Seigniorage and inflation tax in Romania.
What is the executive giving up by adopting the euro?

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Abstract

This paper is concerned with measuring the seigniorage in Romania since the fall of communism and the potential gains after passing to euro. Starting from the balance sheet of the central bank, we estimated these levels of seigniorage for a period of 27 years. Our findings suggest that this source of revenue was at very high rates in the period of the 90's, mostly due to the huge prolonged inflation rates. Ever since the independence of the central bank, these levels of seigniorage dropped and became constant, at around 1-2% of the GDP. Also, we computed the potential gains due to euro adoption. We showed that as Romania converge with the rest of the Eurozone its seigniorage potential gains from euro adoption drops. Because these gains are only very small in relation to national income, we argue that the implications of giving up own currency are not budget related.

Keywords: seigniorage; inflation tax; monetary policy; euro adoption; Romania.

JEL classification: E01; E02.

1. INTRODUCTION

The term seigniorage was first used in Medieval Europe and signified, in the beginning, the profit which the mints sent to the sovereign after the transformation of the precious metals, brought by individuals, into coins, but with time it came to include also other concepts like brassage (the value of the metal the mint kept for itself, as the cost of transformation process) and debasement – for the currency using precious metals, like gold and silver, the face value of the coin indicated the weight value of the material of the coin, but sovereigns have ordered the reduction of the weight of the issued coins in order to save precious metals (of course the face value of the coins kept indicating the same values). This method was widely used in Medieval and Modern times in Europe (Rolnick *et al.*, 1996).

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In time, seigniorage came to signify all the revenue that the sovereign made by having the monopoly on the minting process in its realm. Even though the age of sovereigns and their realms have long disappeared, seigniorage, the revenue that accompanies the monopoly for the creation of the money, keeps on being a steady source of income for many governments (Click, 1998). The term is referred as an attribute of the state, i.e. of the government, but nowadays, as more and more governments become insulated from the execution of the monetary policy, the central banks are the ones which collect this revenue. Still, many authors, as presented below, preferred to regard the central bank and the government as a single entity in order to facilitate the computation of seigniorage.

Seigniorage was very popular among political economists during the 1990's, especially in Europe due to the debates on the margin of the creation of a single currency and a European Central Bank. These studies posed a highly practical question: how much will the national governments lose when they will cede their sovereign monetary policy to the ECB. Nowadays, with the single currency and European bank already in place this subject is no longer so popular among academic debates, but still poses the same practical importance, as in the past, for the other countries awaiting to become full members of the euro area.

This paper is concerned with quantifying the seigniorage in Romania ever since the fall of the communist regime and quantifying also the seigniorage gains after a hypothetical passing to euro. In the pending process of being part of the Eurozone, is important for a country that still manages its own monetary policy to know how big the cost or benefit of giving it up is. Furthermore, as we show here, it is a good indicator of how the executive used monetary policy as a mean for smoothing the eventual financial difficulties of both the government and the banking system, created by the economic transition.

Of course, it can be argued that the National Bank of Romania, as part of the European Central Banks System will receive its share of profit from the ECB, in accordance with the value of the assets it brings and other relevant factors (such as population and GDP share). In this case, even if the profits as an ECBS member will surpass the profits as an independent central bank, we know for sure that Romania will have no control over these profits in the eventual adoption of euro, whereas now, using some mechanisms that will be discussed later, it can.

Even though there were some other authors concerned with quantifying this phenomenon in post-communist Romania, none of them conducted a research on this after 2004, when the statute of the National Bank of Romania (NBR) changed, becoming more independent from government influence. Furthermore, this paper also presents something new to this subject: it computes the optimal inflation-tax rate with respect to seigniorage. From here, it stems the originality of this paper. The academic importance is given by the fact that the methodology we use gives us a better approximation of the seigniorage levels. Even more, the policy making implications of this paper are high, as the estimates we make will show the exact gains or losses of the executive as it will give up the national currency by adopting the euro.

The rest of the paper is structured as follows. In the 2nd Section we make a literature review about the concept of seigniorage and we address the debate of measuring it. In the 3rd Section part we present our chosen methodology and empirical data, while the last two parts (4th and 5th Section) are dedicated to results interpretation and study conclusions.

2. LITERATURE REVIEW - DEBATES OVER MEASUREMENT OF SEIGNIORAGE

Seigniorage, in the most general way possible, can be defined as the revenues that the state (as the sole issuer of currency) gains from minting currency, although there are many different interpretation of the concept depending on the authors (Drazen, 1985).

First, there is the concept of seigniorage as a cash-flow or monetary seigniorage. The idea is that the state can issue currency (which has virtually no cost of production) in order to pay for its spending. This monopoly that the state had in the past helped with paying its debt to the domestic and international creditors, simply by expanding the monetary base and imposing to everyone a so-called inflation tax (in this sense, the hyperinflationary episodes from Germany and Hungary in the immediate following period of World War I and World War II are iconic examples). The states that prefer to use this source of revenue, do it for two reasons: the money they are generating virtually have no cost and can go directly in the treasury and secondly, by launching these quantities in economy, they hope to push to a quick recover of the economy by the multiplier effect that government spending have on the economy. It can be measured as the real increase in value of the monetary base.

$$S_m = \frac{(M_t - M_{t-1})}{P_t}$$

S_m is the monetary seigniorage, M_t-M_{t-1} signifies the annual change in the monetary base and P_t is the price level. As stated above the executive is printing money at virtually no costs, but faces a trade-off; as the monetary base increases, the real value of the money decreases. The lost value of this course of action can be measured as the revenues from a tax: the taxation rate (in this case the rate at which the real money devalues, or inflation) times the base of the tax (the value of the real balances) (Cagan, 1956):

$$T_{infl} = \pi * M/P$$

where T_{infl} is the inflation tax, π represents the rate of inflation. As in the case of any tax, as the taxation rate rises, the tax base decreases due to the deadweight loss of the tax imposed, hence the presence of a Laffer curve.

But, regarding this concept, two issues arise: the first one has to do with the fact that depending on the degree of institutional independence of the central bank, the inflationary pressure from the government could vary a lot, which in turn will influence the new stock of printed money (Klein and Neumann, 1990). The second issue with this type of seigniorage have a more practical aspect: the newly issued currency will require the same value of assets in the balance of the central bank in order to be backed. Because the balance will have (at least in theory) to be maintained between assets and liabilities in the central bank's balance, increasing the monetary base (liability) will also create a minus of the same value in the liabilities side of the balance. In this case, what if the central bank orders the printing of new currency and as a counterpart to it buys interest bearing assets form the privates sector? In this case, not only that the monetary base changes, but also there will be an unwanted wealth transfer from private to public sector. This shortcoming can be corrected using a methodology where we can include the eventual unwanted wealth transfer, but for this we will need to know the exact value of the interest bearing assets acquired by the Central

banks and the aggregate interest rate; as noted, this eventual correction presents high barriers in terms of data collection and computations.

A state that has amounted huge debts will have no concern in this regard, but a state which strives to become more credible for its international financial creditors will face a tradeoff between inflation and credibility/stability.

Even with these shortcomings, the model of monetary seigniorage proposed by Cagan (1956) can be of great utility in computing the seigniorage in Romania for the period between 1990 and 2004 due to the fact that the government then still had a great influence on the central bank regarding the execution of the monetary policy and due to the fact that in the first half of the 90's decade, Romania experienced episodes of staggering inflation. It would also be interesting to compute the Laffer curve of inflation tax in this country.

The second seigniorage concept is as an opportunity cost: by providing currency in form of cash holdings that do not pay any interest rate to the holder (as opposed to the case of investing the money in securities paying interest), the state incurs an opportunity cost of money holding to the domestic sector.

In the most general way it can be measured (S_{OC}) as the nominal interest rate (i) multiplied by the monetary base (M) (Phelps, 1973; Marty, 1978)

$$S_{OC} = i * M$$

Although it seems quite easy to compute seigniorage as opportunity cost only by multiplying the interest rate with the value of the monetary base, in practice is really hard to find a valid measure of the interest rate. As there are numerous securities (both public and private) that pay interest rate in an economy, choosing only one type for the whole economy is quite arbitrary (Klein and Neumann, 1990). Furthermore, it can be argued that this opportunity cost is in fact a price that the domestic sector assumes for having high liquid money.

The third type of seigniorage is the revenue generated from the central bank's assets and from the government's debt held in the central bank. The idea behind this type of seigniorage is that holding interest bearing assets in the central bank, generates some profit for the state. Furthermore, the state can monetize its debt in the central bank; when monetizing its debt, the state will (in theory) have to pay the credit issuer a certain interest rate, but if the issuer of the credit is the central bank (which is also a public institution), the government will pay no interest or a subsidized rate of interest for its debt (a smaller interest rate than the one that can be obtained if the debt would have been monetized on the free market). Of course, nowadays this practice is strictly forbidden in the Eurozone and in Romania since 2005 (Parliament of Romania, 2004), but the idea is to be useful in computing the seigniorage before this year.

Drazen (1985), Klein and Neumann (1990) and Rovelli (1994) were among the firsts to employ this idea of seigniorage from central bank's balance sheet to approximate the value of the revenues, using different methodologies.

Drazen (1985) makes the distinction between fiscal revenues generated from the inflation tax imposed on the already existing real money holdings and the profit obtained from new issuance of money, but also provides a methodology for the unified revenue. The revenue of the first can be measured as the rate of the expansion of the money rate, multiplied by the real balances per capita. The revenue from the second is interest earned for state's net assets (held as a counterpart for the monetary base) adjusted for inflation and rate

of population growth (everything is computed in per capita terms). He also concluded that many of the previous methodologies used before to compute seigniorage were in fact deviations from the measures proposed above (Drazen, 1985). The problem with this measure is that it is quite abstract and vague in regard to the specified variables and a very exact approximation cannot be done using it.

Klein and Neumann (1990) start from the assumption that the total seigniorage of a government is very dependent on its institutional framework and thus the previous measures of monetary seigniorage and seigniorage as opportunity cost are flawed. Indeed, the empirical data presented seems to suggest this fact; the examples put in the beginning regarding West Germany and UK for the year 1987 proved to be inconsistent with the two previous measure. As suggested by the authors and already stated above, seigniorage as an opportunity cost presents the problem of arbitrarily choosing the true interest rate for the whole economy, whereas monetary seigniorage is flawed in the sense that what is actually measuring is the wealth transfer of the private sector for holding base money, which can be higher that the indicated by the monetary seigniorage. Because of these problems, the authors proposed a new model of measuring seigniorage; the total revenue from money creation is distributed among the government (which receives a share of the central bank's annual profits – this figure is easy to look for in the annual statements), the central bank (which uses part of it for operating costs and for reinvestment in assets), the domestic sector (in form of subsidized interest rates for borrowing) and the central bank's foreign debtors (in form of subsidized interest rates due to changes in nominal exchange rate) (Klein and Neumann, 1990). Still, in this work, we are only interested in the seigniorage accruing to the Romanian executive, i.e. to the central bank and government. In this sense, a more exact measure is the one proposed by Rovelli.

Starting from the ideas of Drazen (1985), Klein and Neumann (1990) and Rovelli (1994) in turn, suggested that this type of seigniorage is composed of two sources of income: the one generated by the central bank in base of the assets it has in order to manage the monetary policy (computed as the net difference between the interest earned for the assets and the interest paid for liabilities) and the second one consisting in monetization of the government's debt, also using the central bank's account. The monetization of government deficits took place through three types of central bank operation: 1. purchases of government bills and bonds by the central bank on the primary market; 2. net funds lent to the government from the central bank on the basis of normal 'banking' operations (e.g. overdraft or deposit accounts); 3. open market operations in government bills and bonds (Rovelli, 1994). As specified above, these kind of operations are strictly prohibited since 2005 – although the National Bank of Romania can operate with government bonds and treasury bills (repo and reverse repo operations for injecting or sterilizing liquidity in the market) it can only do it on the secondary market, without being allowed to keep the securities until their maturity (National Bank of Romania, 2018). All these operations were clearly increasing the seigniorage; because the central bank bought the government's debt, the government saves by not paying the interest of the debt issued due to the institutional arrangements in each country between the two parts.

As a note in this regard, the central bank and the government should be considered a single economic unit for seigniorage to be accounted exactly. This because the government appropriates a certain amount of the seigniorage generated by the central bank in the form of tax profits and debt monetization. Legally, the National Bank of Romania is obligated to transfer 80% its annual profits to the Treasury (i.e. to the government), but even counting the

80% due to the government plus the remaining 20% (invested by the central bank in other interest bearing assets for further profit), will not give us an exact approximation of the seigniorage. This is because these sums do not account for other sources like the forgone wealth transfer from government to the creditors for the monetization of public debt in the central bank (is a cost-saving measure in the sense that it indicates what are the creditors losing by not buying state issued securities). Due to the institutional arrangements between the government and the central bank and due to the fact that the central bank's profits not always equals to seigniorage, these two institutions are to be considered as one in this process of revenue generation.

Inferring from this observation, we can also note something quite interesting. These foregone interest payments that should have been made to bond investors could have represented big losses before 2005 since the government had no issue placing its debt with NBR; with the advent of central bank independence, these amount are virtually 0 as such practices are prohibited. One can assume that this practice will be even more out of reach for the government, as the NBR will be part of the totally independent European System of Central Banks, in case of euro adoption and in such case not even a reversion of national legislation can bring once more the public debt monetization with the central bank. But, it might be misleading to believe that bond investors will actually be more safeguarded from such foregone interest payments; ever since the 2015 ECB launched a quantitative easing program which means massive buying of bonds (both corporative and government) which undoubtedly have put upward pressure on demand and prices and negative pressure on interest rates (for some of the effects of QE on bond yields, refer to Krishnamurthy and Vissing-Jorgensen, 2011 and Todorov, 2020). Such mechanism might mean that the Euro area government bonds have an artificially lower level than their EU counterparts (Romania also) which did not adopt quantitative easing measures and it means a potential loss in revenue for bondholders if Romania were to adopt the common currency.

Scanning the literature for measures of seigniorage in Romania we could found some works done in the 1990's and early 2000's. These works employed different methods and due to this fact, yield different results.

Hochreiter et al. (1996) made a comparative study among three economies in transition (Romania, Hungary and Czech Republic) and Austria and Germany (taken as benchmark countries) for seigniorage generation and distribution measurement purposes. In transition economies seigniorage is a good way of smoothing the financial difficulties of both the government and banking system. They discovered that in Romania, due to high inflation the value of the seigniorage is 30 time higher than that in the benchmark countries (as ratio to GDP).

In a study concerned with the value of seigniorage in a worldwide cross section of countries, Click (1998) concluded that the average annual rate of seigniorage for Romania, between 1971-1990 is 2.44% of the GDP, although he does not provide a clear methodology nor a definition for it.

The method of seigniorage as cash-flow is included in the computations made by Cukrowski and Fischer (2003) in a comparative study made across five Eastern and Central European countries - Bulgaria, the Czech Republic, Hungary, Poland and Romania. Using the methodology proposed by Neumann (1996), they computed the seigniorage as a sum of 3 sources: monetary, interest generated and the one generated from central's bank financial operations. In order to avoid the accusation of using such a vague measure as monetary seigniorage in their computations, the authors of this study state that they took into

consideration also the institutional framework (i.e. central bank's efficiency and independence). Still, it isn't clear how these variables have influenced because the authors did not provide any sort of country-specific methodology (only the final results have been provided). Also, another problem is that the central bank's stock of government debt is not included; as discussed above this is clearly a forgone opportunity of investment for the private sector and should be included in the calculations. Furthermore, they are not specific about what are the rest of the financial operations made by the central bank that generates seigniorage.

As can be noted in Table no. 1, which recompiles the data for the approximation of seigniorage found in all the previous works for the Romanian case, the results can be very different. Of course the periods took into consideration vary greatly, but still striking is the fact that the methodology used by Hochreiter et al. (1996) generates a very large result for seigniorage with respect to GDP (almost 30%).

Table no. 1 – the results for seigniorage approximation by various authors for the Romania case

Author/s	Approximate value of the total seigniorage	Period covered
Hochreiter et al. (1996)	29.4%	1993
Click (1998)	2.44% annual average	1971-1990
Cukrowski and Fischer (2003)	3.29%	1993-2001

To put it in contrast with other such findings, for example, Sachs and Larrain (1993) found that during 1975-1985, the highest seigniorage rate collected as ratio to GDP was in Italy (6.6%), but in terms of ratio to nonseigniorage revenues of the government, the highest was registered in Bolivia (139%). Cagan (1956), studying various hyperinflationary episodes from different postwar countries, found that the highest ever registered was Austria between October 1921-August 1922 with a value of 26% of the national income.

A study concerned with the revenue maximizing inflation tax in Argentina (Kiguel and Neumeyer, 1995) showed that an inflation that reached 170% in 1989 was able to bring to the government a revenue of close to 30% of the GDP. Thus, such high values are not to be considered flawed or unsupported by empirical evidence. In a previous work where he put the basis for the seigniorage formula, Rovelli also warned that this model of estimation, which was also used in Hochreiter et al. (1996) will end up giving higher estimates than the previous and simpler methodology proposed in Rovelli (1994).

Another issue that will have to be clarified is the one referring to the inflation tax. Some authors (Easterly et al., 1995) have argued that there is a direct relationship between inflation and seigniorage (or what is known as inflation tax). The idea behind this relationship is twofold; on the one hand the real value of the debt that the government will have to pay in its own currency is reduced (eroded) by the inflation. On the other hand, seigniorage increases with inflation due to the fact that the government orders printing money at an alert rate (thus increasing the monetary base which will eventually lead to higher inflation) due to the need to finance itself rapidly and cheaply (the cost of printing money is virtually 0), but at the cost of the whole population.

A number of researchers studied this link empirically, although the results are not that clear. The first and the most cited one is Cagan (1956), which starting from the demand for real money schedule, concluded that the maximizing point is somewhere between 2 and 3 times the value of the monetary base, i.e. between a rate of inflation of 200%-300 (Romer, 2012, p. 570).

Other studies' findings are not that clear. For instance, Easterly *et al.* (1995) using a panel with 11 high-inflationary countries for the period 1960-1990 discovered that half of their sample (5 countries) experienced maximizing-seigniorage inflation rates, which vary between 102 percent (Ghana) and 376 percent (Peru), whereas the other half did not experienced Laffer curves at all. Authors like Rovelli (1994) cite other studies that found no empirical evidence between the two.

3. METHODOLOGY AND DATA

First, as seen above, the classical sources (monetary seigniorage and seigniorage as opportunity cost) are flawed because they do not show the true quantity of the revenue generated by having the monopoly on the money creation. For this, we used the methodology of Rovelli (1994), which employs the central bank's balance sheet in order to compute this revenue. Another advantage of this methodology is that we only need to look in one place to find all the variables (i.e. in the annual reports of the National Bank of Romania) of interest. This methodology is summing the following sources:

1. The basic seigniorage, i.e. the interest earned by the NBR as a counterpart to the currency in circulation, under the assumption that the monetary base earns interest at the rate of the government bonds. In order to avoid the eventual arbitrariness of taking a debatable interest rate of reference, we used the data from European Central Bank on long term interest rate for convergence purposes because we believe this is the closest to the most objective indicator of such interest rate[1]. Unfortunately, the data span only for the period 2005-2016, so data previous to this period was estimated using the model indicated in (5). The basic seigniorage is computed as follows:

$$S_1 = i_B(B_C + \Phi + L_C - R) \tag{1}$$

where i_B is the interest rate of government securities, B_C represents the value of the debt of the state placed with the central bank, Φ represents the value of the foreign denominated securities, L_C the value of the loans given by the central bank to the domestic sector and R the value of the required reserves placed by the domestic sector with the central bank.

2. Seigniorage from bank reserves, from both required and free, i.e. the interest earned by the NBR as a counterpart for the reserves, under the assumption that these reserves could have earned an interest at the rate of governmental bonds minus the rate of the reserves that NBR pays, in absence of such a legal requirement. Just like in a game of divide the dollar, the central bank has the power of agenda setting in respect to the imposition of the interest paid for required reserves; it will clearly impose a lower interest rate in order to generate profit for itself and if the commercial banks do not agree with it, there is not much they can do about it – they either accept or they have their licenses revoked. This source can be computed as follows:

$$S_2 = (i_B - i_R)R \tag{2}$$

where I_R represents the interest rate that the central bank has to pay for the required reserves place by the domestic sector with the central bank.

3. The excess monetization, i.e. the role that the inflation tax and the GDP growth rate has on the decrease of the debt-to-GDP ratio will be included, even after 2004 (the results of this excess monetization should be included because it will be 0 after 2004). The excess monetization can be computed as follows:

$$S_3 = \Delta B_C - (n + \pi)B_C \qquad (3)$$

where n represents the GDP growth rate and π the inflation rate. This last source of revenue can be understood as the extra debt that the government can place with the central bank due to the increase in inflation and the increase in the GDP (which in turn decreases the debt-to-GDP ratio).

So, the total seigniorage generated by the government and the central bank is:

$$S_T = S_1 + S_2 + S_3 \qquad (4)$$

A problem of this study is the lack of data on the interest rate of government bonds for the period 1990-2005 (at least from our searches in different databases and queries to the National Bank of Romania we could not find such data). The fact that there is not public data for this variable and that NBR did not have such information could indicate that the Romanian government couldn't place public debt in the form of long term state bonds (for a period of 10 years) due to the fact that it was a post-communist country in transition and it had a very unstable investment position. This is to be expected from such countries; most of the countries of this profile do not issue public debt, since they use international financial institutions for credits. Indeed, a quick look at Romania's country rating confirms that only around 2005 the prospects for investment for this country improved (Country Economy, 2018).

Indeed, a more in-depth review of the literature about the public debt market in Romania, will show that the government hardly issued debt, especially in the 1990s decade; for instance, medium and long-term debt was only issued for the first time in 1999 (Stoica, 2002; Pop *et al.*, 2012).

Still, this doesn't mean that there were no alternatives for investing in interest bearing securities in Romania before 2005. The question now is what is the best indicator for the aggregate interest rate? In order to avoid any debates over the right interest rate we have used the long term interest rate for convergence purposes as the right indicator (see European Central Bank, 2018) for the period 2005-2016. But for the period 1990-2005, data were also lacking from ECB's database. So we came up with an estimate of this.

We computed a synthetic indicator using the most relevant factors identified in the literature (Holston *et al.*, 2017; Hsing, 2015; Ichiue and Shimizu, 2012) that influence the interest rate of public securities: the inflation rate from previous year (assuming that the expectation of the securities buyers are made on the basis of the previous year inflation rates), the debt-to-GDP ratio, the growth rate of GDP (which should influence the demand positively if the perspectives for growth are high) and the development of the country measured as GDP per capita (the more developed a country, the higher the demand for interest bearing assets and for government bonds implicitly). The model is the following:

$$\hat{\imath}_B = \beta_0 + \beta_1 inflation\ rate_{it-1} + \beta_2 debt\ to\ gdp\ ratio_{it} + \beta_3\ growth\ rate_{it} + \beta_4 gdp\ per\ capita_{it} + \mu_{it} \qquad (5)$$

The model presents a high coefficient of determination (0.71) and was estimated with panel data from ten Eastern European countries (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) for the period 2005-2016 using fixed-effects. The results of the estimation are robust and statistically significant (for more details see Annex).

In relation to the possibility of existence of a Laffer curve of the inflation tax we have employed an OLS model where we accounted for eventual nonlinearities by squaring and used data from our findings. The model is the following:

$$S = \beta_0 + \beta_1 infl + \beta_2 infl^2 \tag{6}$$

The factor that will influence the potential seigniorage gains from adopting the euro in Romania is that the country will get a certain share of the benefits from a much larger central bank with a much larger balance sheet (Grauwe, 2009, p. 72). The issue whether these smaller share of much higher benefits will top the bigger share of smaller benefits is up for debate and computations. Theoretically, the seigniorage considered by ECB is the monetary income, i.e. the profits made by the national central banks of the Eurosystem on account of assets they hold to back their monetary base, and the shares earmarked for each country from the total should be accordingly to their asset shares in ECB. Still, in a union where there is total freedom of movement for persons and capital, such basis for dividing the revenue from central banks is quite unreliable; that is why, the accorded division scheme is based on the country specific percentage of population and GDP with respect to the Eurozone (Smaghi and Gros, 2000).

Fortunately, Gros (2004) provided us with a very helpful methodology[2] that can quantify these potential gains, based on the capital share formula used by ECB[3]:

$$r\left[\frac{1}{2}\left(\frac{1}{y_{RO}} + 1\right)m_{euro} - m_{ro}\right] \tag{7}$$

where r stands for the interest rate, both in Romania and Eurozone (this assumption is quite realistic given the fact that is one of the admission criteria), y_{RO} represents the ratio between Romania's and Eurozone GDP/capita and the lower case m_{euro} and m_{ro} stands for the ratios between currency and GDP in Eurozone and Romania, respectively. Due to the fact that it is very difficult to predict these variables, both for Romania and the Eurozone, our computations were done for the period 2007 (the year Romania joined EU) − 2017, thus giving us an idea of how much bigger would have been the gains from seigniorage if Romania would have adopted the euro at any point between these years.

4. THE RESULTS

The results in respect to seigniorage generation (Figure no. 1) show that seigniorage was a constant source of revenues for the government in period of 1990's, when the country passed a long and painful transition to market economy. Noticeable is the 10.8% of the GDP in its peak year (1994) when the annual inflation was at the staggering figure of 136%. This results are quite surprising; in the previous three years, the inflation rates were even higher (170.2% 210.4% and 256.1%, respectively), but the peak was reached in 1994. This peculiar

observation seems to suggest that when inflation for Romania surpasses more or less 130% it already enters on the diminishing revenue side of the Laffer curve (this inflation rate seems to be the one where the peak of seigniorage generation is achieved). The policy implication for this finding is quite profound; the executive, not knowing the exact limit of the efficiency curve of this inflation driven seigniorage, had fallen into the right-hand side of it, imposing excessive costs on an already financially impoverished domestic population.

Although using a very similar methodology as Hochreiter *et al.* (1996), our results are quite different (for the year 1993 for instance, the difference is 18.6% of the GDP in terms of estimate). This is explained by the fact that the above mentioned authors have used (due to the lack of data) instead of the interest rate for government securities the inflation rate; this is why their results are quite extreme. But, as we have showed in our regression regarding the determinants of the long run interest rates for the government securities in Eastern Europe, a marginal increase in the inflation with one percentage point only increases the interest rate with 0.348% (see below in Annex).
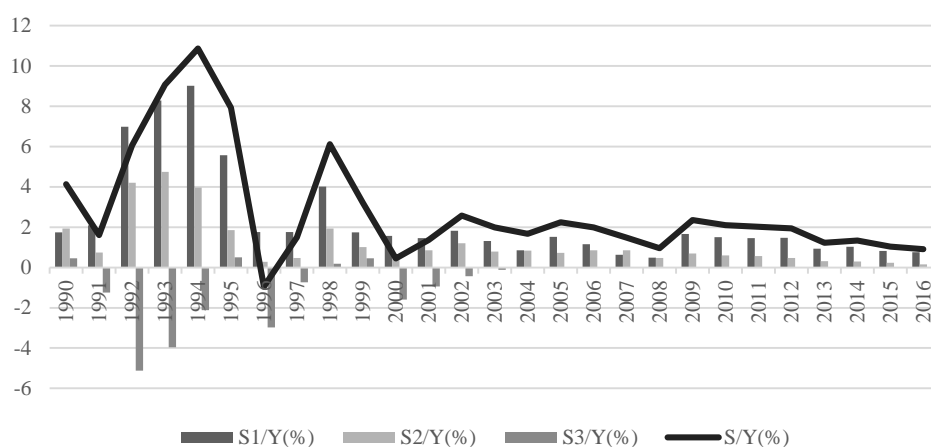

Figure no. 1 – Distribution of seigniorage generation by sources in Romania 1990-2016
Source: own computation

Also, one can notice the high drop in seigniorage in 1996, which translated in losses for the government (in fact it is the only year in our sample when the executive generated a negative seigniorage). This has to do with what Zaman (2002) pointed out in his work: 80% of the central bank's loans for the period up to 1996 were handed to two highly unperformant public banks, controlled by the politicians – Bancorex and Banca Agricola. In the eve of the 1996 elections, these two financial entities had to be bailed-out by the central bank with public money (thus diverting central bank's assets from investments in interest bearing assets).

Another result that stand out is the high variation (this is 11.8% of GDP) and two main periods of great drops (1996 and 2000). These two observations, both in variation and the existence of drops in seigniorage levels can be explained through the fact that Romania passed from being a communist country to a market economy with a nonindependent central bank and then again passed to a market economy with an independent central bank (this, of course, besides extra reasons for the drop from 1996 that was given above). The need of the

NBR to adopt the rules of the games, as stated in Hochreiter *et al.* (1996) is a reason for which we can observe very high variations in seigniorage in Romania in the 90's and early 2000's. This phases supposed structural changes that came at a cost in terms of seigniorage. This is very evident in the period previous to 2004, when preparations were in process to give more independence to the central bank and when the seigniorage dropped so low that it became close to 0. Indeed, in our results it can be seen that the after 2005 (after NBR became legally independent), the variance in seigniorage has dropped a great deal and the annual values for it are very stable (close to 2% of the GDP).

In relation to the sources, one can notice also that the most reliable and the most "lucrative" was S_1, i.e. the revenue generated from difference between the interest gained on the assets and the interest paid on the liabilities of the central bank; even after 2005 this sources brings in the highest bulk of the seigniorage. A very interesting finding is that the Romanian executive did not take advantage of the excessive monetization source (S_3) in the period previous of central bank independence, this being obvious through the fact that S_3 presents negative values in 11 out of 15 years from 1990 to 2004. Of course, after this year this source had totally disappeared, due to the legislative framework that prohibits the central bank to operate in the primary market of public debt. This puzzling fact has two reasons; when generating seigniorage using the instrument of monetary policy (i.e. inflation), the other sources become secondary in importance and the second reason is that before 2004 independence, the executive needed some time to deplete the balance of the NBR of any remaining state securities in order to comply with the already agreed legal framework for central bank independence.

For comparative purposes we also added Figure no. 2, where besides the results from Figure no. 1 there are also the results of seigniorage estimation using the classical method (monetary seigniorage plus seigniorage as opportunity cost plus the foregone interest due to the placement of the state debt with the central bank). A simple look at this graph shows the shortcomings of the latter – the even higher variability and the upward bias of the estimation, i.e. extremely high values (with a peak of 19.05% of the GDP reached in 1992 – interestingly, neither in this case this peak was not reached in 1993 when the inflation was the highest). The trend though, seems to suggest the same thing: as the independence of the central bank was achieved and as the economy became gradually more performant, this source of revenue for the government budget decreased.
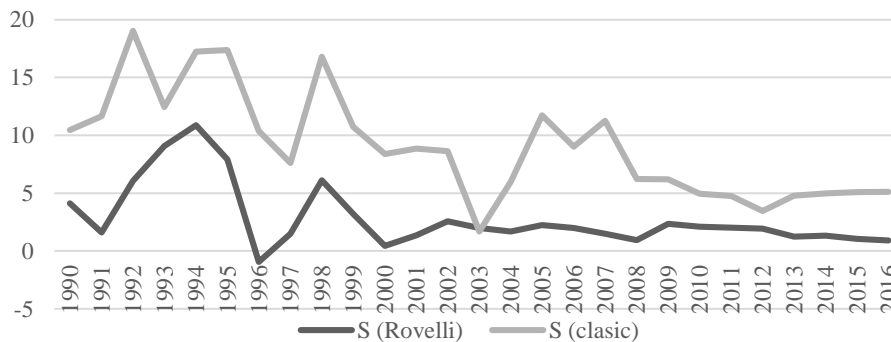

Figure no. 2 – Comparison between the results estimated using Rovelli (1994) method and the classic method
Source: own computation

In relation to the Laffer curve of the inflation tax, our results suggest that the relationship with the squared term is nonsignificant. Although the linear relation between the two is significant, the coefficient of determination is not so high ($R^2 = 0.3$). The scatterplot with a quadratic term does not seem to indicate the existence of a Laffer curve (Figure no. 3); in fact, due to the high dispersion of the points, the line does not show any non-linear curvature. We cannot know for sure if this is the highest possible revenue that can be achieved through inflation. This is to be expected due to the small sample (27 observations) and the fact that in our methodology, the impact the inflation has on seigniorage generation is diluted by adding more variables.
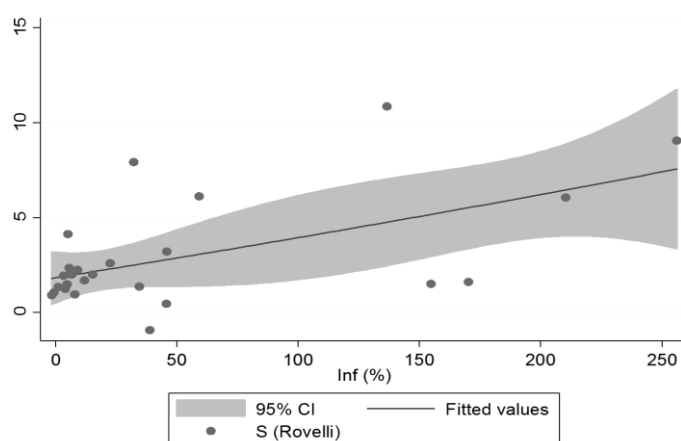

Figure no. 3 – Scatter plot inflation-seigniorage with quadratic regression line and confidence interval
Source: own computation

Still, one can determine this Laffer curve by using a quadratic regression line between inflation and the monetary seigniorage. As depicted in Figure no. 4, the results in this case are clearer than before. A clear curvilinear trend exists with a peak between 110% and 140% inflation rate. Thus the 136% inflation rate that we have identified as the peak in our computations seems to be in line with these findings. The results fail to meet the rigorous scientific standards for significance and the regression fit line with the 95% confidence intervals spreads does not accommodate many of the observations. This is due to the shortcoming stated above (small sample) and due to the fact that the empirical data presents so extreme values of inflation that the leverage of those observations bias the regression curve. Even so, we also employed the model used by Cagan (1956) to determine the peak of seigniorage in a high inflation economy and the results are in line with the graphics presented above. The model is as follows:

$$\ln\left(\frac{M}{P}\right) = a - bi + lnY \tag{8}$$

where M/P represents the real value of the monetary base (taken as M2), i is the interest rate and Y is the real value of the output. In this model, b coefficient should be between 1/2 and 1/3, so the peak will be reached at values of monetary base growth between 2 and 3. In our empirical results, the value of b is -0.85, so the peak will be reached at 1/-(-0.85), i.e. at 117% inflation.
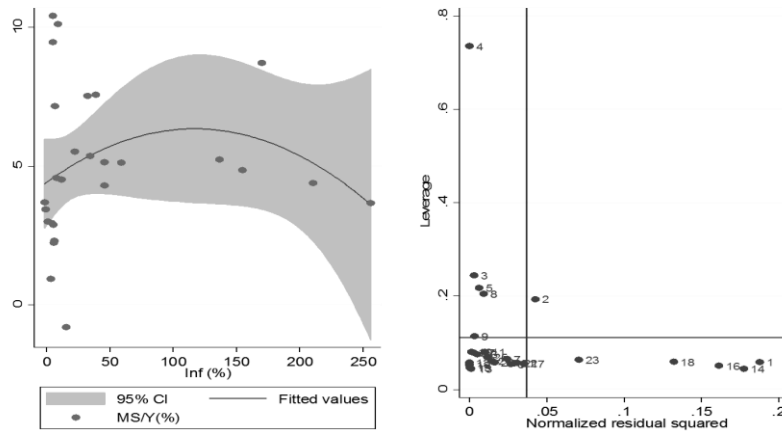
**Figure no. 4 – Scatter plot inflation-monetary seigniorage with regression line and confidence
interval and a leverage-normalized residuals square; the numbers of the points in the graph
indicate the ID number of the year**
Source: own computation

The results for the hypothetical gains are presented in Figure no. 5 and shows that as
Romania continue to converge with the rest of the Eurozone in terms of GDP/capita, these
gains will continue to drop. An interesting effect is observed regarding the currency-to-GDP
ratio: some of the gains are made due to the fact that fact the difference between the
Eurozone and Romanian cash-to-GDP ratio is positive; if Romania were to adopt the euro, it
is supposed that it would have the same ratio as the rest of the Eurozone, thus gaining
additional seigniorage from it. Still, the small values and even smaller expected future
values cannot represent for the Romanian executive a budgetary incentive to pass to euro.
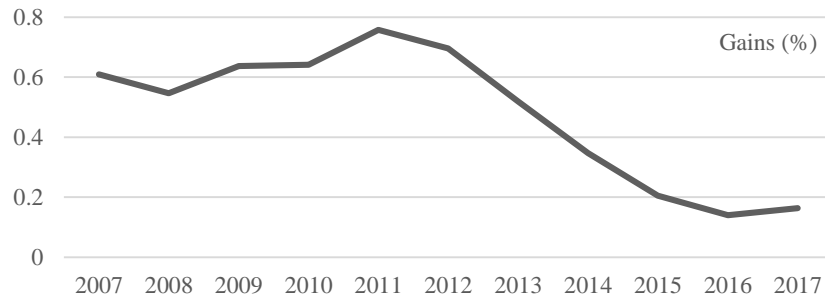The wish to adopt the single currency is motivated by other rationales.

Figure no. 5 – Hypothetical seigniorage gains from euro adoption in Romania between 2007-2016
Source: own computations

5. CONCLUSIONS

In this paper we have shown that seigniorage was a constant form of revenue generation for the Romanian executive in the period of the economic transition in the decade of the 90's, but as the economy improved and as the "rules of the game" were slowly adopted as prerequisites for the European Union accession, this source became insignificant. Furthermore, this source will not totally disappear for the executive, because as we have showed the distributed fiscal revenue from ECB to Romania is expected to be at least, or even a little, above the present values; what is really lost for good is the possibility of using your own monetary policy and the monopoly of creating money in order to generate fiscal revenue.

In our perspective, this is a good opportunity for the authorities to prove their commitment to fiscal discipline and to gain even further credibility in the eyes of the international creditors; after all, a high seigniorage level indicates a very weak and unthrusting government that generates its revenues from inflation tax. So, we believe that the implication of this process of giving up the sovereignty of the monetary policy is that the Romania government should become even less dependent on this source of revenue and should adopt a reform of the fiscal system.

Referring to our research work we have to recognize the limitations of our findings. The calculations were greatly influenced by our estimate of the rate of interest on long term government issued debt, but in our opinion this is the best way we could have dealt with the problem of missing data. Furthermore, the issue of extreme values of empirical data (like inflation) affected the statistical significance of some of the findings, but still, knowing this fact is already an advance in the study of this issue. We are determined to continue this study in case the relevant data will become available.

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ANNEX 1
Table no. 1 – Linear regression for the long term interest rate estimation purposes,
with country specific fixed effects

Interest rate	Coef.	St. Err..	t-value	p-value	[95% Conf.	Interval]	Sig
Lag inflation	0.349	0.053	6.54	0.000	0.243	0.455	***
Debt to GDP ratio	-0.041	0.011	-3.66	0.000	-0.063	-0.019	***
GDP growth	-0.187	0.036	-5.24	0.000	-0.258	-0.116	***
GDP per capita	0.000	0.000	-2.31	0.023	0.000	0.000	**
Constant	7.962	0.996	7.99	0.000	5.987	9.938	***
Mean dependent var.	4.755			SD dependent var.	2.250		
R-squared	0.626			Number of obs.	119.000		
F-test	43.973			Prob. > F	0.000		
Akaike crit. (AIC)	391.571			Bayesian crit. (BIC)	405.467		

*Note: *** p<0.01, ** p<0.05, * p<0.1*

Table no. 2 – Linear regression using Cagan's equation for determining the value of constant b

M2 monetary base	Coef.	St. Err.	t-value	p-value	[95% Conf.	Interval]	Sig
Interest rate	-0.857	0.238	-3.60	0.001	-1.349	-0.366	***
Log real GDP	0.957	0.021	46.43	0.000	0.914	0.999	***
Constant	-0.438	0.309	-1.42	0.168	-1.075	0.198	
Mean dependent var.	11.901			SD dependent var.	2.957		
R-squared	0.993			Number of obs	27.000		
F-test	1820.658			Prob > F	0.000		
Akaike crit. (AIC)	4.368			Bayesian crit. (BIC)	8.256		

*Note: *** p<0.01, ** p<0.05, * p<0.1*

Notes

[1] These are the statistics for EU Member States relate to interest rates for long-term government bonds denominated in Euro for euro area Member States and in national currencies for Member States that have not adopted the Euro at the time of publication. Where no harmonized long-term government bond yields are available, proxies derived from private sector bond yields or interest rate indicators are presented, where available. For more detail consult European Central Bank (2018).

[2] In this formula only the seigniorage as opportunity cost is accounted for which is quite alright because the ECB cannot generate seigniorage by buying Eurozone sovereign debt. Including the seigniorage gain from required reserves would have overcomplicated the model and would have not gave us a very different results.

[3] The formula used by Gros that determined the capital shares in the ECB is as follows:

$$\frac{1}{2}\left(\frac{Population-of-the-country}{Population-of-the-Eurozone} + \frac{GDP-of-the-country}{GDP-of-the-Eurozone}\right).$$

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