perron (1989) and Zivot and Andrews (1992) if the alternative to a unit root model is a stationary model with a shift in break, the stationary variable takes the form:

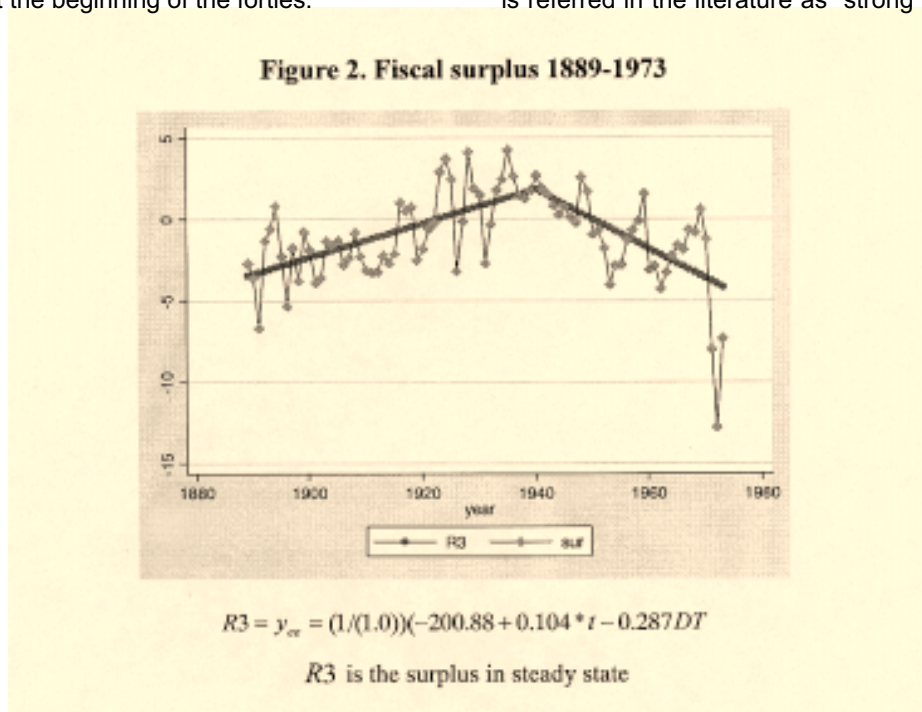
$$\Delta sur = y_t - y_{t-1} = \mu + \beta t + \gamma DT_t + \alpha y_{t-1} + \sum_{j=1}^k c_j \Delta y_{t-j} + e_t \quad (10)$$

Table 3. From that table, it seems apparent that the surplus's trend changed from positive to negative trend during 194. This Change in regime is shown in Figure 2.

Our results imply that the only shocks that have had a permanent effect on the long run behavior of the Chilean fiscal deficit are those events that happen to occur about the beginning of the forties.

5. CONCLUSIONS

The intertemporal budget constraint imposes a particular set of properties on the order of integration of the fiscal time series. Accordingly, if fiscal deficit is $I(0)$ with a flat trend, the government's intertemporal budget constraint (GIBC) holds and no adjustment to the debt process becomes necessary. This situation is referred in the literature as "strong sustainability".



However, if fiscal deficit is $I(1)$, even though there are cases where the GIBC holds - as in the case where taxes and spending are cointegrated- or if it is stationary around a positive trend, the ability to pay the debt is compromised. Therefore, a sudden change in the debt process is expected in order for the government to keep the public debt marketable. This situation has been referred in the literature as weak sustainability.

Overall, our empirical analysis concludes that fiscal deficit has been stationary around a mean (and therefore strongly sustainable) for the whole period of the sample 1833-1999. Nevertheless, it has been stationary for the period 1889-1973 with a structural break in trend around 1940.

Accordingly, we conclude, that during the whole history of the republic, every shock had only a transitory effect

on the fiscal account with the only exception of those events marking the end of the Great Depression and the beginning of Second World War -such as the implementation of a model of development from an outward oriented to an inward oriented strategy of development and other events- that seems to have had a permanent effects on the Chilean fiscal deficit process.

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