A SIMPLE ASSESSMENT OF FISCAL SUSTAINABILITY FOR THE ROMANIAN ECONOMY

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Abstract

The financial crisis has seriously impacted the economies around the world, emerging and developed alike. With interest rates at historical low levels, constrained in many cases by the zero lower bound, the emphasis is put on fiscal policy to restore the economies on the path of sustainable growth. This paper attempts to shed light on the issue of fiscal sustainability of the Romanian economy, by checking if the intertemporal fiscal constraint of the government is respected. According to the constraint, the current value of debt equals the sum of the discounted values of future government surpluses, which means that the government is not financing itself through a Ponzi scheme. I build on the econometric approach used in papers such as Hamilton and Flavin (1986), Hakkio and Rush (1991), Quintos (1995), Santos Bravo and Silvestre (2002), Bohn (2007). More specifically, I focus on the time series properties of government debt, revenue and expenditure, determining: i) the order of integration for the government debt series; ii) whether or not government revenue and expenditure are cointegrated. Thus I am able to evaluate the strength of the fiscal position of the Romanian economy and to see the impact of the financial crisis on this position.

***Keywords**: fiscal policy, intertemporal budget constraint, cointegration*

Introduction

The financial crisis has seriously impacted the economies around the world, emerging and developed alike. One of the most important consequences is the current sovereign debt crisis, affecting a number of countries including members of the European Union (EU) and the euro area. Economies which promoted an unsustainable growth, with unconsolidated budgets and a large volume of debt, currently encounter difficulties financing that debt.

Against this background, this paper studies the fiscal sustainability of the Romanian economy, by checking if the intertemporal fiscal constraint (henceforth IFC) of the government is respected. According to the constraint, the current value of debt equals the sum of the discounted values of future government surpluses, which means that the government is not financing itself through a Ponzi scheme. More details are given in the following section which contains a theoretical presentation of the problem and an empirical application.

Previous papers study and derive necessary and sufficient conditions for the IFC to hold. For example, Hamilton and Flavin (1986) notice that the government can have a permanent deficit including interest payments on debt, and still the constraint would be respected, however, not in the case of a permanent deficit excluding interest payments on debt. Trehan and Walsh (1991) consider in their analysis two cases: constant and variable interest rate. They show that if interest rate is a positive stochastic process, a sufficient condition for the IFC is that the first difference of the debt series is stationary (and the debt series is integrated of order 1 – I(1)). Focusing on government revenue and expenditures, Hakkio and Rush (1991) show that if the two variables are cointegrated, the IFC holds, even though expenses rise faster than revenue. Still, they argue that in this case, government credibility is affected which makes financing deficits more difficult. Quintos (1995) distinguishes between a strong and a weak condition for fiscal sustainability: she shows that revenue and expenditure cointegration is a sufficient but not necessary condition for the bubble term in the fiscal constraint to converge to 0, still a faster convergence is achieved when the debt process is

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stationary or I(1) (this corresponds to the strong condition). Empirical testing of the IFC relies on econometric tests to see if these conditions (stationarity of the debt process, cointegration between expenditures and revenues, etc.) hold. The studies mentioned above focus on the U.S. economy, and similar approaches have been put forward in papers that focus on other economies (see Afonso (2004) for a review). Recent papers in this strand of literature study the IFC for groups of countries using panel data (see for example Prohl and Schneider (2006), Afonso and Rault (2007)), which allows them to capture fiscal spillover effects. Bohn (2007) adopts a critical point of view with regard to the unit root and cointegration tests used in the literature. He proves that the IFC is satisfied if public debt follows an integrated process of any finite order (this is also shown in Bergman (2001)) and argues that the strict econometric approach delivers weak conditions, in a sense that one can show that the IBC is satisfied, and still that economy could default.

This paper studies the sustainability of the fiscal position of the Romanian economy, by determining: i) the order of integration of the government debt series; ii) whether or not government revenue and expenditure are cointegrated. This study has two main motivations. First of all, it is instructive to analyze the fiscal position of a country, to better understand the risks the country is facing, especially in the current economic context. Even though the level of government debt is relatively low compared with the other countries of the EU, according to Reinhart and Rogoff (2009), as debt levels rise to historical limits (as is the case for the Romanian economy), risk premia begin to rise sharply, and so the economic situation will deteriorate. The second reason concerns the impact of fiscal policy on economic growth. A fiscally sound country is able to provide public investments and at the same time its credibility attracts foreign investors.

Paper content

In this section I briefly present the theoretical background of the paper, following Bohn (2007). Then I review the results of my case study of the Romanian economy.

Theoretical background

In every period, the government's budget constraint is:

$$B_t = G_t^0 - T_t + (1 + r_t) \cdot B_{t-1} \quad (1).$$

The government uses currently issued debt (B_t) to cover its deficit (G_t^0 represents public spending excluding debt payments and T_t represents public revenue) and the payments on the previous period's debt. The following notations are often used:

$$\Delta B_t = B_t - B_{t-1} = G_t^0 + r_t \cdot B_{t-1} - T_t \quad (2)$$

ΔB_t is the first difference of government debt and the period's *with interest deficit*. Excluding the interest payment from (2), we get the period's primary or no interest deficit:

$$DEF_t = G_t^0 - T_t \quad (3)$$

In order to obtain the IPC for each period's budget constraint, assumptions are made regarding the interest rate process. The most common are:

- ✓ The interest rate is positive and constant: $r_t = r > 0$
- ✓ The interest rate is uncorrelated over time with a positive constant conditional expectation: $E_t r_{t+1} = r > 0$
- ✓ The interest rate is a stationary process with mean $r > 0$.

For the last assumption, additional restrictions may be imposed to assure that the process G_t has similar properties to G_t^0, where:

$$G_t = G_t^0 + (r_t - r) \cdot B_t \quad (4)$$

is government adjusted spending.

For either assumption, writing (1) for period *t+1,* with information from the current period *t*, and defining $G_t = G_t^0$ in the first two cases, we get:

$$B_t = \frac{1}{1+r} E_t (T_{t+1} - G_{t+1} + B_{t+1}) \quad (5)$$

Iterating forward, we obtain:

$$B_t = \left(\frac{1}{1+r}\right)^N \cdot E_t B_{t+N} + \sum_{i=i}^{N} \left(\frac{1}{1+r}\right)^i \cdot (T_{t+i} - G_{t+i}) \quad (6)$$

Taking $N \to +\infty$ in (6), the result is:

$$B_t = \lim_{N \to +\infty} \left(\frac{1}{1+r}\right)^N \cdot E_t B_{t+N} + \sum_{i=i}^{+\infty} \left(\frac{1}{1+r}\right)^i \cdot (T_{t+i} - G_{t+i}) \quad (7)$$

The IPC is respected if and only if the first term of the right-hand side of (7) is 0, that is:

$$\lim_{N \to +\infty} \left(\frac{1}{1+r}\right)^N \cdot E_t B_{t+N} = 0 \quad (8).$$

This corresponds to the government not financing its activity through a Ponzi scheme, so that the current value of debt equals the discounted value of future government surpluses.

Bohn (2007) shows that any stochastic process that is integrated of a finite order (and even a mildly explosive process) satisfies (8) and thus the IPC, but follows Quintos (1995) and argues for a qualitative evaluation, the general idea being that the larger the order of integration for the debt series, the *weaker* the sustainability of government finances (even though strictly speaking the IPC continues to hold and (8) is respected, the convergence is much slower the higher the integration order of debt).

With regard to the relation between government revenue and expenditure, first one can define the government spending including interest payments on debt as:

$$G_t^r = G_t^0 + r_t \cdot B_{t-1} \quad (9)$$

With this notation, from (2) we obtain:

$$\Delta B_t = G_t^r - T_t \quad (10)$$

Bohn (2007) shows that G_t^r is $I(m_G)$ and T_t is $I(m_T)$, than the IPC holds if B_t is $I(m)$ and $m \le \max(m_G, m_T)+1$. However, if both G_t^r and T_t are $I(1)$ and cointegrated such that:

$$T_t = \mu + b \cdot G_t^r + \varepsilon_t \quad (11)$$

with ε_t stationary, from (10) we get that:

$$\Delta B_t = -\mu + (1-b) \cdot G_t^r - \varepsilon_t \quad (12)$$

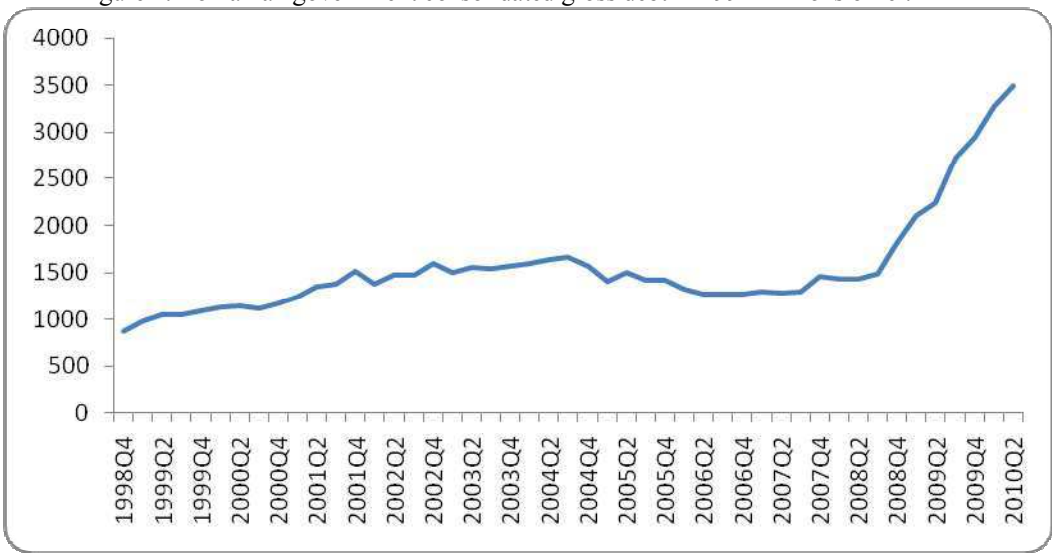
which means that ΔB_t is either stationary or $I(1)$, so B_t is either $I(1)$ or $I(2)$. In this case, convergence in (8) is much faster.

Empirical results

I test the IPC for the Romanian economy by determining: i) the order of integration for the government debt series; ii) whether or not government revenue and expenditure is cointegrated. The sample consists of quarterly data covering the period 1998Q4 – 2010Q2 for the government debt series and 1995Q1 – 2010Q2 for government revenue and expenditure. The variables are expressed in real terms, more precisely, they are expressed in 1994 lei, the series in nominal terms is deflated using the Consumer Price Index. Other possibilities are to work with per – capital values or with percentages of GDP. The data source is the Eurostat.

Figure 1 shows government consolidated gross debt for the analyzed period.

Figure 1: Romanian government consolidated gross debt in 1994 millions of lei.



Source: Eurostat

A visual inspection reveals that the series is stationary up to the year 2008, when it registers a significant increase. Keeping in mind that the fiscal situation of an economy is more sustainable if the convergence in (8) is faster, an increase in the order of integration of the series in 2008 would signify a deterioration of the fiscal position. I formally test this using the *Augumented Dickey – Fuller* and the *Kwiatkowski – Philips – Schmidt – Shin* tests. The results of the tests are highlighted in Table 1. The tests are applied to the natural logarithm of the raw series, as there is no visible pattern of seasonality.

Table 1: Stationarity tests for ln (gov debt)

Test	**Sample**	**Test statistic**	**Theoretical statistic**
ADF	1998Q4 – 2010Q2	3,84	-2,60 (10%)
KPSS	1998Q4 – 2010Q2	0,51	0,46 (5%)
ADF	1998Q4 – 2008Q3	-2,58	-2,61 (10%)
KPSS	1998Q4 – 2008Q3	0,34	0,35 (10%)
ADF	2008Q4 – 2010Q2	0,37	-2,80(10%)
KPSS	2008Q4 – 2010Q2	0,40	0,35 (10%)

Source: my own calculations in Eviews 5

Both tests reveal that the whole sample is non-stationary. The ADF cannot reject the null hypothesis that the series has a unit root, and the KPSS rejects the null that the series is stationary at the 95% level. Running the tests on two subsamples (one runs from the start of the available data to the third quarter of 2008 and would correspond to "normal times" in the economy, while the other would correspond to "crisis times") reveals that the first period is characterized by "more stationarity" than the second. The ADF rejects the null at a 89% level of confidence (the p-value is 0,1042), still the KPSS also comes very close to rejecting the null at the 90% level. Because of the contradictory results, one cannot say based on only the two tests whether the series is stationary or not. It is possible to gain more insight using appropriate fractional integration tests. Testing stationarity on the second sample should be taken with a grain of salt, because of the small number of

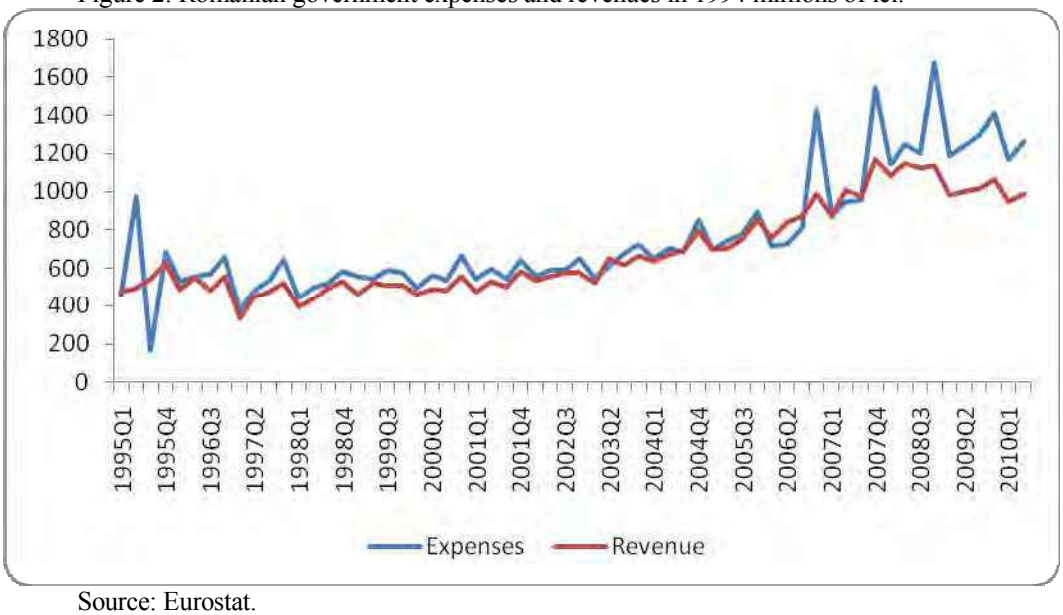
observations. However, both tests indicate the same result of non-stationarity (ADF cannot reject the null and KPSS rejects the null at the 90% level of confidence).

With respect to the order of integration of the debt series, the ADF reveals that for the whole sample, the series is *I(2)*. For the first period, we can almost reject the null of a unit root with 90% confidence, so in the first period, debt is *I(0)*. For the second sub-sample, debt is *I(1)*, we can reject the null for the first difference series with 99% confidence.

These results indicate that that the fiscal position has deteriorated in the second period. The government contracted loans to finance its expenses, at the same time pursuing a fiscal consolidation agenda which implied a decrease in the level of the budget deficit, while public revenues were dropping as a result of the crisis. Even though strictly speaking, the IPC is respected, maintaining credibility is crucial in order for the government to finance itself.

The second empirical test refers to revenue and expenses cointegration. If two series are not stationary, and are integrated of the same order (we shall see that this is the case in this study), most of their linear combinations are also integrated of the same order. However, if there is a linear combination that is stationary, the two initial time series are cointegrated. Intuitively, cointegration can be interpreted as the two series which have nonstationary trajectories never drifting off too far away from each other. Referring to government finances, one can say that they are sustainable even if expenses are on a path of growth, if revenues move "together" with expenses. Figure 2 shows the two time series for the period 1995Q1 – 2010Q2.

Figure 2: Romanian government expenses and revenues in 1994 millions of lei.



Source: Eurostat.

Both series but especially government expenses display seasonal patterns, so I shall perform a seasonal adjustment for both series using the Census X12 method implemented in Eviews.

In order to test for cointegration two methodologies are employed, Engle – Granger test and Johansen. Both of them require that the order of integration of the initial series be determined, which is done using the ADF and KPSS tests. They reveal that the series are *I(1)*. The results are displayed in table 2.

Both tests indicate the series are *I(1)*.

Table 2: Order of integration for government income and expenditure

Test	Series	Test statistic	Theoretical statistic	Conclusion
ADF	Exp: level	3,53	-2,59 (10%)	unit root
ADF	Exp: 1 diff	-15,28	-3,56(1%)	no unit root
KPSS	Exp: level	0,79	0,73 (1%)	not stationary
KPSS	Exp: 1 diff	0,34	0,35 (10%)	stationary
ADF	Rev: level	0,43	-2,59 (10%)	unit root
ADF	Rev: 1 diff	-9,24	-3,56(1%)	no unit root
KPSS	Rev: level	0,75	0,73 (1%)	not stationary
KPSS	Rev: 1 diff	0,34	0,35 (10%)	stationary

Source: my own calculations in Eviews 5

The Engle-Granger methodology consists of regressing the two series and verifying to see if the residuals are stationary. I estimate regression (11) and use the ADF to see if the series $\hat{\varepsilon}_t$ is stationary. I do this for the whole sample and the two sub-samples. The results are displayed in table 3.

For the whole sample, the test indicates the existence of cointegration between government expenditures and income. However, sub-sample testing reveals that the cointegration relation is not consistent with the second part of the studied period. This points to a negative impact of the economic crisis on the sustainability of public finances in Romania, though the second sample is of a very short length, and the results should be interpreted with caution for the second sub-sample.

Table 3: Engle-Granger test for government revenue and expenses

Sample	$\hat{b}$	$R^2 - adj.$	ADF stat.	Conclusion
1995Q1 – 2010Q2	0,69***	85,11%	-1,78*	cointegrated
1995Q1 – 2008Q3	0,77***	81,92%	-7,79***	cointegrated
2008Q4 – 2010Q2	0,1	-2,29%	-1,08	not cointegrated

Source: my own calculations in Eviews 5

Note: * corresponds to a 90% level of confidence, *** corresponds to a 99% level of confidence.

The second methodology I apply is the Johansen test. As noticed in (Enders, 2004), this is nothing more than a generalization (basically, an extension to a multivariate case) of the Dickey – Fuller procedure. It involves building the following model:

$$\Delta x_t = \pi \cdot x_{t-1} + \sum_{i=1}^{p-1} \pi_i \cdot \Delta x_{t-i} + \varepsilon_t \quad (13)$$

The residuals in (13) are stationary. x is a vector that contains the variables for which cointegration is being tested, in our case, $x_t = \left(G_t^r \quad T_t\right)^{trans}$. The rank of the matrix π equals the number of cointegration relations between the variables in x. Since the latter is a (2,1) vector, this means that π is a (2,2) matrix, and its rank can either be 0, 1 or 2. If the rank is 0, this means that $\pi = 0_2$ and both series are unit root processes with no linear combination of them being stationary. If π is full-rank, both series are stationary. If the rank is 1, the variables are cointegrated. Determining the rank of π is done using the maximum eigenvalue and the trace statistics. More details are available in (Enders, 2004).

I use the Johansen procedure for the entire sample and the firs sub-sample. The small number of observations in the second sample makes it difficult to draw meaningful conclusions. I use two specifications of the model depicted by (13), one that includes an intercept in the cointegrating equation and the VAR (I shall call it specification A) and another that includes an intercept and a trend in the cointegrating equation and an intercept in the VAR (specification B). I include a maximum of 4 lags in the VAR. The Johansen test results are displayed in table 4.

Based on the results in table 4, it can be concluded that there is a cointegration relation between government revenues and expenditures for the first sub-sample and the whole sample. It would seem that government finances are in a sustainable position, however due to the small number of observations in the second sub-sample, the impact of the economic crisis is rather unclear.

Table 4: Johansen test results

Sample	Specification	Lag(s)	Trace stat.	Max. eigenval. stat.	Conclusion
full	A	1	34,61***	34,38***	cointegrated
full	A	2	16,07**	15,04**	cointegrated
full	A	3	15,95**	15,13**	cointegrated
full	A	4	15,07*	12,55*	cointegrated
full	B	1	40,58***	37,69***	cointegrated
full	B	2	25,79*	15,37	mixed
full	B	3	26,76**	15,14	mixed
full	B	4	29,38**	17,28*	cointegrated
1st subs.	A	1	52,33***	47,13***	cointegrated
1st subs.	A	2	19,44**	15,42**	cointegrated
1st subs.	A	3	17,64**	12,61*	cointegrated
1st subs.	A	4	10,56	9,70	not cointegrated
1st subs.	B	1	57,01***	47,21***	Cointegrated
1st subs.	B	2	31,06**	17,53*	Cointegrated
1st subs.	B	3	31,21***	18,95*	Cointegrated
1st subs.	B	4	29,34**	21,16**	Cointegrated

Source: my own calculations in Eviews 5

Conclusions

In this paper I used an econometric approach consisting of unit root and cointegration tests to see if the debt issuing process of the Romanian government is sustainable or is in fact a Ponzi – scheme. In the current context, this issue is very important as more and more countries experience a decrease in public revenues and rely on public debt to finance their expenses.

Unit root testing has revealed that public debt has been stationary until the beginning of the crisis, while in the second sub-sample, it is a *I(1)* process. Cointegration tests between government revenues and expenditures have shown that between 1995 and the second half of 2008, they are cointegrated. For the second sub-sample, the Engle – Granger methodology indicates lack of cointegration. Overall results point to a generally sound fiscal position of the Romanian government, however, the economic crisis had a consistent negative impact.

An interesting avenue to continue this research would be to study the relationship between government deficit and debt, by estimating a fiscal reaction function.

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