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Assessing Different Methodologies for the Estimation of Uruguay's Structural Fiscal Balance*

FIORELLA PIZZOLON AND ALEJANDRO RASTELETTI

Abstract

This document assesses the advantages and disadvantages of using different methodologies to estimate Uruguay's structural fiscal balance. Results indicate that disaggregated methods or methods with more than one economic cycle are the more appropriate ones, as they are better suited to handle the changes in revenues and expenditures composition observed in recent years. The document also discusses some of the difficulties faced while estimating the temporary components in interest payments and in the primary results of state-owned enterprises. As model-based corrections tend to be unreliable; it might be preferable to deal with the temporary components of these items as one-off corrections.

JEL Codes: H6 E62

Keywords: Fiscal Policy, National Budget, Cyclicality

I. Introduction

While assessing the fiscal stance of a Government, it is important to distinguish between permanent and temporary factors. Most economists argue that fiscal sustainability analysis should mainly focus on permanent factors. Temporary factors can distort headline figures and are unlikely to affect fiscal sustainability if they are relatively small in size. The fiscal balance obtained once temporary components are eliminated is usually referred to as the structural fiscal balance.

Distinguishing between permanent and temporary factors is not an easy task. Some temporary factors relate to single events. Examples of these include public firm privatizations, license sales and fiscal amnesties. These factors are usually referred to as one-off events and tend to be relatively straightforward to detect and adjust for. However,

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other temporary factors are harder to deal with. For instance, during economic booms, output and consumption tend to be relatively high, which boosts fiscal revenues. At the same time, unemployment and other social protection related expenditures tend to be low, reducing public spending. Determining how large a boom an economy is undergoing and how this boom is affecting fiscal revenues and expenditures is not straightforward. Therefore, the use of econometric techniques is required to estimate the impact of these temporary factors on fiscal variables.

Given the importance of the structural fiscal balance for the assessment and formulation of economic policies, economists have been debating for several years on how to estimate it. Most of the debate has focused on the estimation of the Central Government's structural revenues and structural primary expenditures. As the result of this debate, there are currently four methodologies being commonly used by researchers and renowned international organizations. These four methods can be divided into two groups, which have been labeled by Bornhorst et al. (2011) as aggregated and disaggregated methods. The difference between these two groups is that while the former adjusts overall revenues and primary expenditures to produce an estimate of the structural primary balance, methods in the latter correct expenditure and revenue items, which are then aggregated up to produce an estimate of the structural primary balance.

In this paper we present estimates of the Uruguayan Central Government's structural primary balance using the four different methodologies commonly used in the literature. The goal is to determine whether they produce significantly different results in the case of Uruguay and, if that is the case, to assess which of these methodologies is the most relevant for the Uruguayan economy. Results indicate that the different methodologies analyzed can produce large differences in estimates. The largest differences tend to appear around periods of economic crisis or turmoil, when macroeconomic imbalances emerge and the composition of revenues tends to change. This finding suggests that disaggregated methods and methods that introduce corrections based on more than one economic cycle might be more appropriate for the estimation of the Uruguay's Central Government primary balance. Disaggregated methods are able to account for changes in revenue and expenditure composition while methods that correct fiscal figures taking into account more than one economic cycle are better suited to handle macroeconomic imbalances.

The document also discusses some of the difficulties faced while trying to correct for temporary factors beyond the Central Government's primary balance. These corrections are needed to produce estimates of the General Government's structural fiscal balance. The discussion focuses on the primary results of state-owned enterprises and on interest payments, since these are the largest components of the fiscal balance not included in the Central Government's primary balance. Estimates of the temporary component of these two items are highly dependent on model specifications. As there is no generally accepted model to estimate the temporary components in these two items, introducing corrections as one-off factors might be the most appropriate approach.

The rest of the paper is organized as follows. In the next section we present the recent evolution of fiscal revenues and expenditures in Uruguay and we describe some of the main one-off factors observed in the data. In section 3 we discuss the two aggregated methods commonly used to estimate the Central Government's primary structural balance and present results obtained for Uruguay. In section 4 we focus on the two disaggregated methods, discussing the methodology and the results obtained. Section 5 discusses some of the difficulties faced while trying to correct for temporary factors beyond the Central Government's primary balance. The section focuses on the two major items, the primary results of state-owned companies and interest payments. Section 6 concludes.

II. Fiscal Revenues and Expenditures. Composition and Recent Trends.

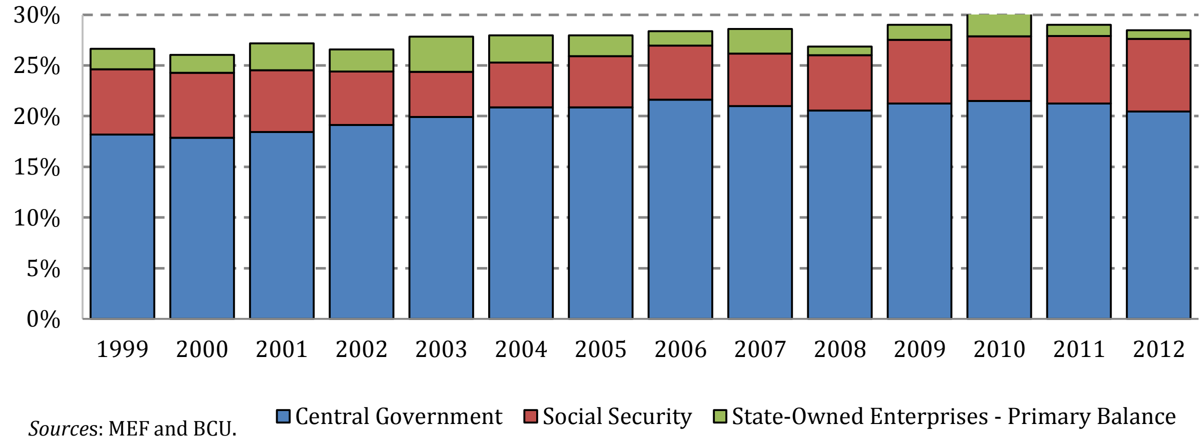
This section presents the composition and evolution of the public sector's revenues and expenditures. Knowing the characteristics of these time series is important for the assessment of the benefits and drawbacks of the different methodologies used for the estimation of the structural balance, presented in the following sections of the paper. The datasets used are described in appendix A.

II.1. Public Sector Revenues

The Uruguayan Ministry of Economics and Finance (MEF) divides the public sector revenues into three categories: Central Government (CG) revenues, Social Security (SS) revenues and revenues related to the primary balance of the state-owned enterprises (SOEs). Between 1999 and 2012, public sector revenues represented on average 27.9% of GDP (see graph 1).[2] The vast majority of revenues were related to the CG, accounting on average for 72.4% of all revenues. Meanwhile, SS revenues represented 20.6% and SOE's primary balance accounted for the remaining 7.0%.

[2] The main dataset on fiscal results used in this work is produced by the MEF and spans the years 1999 to 2012. The dataset is publicly available at http://www.mef.gub.uy/indicadores.php.

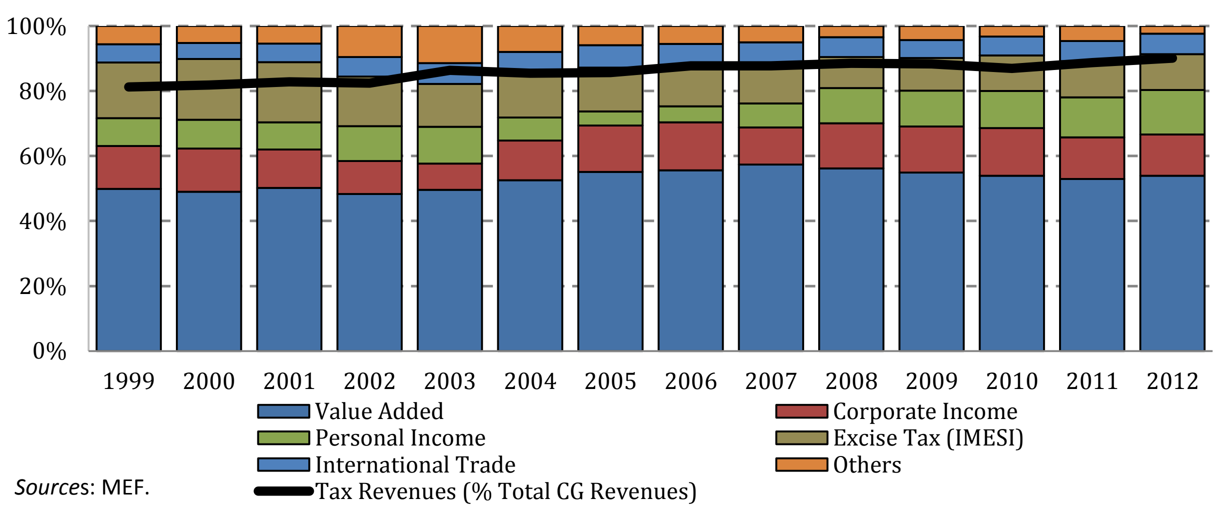
Graph 1: Public Sector Revenues (as % of GDP)



Sources: MEF and BCU.

The CG revenues originate mostly from tax revenues, which accounted on average for about 86% of total revenues in the period under consideration (see graph 2). The composition of tax revenues changed as a consequence of a tax reform which took place in mid-2007.[3] The objective of the tax reform was to simplify and modernize the tax system, in order to make it more efficient. It also aimed at increasing incentives to invest as well as making the tax system more egalitarian. The tax reform eliminated fourteen taxes, introduced three new taxes and modified another three. Important changes to the personal income tax were introduced, which significantly boosted revenues from direct taxation. Before the tax reform, indirect taxes accounted for about 80% of total taxes. After the reform this share was reduced to 74.5%.

Graph 2: Central Government's Tax Revenues (as % of Total Tax Revenues)



Sources: MEF.

[3] The tax reform was implemented in mid-2007. For the details of the reform, see Law Nº 18.083 at the Parlamento del Uruguay webpage (http://www.parlamento.gub.uy).

The value added tax (VAT) is the main source of indirect tax revenues. After the tax reform, it accounted on average for 73% of all indirect taxes. This value represents a large increase with respect to its pre-tax reform share, when the VAT and the COFIS[4] represented 65% of indirect tax revenues. The increase in share of the VAT was at the expense of IMESI, an excise tax, whose participation in indirect taxes fell from 19% to 14%. The third largest source of indirect tax revenues for the Government is taxes related to international trade. They accounted for about 8% of indirect tax revenues, both before and after the tax reform.

The tax reform also had a significant impact on direct taxes. Before the 2007 tax reform, about 60% of direct tax revenues originated from the corporate income tax. The tax reform eliminated two corporate income taxes and introduced a new one. The tax rate of the new tax is lower than the ones for the previous two taxes, but it has a wider tax base. As it was already mentioned, one of the main features of the tax reform was the changes introduced to the personal income tax (PIT). This consisted in the elimination of the previous PIT (the IRP) and the introduction of a new PIT (the IRPF). The new PIT extended the tax base and introduced a more progressive scheme of tax rates. After the reform, revenues from the PIT grew rapidly. In 2012 they accounted for about 52% of total direct taxes.

In respect to the Central Government's non-tax revenues, they come mostly from the use of unrestricted funds (Fondos de Libre Disponibilidad) and direct contributions from state-owned enterprises.[5] They accounted on average for 49% and 32% of non-tax revenues, respectively, during the period analyzed.

The two other sources of public sector revenues, namely the SS contributions and revenues related to SOEs primary balance have been very volatile. In the case of SS contributions, they have presented a high sensitivity to the economic cycle. In 2000, before the economic crisis, contributions to social security totaled an equivalent of 6.4% of GDP. In 2003 and 2004, years when unemployment and informality were high and the real wages low, the contributions to SS fell to 4.4% of GDP. Since then, contributions to SS entered a period of rapid growth, outpacing GDP growth. In 2012, at 7.2% of GDP, SS contributions reached an all-time high.

Meanwhile, revenues from SOEs have been the most volatile component of public revenues. The coefficient of variation of the SOE´s primary balance to GDP ratio between 1999 and 2012 was 0.35, 2.6 times larger than that of SS revenues and 5.4 higher than that of CG revenues.[6] Contributions from SOEs to the Central Government, which are included as part

[4] The COFIS was a tax implemented in 2001 as a contribution for the financing of Social Security. The tax was levied on imported goods. It was eliminated in 2007 Tax Reform.

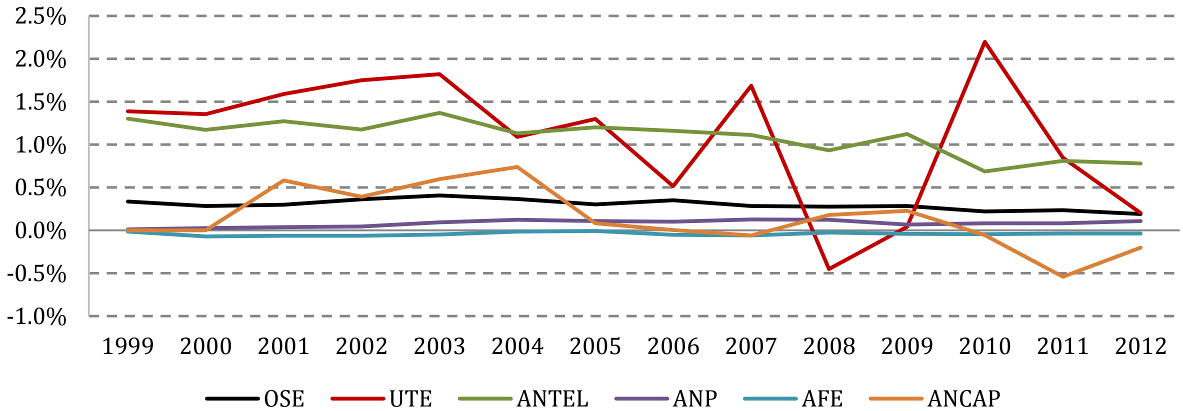
[5] These contributions from public enterprises are different from the SOEs primary balance analyzed in section. The main firm included in this group is the Banco de la República Oriental del Uruguay (BROU).

[6] The coefficient of variation is a commonly used statistic to measure the volatility of a series. This statistics normalizes the dispersion in a series by dividing the standard deviation of a series by its mean.

of Central Government revenues, have also been very volatile. The coefficient of variation of these contributions, as a share of GDP, was 0.29.

The high volatility of SOE's primary balances is mainly due to the results of the state-owned energy company UTE and, to a lesser extent, to the results of the state-owned oil company ANCAP (see graph 3). In a typical year, most of the energy produced by UTE comes from hydric sources. In 2008-2009 and 2011-2012, the country was affected by severe droughts. This forced UTE to switch from hydric to thermal power generation, increasing sharply the production costs. Meanwhile, the oil company ANCAP suffered a large drop in current profits in 2011 and 2012, as the large increase in oil prices was not fully translated into price increases.

Graph 3: State-Owned Enterprises – Primary Results (as % of GDP)

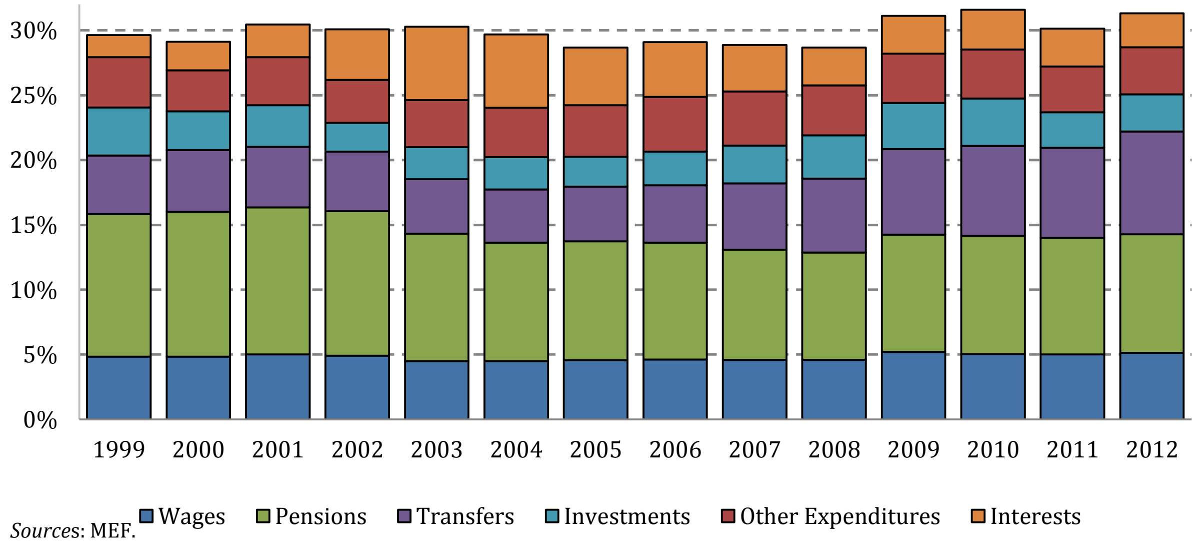


Sources: MEF.

II.2. Public Sector Expenditures

Between 1999 and 2012, public sector expenditures represented about 30% of GDP on average (see graph 4). Primary expenditure, excluding public investment, accounted for over 82.5% of total expenditure in 2012. Pension payments are the largest component of public expenditure, totaling 9.2% of GDP in 2012. Transfers have been increasing rapidly. They represented 7.9% of GDP in 2012, up from 4.4% of GDP on average between 1999 and 2006. Meanwhile, public workers compensations have remained relatively stable, at about 5% of GDP.

Graph 4: Public Sector Expenditures (as % of GDP)



Sources: MEF.

Public investments have been volatile. In 2002, in the midst of the economic crisis, investments fell by one percentage point of GDP, to represent 2.2% GDP. In the following years public investment remained at low levels, averaging 2.5% of GDP between 2003 and 2006. Since then they have increased rapidly, reaching 3.6% of GDP in 2010. In 2011, investment fell by almost one percentage point, to account for 2.7% of GDP. This was mainly due to a fall in the oil stock of ANCAP, as the company started maintenance work on its main refinery. Investments in 2012 reached 2.9% of GDP.

Lastly, interest payments showed a clear countercyclical pattern. In the aftermath of the economic crisis the peso experienced a large depreciation. This increased the burden of the debt, which was mostly denominated in dollars. Interest payments, which represented 2.5% of GDP in 2002, jumped up to 5.6% of GDP in 2003 and 2004. Since then interest payments fell rapidly, to average 2.9% of GDP between 2008 and 2012. This was mainly the consequence of the fall of the debt-to-GDP ratio and the appreciation of the nominal exchange rate.

II.3. Public Sector Balance and One-Off Factors

Given the evolution of public sector revenues and expenditures described above, the fiscal balance went through three phases in the period analyzed (see graph 5). During the years of the recession and the economic crisis, the headline public sector deficit was large, while the primary balance experienced an improvement. From 2003 through 2007, the primary balance improved very rapidly, to average 3.6% of GDP. Meanwhile, the headline fiscal balance also improved, becoming positive in 2007. Since then, both the primary and headline fiscal balance worsened.

As mentioned above, several temporary shocks affected fiscal revenues and expenditures. Given that temporary shocks distort the analysis of the underlying fiscal position, some economists have recommended the elimination of one-off factors (OOF) while analyzing fiscal balances (Jourmard et al., 2008). The identification and measuring of OOFs is neither easy nor free of controversy. In this study we decide to include as OOFs those revenue windfalls or expenditure increases that are unrelated to an economic cycle. We introduce five sets of corrections for OOFs.

The first set includes three corrections related to the performance of the state-owned energy company UTE, which relate to the increase in operating costs of UTE during the 2006, the 2008-2009 and 2011-2012 droughts. Analysts have estimated that the 2006 drought increased operating costs by 1% GDP and that the 2008-2009 one raised costs by 1.6% of GDP in 2008 and 1% of GDP in 2009. Meanwhile, the 2011-2012 drought is estimated to have had a negative impact of 0.2% of GDP in 2011 and 1% of GDP in 2012. We use these figures in the OOF corrections.

The second set of corrections is also related to energy production. In 2010, the GC decided to constitute a fund to absorb the fiscal impact of changes in the cost of energy production. The contributions to this fund equaled 0.4% of GDP in 2010 and they were registered as government expenditure. These funds were then used during the 2012 drought and were computed as a Government income.

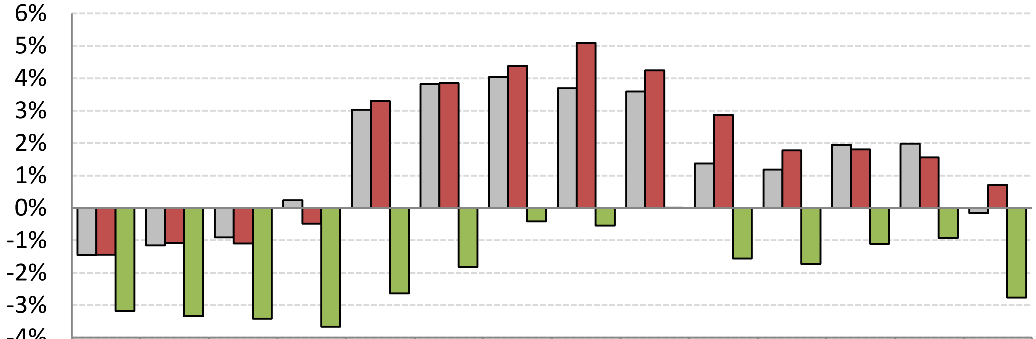
The third set of OOF corrects for irregular transfers of a state-owned bank (BROU) to the Central Government. The largest values are observed in 2009 and in 2011, when extraordinary transferred increased revenues by 0.5% of GDP and 0.3% in 2009, respectively. In 2008, transfers from the BROU were low, subtracting 0.2% of GDP from CG revenues.

The fourth set of OOF includes corrections related to the actual timing of revenues and expenditures, as in MEF (2012). In particular, we correct for differences in timing of income collection by the tax authority and the transfer of these resources to the Central Government. We also correct for increases in debt stocks with Government suppliers.

A final group includes changes in ANCAP's oil stock as well as all the corrections related to other atypical revenues and expenditures, such as license sales and settlements. This group had a sizeable impact in in 2012, the closure of an airline and a settlement related to a bank closure increased expenditures by 0.4% of GDP.

The resulting public sector primary fiscal balance after adjusting for all these one-off factors is depicted in graph 5.

Graph 5: Public Sector Fiscal Balance (as % of GDP)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Primary Balance (PB)	-1.5%	-1.2%	-0.9%	0.2%	3.0%	3.8%	4.0%	3.7%	3.6%	1.4%	1.2%	1.9%	2.0%	-0.2%
Adjusted PB	-1.4%	-1.1%	-1.1%	-0.5%	3.3%	3.9%	4.4%	5.1%	4.2%	2.9%	1.8%	1.8%	1.6%	0.7%
Headline Balance	-3.2%	-3.3%	-3.4%	-3.7%	-2.6%	-1.8%	-0.4%	-0.5%	0.0%	-1.6%	-1.7%	-1.1%	-0.9%	-2.8%

Sources: Own calcuations based on MEF and BCU.

III. Aggregated Methods for the Estimation of the Central Government's Primary Structural Balance[7]

The methodologies used by economists to produce estimates of the structural fiscal balance can be divided into aggregated and disaggregated methods. As it was mentioned earlier, the main difference between these two groups is that while the former adjusts the overall levels of revenues and primary expenditures, the latter corrects individual expenditure and revenue items. Within the aggregated methods, we focus on two different methodologies that are commonly used in the literature. The first one, usually referred to as the standard method (SM), only corrects for one-off factors and the effect of the business cycles on the primary balance. This methodology is commonly used by the IMF (Hagemann, 1999). A version of this methodology has been used by the Uruguayan Ministry of Economics and Finance (MEF, 2012). The second aggregated method is relatively new and has been suggested by the European Commission (European Commission 2010). We refer to this method as the European Commission Method (ECM). This method corrects not only for business cycle fluctuations but also for current-account imbalances. In particular, this method recognizes that periods of high absorption are periods when fiscal revenues are temporarily high. Therefore, a correction is introduced to account for this temporary increase in fiscal revenues.

[7] Results in this section include revenues and expenditures related to Social Security, most of them administered by the Banco de Previsión Social (BPS). We decided not to introduce OOF corrections for irregular transfers to the Central Government by the SOEs analyzed in section 5. Even if these irregular transfers distort the CG fiscal results, they do not affect the overall Public Sector fiscal result.

Before describing these two aggregated methods in more detail, we introduce some notation which will simplify the description of the different methodologies. All four methods assume that the primary balance (PB) can be divided into a structural component, the structural primary balance (SPB), and a temporary component, the temporary primary balance (TPB):

$$PB = SPB + TPB \quad (1)$$

The SPB is the term of interest and the TPB includes all the temporary factors one wants to disregard. To obtain an estimate of the TPB, a functional form for this term needs to be specified, which is then estimated via econometric techniques, or simply computed after making further simplifying assumptions.

The two aggregated methodologies analyzed in this section differ on their specification of the TPB term. The TPB term used in the standard method (TPB^{SM}) is:

$$TPB^{SM} = OOF + CYC \quad (2)$$

where the OOF term captures all the relevant one-off factors and the CYC term captures the effect of cycles in output on the fiscal result. Meanwhile, the TPB term used in the European Commission method (TPB^{ECM}) is:

$$TPB^{ECM} = OOF + CYC + ABS \quad (3)$$

where the ABS term corrects for the effect of cycles in absorption on the fiscal accounts.

III.1. The Standard Method

The standard method is probably the method most widely used for estimating the structural balance. It assumes there are stable relations between revenues and the level of economic activity as well as between primary expenditures and economic activity. Furthermore, it is usually assumed that this relation is linear in logs. More specifically,

$$\log(R) = \alpha + \varepsilon_{RY}^{SM} \log(Y) \quad (4)$$

$$\log(E) = \delta + \varepsilon_{EY}^{SM} \log(Y) \quad (5)$$

where R and E represent fiscal revenues and primary expenditures, respectively, and Y is the economy's gross domestic product (GDP). These functional forms are particularly useful since ε_{RY}^{SM} and ε_{EY}^{SM} are the output elasticities of revenues and primary expenditures.

The methodology defines structural revenues and structural primary expenditures as those consistent with GDP being at its potential level (Y^*). As GDP usually differs from potential GDP due to business-cycle fluctuations, current revenues and expenditures are not equal to their structural levels. The temporary components of revenues ($R^{T.SM}$) and expenditures ($E^{T.SM}$) are then defined as the revenues and expenditures that are or are not generated because output differs from its potential level. More specifically,

$$TPB^{SM} = OOF + R^{T.SM} - E^{T.SM} \tag{6}$$

where

$$\log(R^{T.SM}) = \varepsilon_{RY}^{SM} \log(Y/Y^*) \tag{7}$$

$$\log(E^{T.SM}) = \varepsilon_{EY}^{SM} \log(Y/Y^*) \tag{8}$$

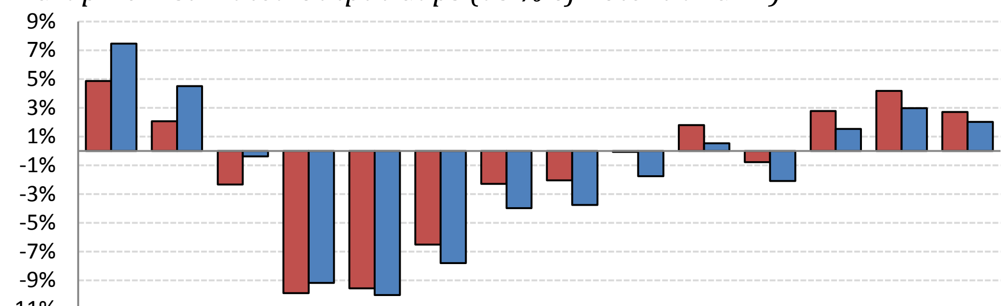
Since not all government primary expenditures are directly linked to economic activity, most economists tend to only adjust those expenditures related to social protection benefits and leave all other expenditures unaltered. This implies assuming a zero output elasticity for all other primary expenditures. In the case of Uruguay, it might be also relevant to adjust pension payments for business cycle fluctuations. The country's Constitution establishes that pension payments must be indexed to salaries, which tend to be affected by the economic cycle.

The main advantage of the standard methodology is the straightforwardness of its implementation. It only requires the estimation of the potential output level (Y^*) and two elasticities (ε_{RY}^{SM} and ε_{EY}^{SM}). This simplifies the communication of the results obtained, which can be important in political discussions. This is one of the reasons why several countries that have implemented fiscal rules on structural balances use variants of the standard method to define the rules.

The baseline standard methodology has nevertheless several disadvantages. Firstly, beyond one-off factors, it only allows the output cycle to temporary affect revenues and primary expenditures. This can be problematic if other relevant cycles (e.g. consumption cycles, personal income cycles) do not fully coincide in timing with the output cycle. Secondly, it assumes that the effect of the business cycles on revenues and expenditures is invariant over time (e.g., output elasticities are constant). This assumption implies that either the output cycles have the same impact on all expenditure items or that there are no composition effects in revenues and expenditures through the output cycles (e.g., all revenues and expenditure items vary in the same proportion). Thirdly, the method can fail to capture structural changes due to tax and expenditure reforms, as elasticities are assumed to be constant.

Even though the SM is straightforward to implement, the quality of the estimates produced depends on the quality of the estimates of the potential output level (Y^*) and output elasticity of revenues and primary expenditures (ε_{RY}^{SM} and ε_{EY}^{SM}). To estimate the potential output, we implement a methodology similar to the one used by the OECD (Giorno et al., 1995), which follows a production function approach. A detailed explanation of this methodology is presented in appendix B. The output gaps obtained using this methodology are summarized in Graph 6. The graph also presents the estimates obtained using a Hodrick-Prescott (HP) filter to calculate the potential output level.[8] Results suggest that during most of the 2000s the Uruguayan economy was producing below its potential level, as the economic crisis that affected the economy in 2002 led to high levels of unemployment and low levels of total factor productivity. Towards the end of the decade, after several years of rapid economic growth, the economy was able to close the output gap and finished the decade producing above its potential level.

Graph 6: Estimated Output Gaps (as % of Potential GDP)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Production Function	4.9%	2.1%	-2.3%	-9.9%	-9.5%	-6.5%	-2.3%	-2.0%	-0.1%	1.8%	-0.8%	2.8%	4.2%	2.7%
HP Filter	7.5%	4.5%	-0.4%	-9.2%	-10.0%	-7.8%	-4.0%	-3.7%	-1.7%	0.5%	-2.1%	1.5%	3.0%	2.0%

Sources: Own calcuations based on BCU and INE.

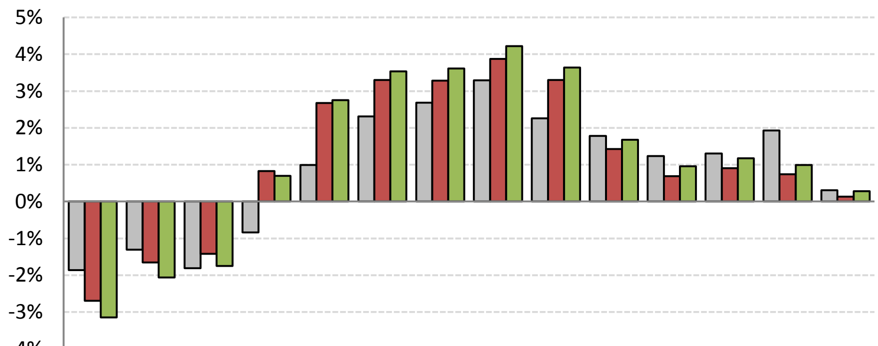
In regards to output elasticity of revenues and primary expenditures, we obtain them by estimating vector error-correction models. Using a methodology described in appendix C, we obtain an output elasticity of revenues of 0.95. In respect to the output elasticity of expenditures, we tried following the common practice of assuming that only unemployment benefits and transfers to poor families are related to the output cycle and assuming that all other primary expenditures have a zero output elasticity. We were unable to precisely estimate the output elasticity of unemployment benefits and transfer to poor families, as the relation between these transfers and output seems to be unstable over the period analyzed. This is probably due to several changes introduced to the social protection system in the last decade as well as important changes in employment formalization. Given the unstable relation between output and these social benefits, we assume a zero output

[8] Output gaps estimates using the HP filter were obtained using a smoothing parameter equal to 100. Output projections from the World Economic Outlook (October 2012) were used to reduce the end-of-sample bias.

elasticity for this type of expenditure.[9] Following MEF (2012), we also study whether output cycles affect pension payments. Using a vector error-correction model, we estimate an output elasticity of pension payments of 0.57 (see Appendix C). We use this elasticity to calculate the structural level of pension payments.

Figure 7 plots the estimated structural primary balances. The plot includes two sets of results; one for each of the methods used to estimate the output gap. For the years analyzed, the average difference between the two methods was about 0.3% of the GDP. This highlights the importance of using accurate estimates of the output gap. The use of precisely estimated elasticities seems to be of second order importance, as small changes in the elasticity estimates only produce significant changes in the estimates of the structural fiscal balances when output gaps are large.

Graph 7: Estimated Structural Primary Fiscal Balance
(Central Government and Social Security, as % of GDP)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Observed Primary Balance	-1.9%	-1.3%	-1.8%	-0.8%	1.0%	2.3%	2.7%	3.3%	2.3%	1.8%	1.2%	1.3%	1.9%	0.3%
Structural Balance - Production Function	-2.7%	-1.7%	-1.4%	0.8%	2.7%	3.3%	3.3%	3.9%	3.3%	1.4%	0.7%	0.9%	0.7%	0.1%
Structural Balance - HP Filter	-3.1%	-2.1%	-1.7%	0.7%	2.8%	3.5%	3.6%	4.2%	3.6%	1.7%	1.0%	1.2%	1.0%	0.3%

Sources: Own calcuations based on MEF, BCU and INE.

III.2. The European Commission Method (ECM)

Economists at the European Commission have suggested that it might be worthwhile to extend the standard methodology to take into consideration other relevant economic cycles. In particular, they argue in favor of introducing corrections for cycles in absorption. The reason behind this suggestion is that in several countries a large share of Government revenues is linked to domestic demand rather than domestic output. If the output and absorption cycles do not fully coincide, only correcting for the output cycle will fail to

[9] This assumption should not introduce a large error in the estimation of the structural primary balance, as unemployment benefits and transfers to poor families accounted for less than 5% of the Central Government current primary expenditure.

uncover the underlying structural balance. For example, if consumption experiences a temporary increase but output does not, fiscal revenues will also experience a temporary increase due to a higher collection of taxes related to consumption. The standard method will fail to capture this temporary boom in revenues.

The correction for cycles in absorption was originally proposed by the European Commission to account for the rapid changes in current account balances observed in some European economies after the adoption of the Euro. This correction is also likely to be relevant for developing economies. As noted by Aguiar and Gopinath (2007), in emerging countries consumption volatility tends to exceed output volatility and current account balances tend to be strongly countercyclical.

To introduce the corrections for cycles in absorption, the European Commission (2010) and Lendvai et al. (2011) assume the existence of a stable relation between revenues and the level of economic activity and absorption. A similar assumption is made for primary expenditures. Structural revenues and expenditures are defined as those that are consistent with the potential level of GDP (Y^*) and the potential level of absorption (A^*). The temporary component of revenues and expenditures is then defined as the revenues and expenditures generated (or not) because output and absorption differs from their potential levels. More specifically,

$$\log(R^{T.ECM}) = \varepsilon_{RY}^{ECM} \log(Y/Y^*) + \varepsilon_{RA}^{ECM} \log(A/A^*) \quad (9)$$

$$\log(E^{T.ECM}) = \varepsilon_{EY}^{ECM} \log(Y/Y^*) + \varepsilon_{EA}^{ECM} \log(A/A^*) \quad (10)$$

The temporary component of the primary fiscal balance is then defined as

$$TPB^{T.ECM} = OOF + R^{T.ECM} - E^{T.ECM} \quad (11)$$

This methodology requires the estimation of more variables than the standard method. Besides the estimation of the potential output level (Y^*) and two income elasticities (ε_{RY}^{ECM} and ε_{EY}^{ECM}), the method also requires the estimation of potential absorption (A^*) and two absorption elasticities (ε_{RA}^{ECM} and ε_{EA}^{ECM}).

To produce an estimate of A*, the method takes advantage of the current account equation, which is evaluated at the level of potential output and a current account norm (CA^*). More specifically,

$$A^* = Y^* - CA^* - I \quad (12)$$

where I represents net foreign income. Given equation (12), the methodology requires estimates of Y^* and CA^* in order to produce an estimate of A^*. The methodology does not recommend any particular method for the estimation of Y^*. We use the same estimates presented above, which were obtained using a production function approach. To produce an estimate of CA^*, Lendvai et al. (2011) recommend first running a regression of the current account/GDP ratios on a set of explanatory variables, as in Chinn and Prasad (2003) and Lee at al. (2008), using a panel of countries. Once the equation coefficients are estimated, the current account norms are defined as the expected values given the levels of the explanatory variables for the country. Lendvai et al. (2011) run one of such regressions using a panel of 60 industrial and emerging economies that spans the years 1970 through 2009. We use their specification and coefficient estimates to produce the current account norm for Uruguay.[10]

In what respect to elasticities, their joint estimation is problematic because of a multicollinearity problem. Given this problem, the EC method assumes some of the relevant elasticities. Firstly, the EC method assumes that primary expenditure is affected by output but not by absorption. This then implies that ε_{EA}^{ECM}=0 and $\varepsilon_{EY}^{ECM} = \varepsilon_{EY}^{SM}$. Secondly, the EC method assumes that changes in absorption only affect revenues from indirect taxes and that this elasticity is unitary. Thirdly, it assumes that all Central Government revenues that do not originate from indirect taxes are not affected by changes in absorption. These last two assumptions taken together imply that the elasticity of overall revenues with respect to absorption equals the share of indirect taxes in total revenues (γ_t). That is, $\varepsilon_{RA}^{ECM} = \gamma_t$. Finally, the methodology assumes that direct taxes are only affected by output (and not absorption) and that the output elasticity of direct taxes equals the output elasticity of overall revenues. All the assumptions made above imply that $\varepsilon_{RY}^{ECM} = \varepsilon_{RY}^{SM} - \gamma_t$.

The main advantage of the ECM over the SM is that it allows both output and absorption cycles to affect revenues and primary expenditures. The implementation of the methodology is also straightforward, but the estimates obtained might be less precise. This is due to the use of an absorption norm to define the absorption gap, estimate which is itself based on two other estimates (the output gap and the current account norm). Furthermore, the four elasticities needed to implement the method without the introduction of simplifying assumptions are difficult to estimate due to the multicollinearity problem.

The ECM method also faces most of the same disadvantages as the SM. Firstly, even if it allows for two cycles to affect revenues and primary expenditures, other cycles might be important (e.g. income cycles, unemployment cycles). Secondly, it assumes that the effects of the different cycles on revenues and expenditures are invariant over time. As in the SM, this assumption implies that either the cycles have the same impact on all expenditure items or that there are no composition effects in revenues and expenditures through the cycles (e.g., all revenues and expenditure items vary in the same proportion). Thirdly, the

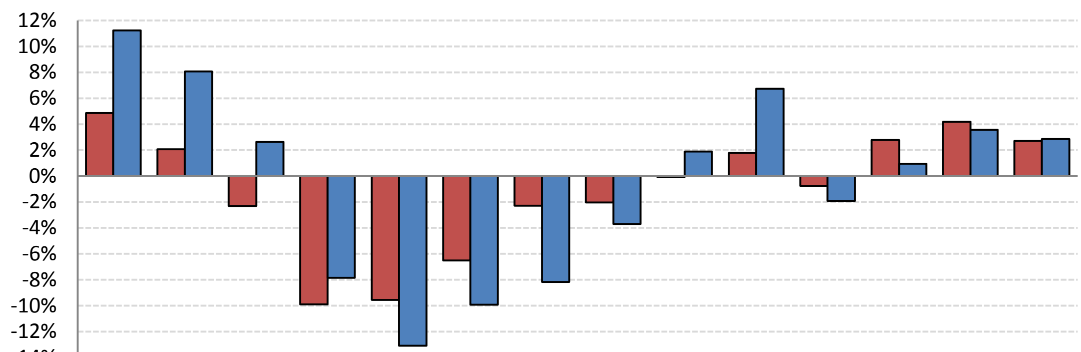
[10] The Lendvai et al. methodology includes a variable capturing the oil gap. This variable that cannot be constructed for Uruguay, as it does not produce oil. We therefore drop this variable from the equation.

constancy of the elasticities can fail to capture structural changes due to tax and expenditure reforms.

The main problem with the application of the standard methodology to Uruguay relates to the fiscal treatment of large investment projects. Investments related to these projects tend to increase the absorption gap, but they are usually exonerated from paying the import and value added taxes. Therefore, the large absorption gap generated by these investments does not generate a large increase in tax revenues. This distortion was particularly important in the case of the construction of two large paper-mill factories, one in 2006-2007 and the other in 2011-2012, with investments that represented over 7.5% and 3.5% of GDP, respectively. We decided to exclude these investments from the data, not to introduce distortions in the investment figures.

Graph 8 below plots the estimates obtained for the absorption and output gaps. Absorption gaps are defined as the difference between the observed absorption, excluding investments in the two paper-mill factories, and the absorption norm, as a percentage of potential GDP. Our results reveal that distinguishing between output and absorption gaps might be empirically relevant. In the period analyzed, the cycles in absorption presented larger amplitude than output cycles. Besides, the differences in gap sizes are large for some years.

Graph 8: Output and Absorption Gap



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Output Gap	4.9%	2.1%	-2.3%	-9.9%	-9.5%	-6.5%	-2.3%	-2.0%	-0.1%	1.8%	-0.8%	2.8%	4.2%	2.7%
Absorption Gap	11.2%	8.1%	2.6%	-7.9%	-13.1%	-9.9%	-8.2%	-3.7%	1.9%	6.7%	-1.9%	0.9%	3.6%	2.9%

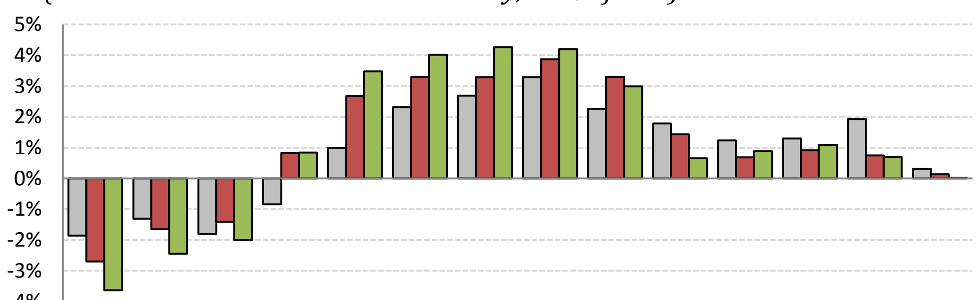
Sources: Own calcuations based on BCU and INE.

To estimate the structural primary balance using the ECM, we use the estimates of the output and absorption gaps presented in Graph 8. We assume, as in the SM case, that pension payments are only affected by the output cycle, with an output elasticity of 0.57, and that all other expenditures are not sensitive to it. In regards to income elasticity, following EC (2010) and Lendvai et al. (2011), we assume that revenues from indirect taxation depend only on absorption cycles and that all other revenues are only affected by output cycles. Conditional on those assumptions, we estimate an error correction model and obtain an absorption elasticity of indirect taxes of 1.06 and an output elasticity of all other revenues of 1.08 (see appendix C). Using these estimates, the implied time-varying revenues elasticities used are $\varepsilon_{RY}^{ECM} = 1.08 * (1 - \gamma_t)$ and $\varepsilon_{RA}^{ECM} = 1.06 * \gamma_t$.

The estimates obtained for the Central Government's structural primary balance using the ECM are plotted in graph 9. The graph also includes the estimates obtained using the SM to facilitate the comparison between the results of the two methods. For the years analyzed, the average difference between in the methods, in absolute terms, was about 0.5% of the GDP. As it might have been expected, the two methods only present sizeable differences in those years when the output and absorption gap tend to differ significantly. In 2008, for example, the absorption gap is considerably larger than the output gap. This leads to a large difference in the estimates of the structural balance. While the SM estimates a structural deficit of 1.5% of GDP, the ECM estimates a structural deficit of half the size. The largest difference, as a share of GDP, is observed in 1999, year when the difference between the absorption and output gap was the largest, at 6.3% of GDP.

Graph 9: Estimated Structural Primary Fiscal Balance

(Central Government and Social Security, as % of GDP)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Primary Balance	-1.9%	-1.3%	-1.8%	-0.8%	1.0%	2.3%	2.7%	3.3%	2.3%	1.8%	1.2%	1.3%	1.9%	0.3%
Standard Method	-2.7%	-1.7%	-1.4%	0.8%	2.7%	3.3%	3.3%	3.9%	3.3%	1.4%	0.7%	0.9%	0.7%	0.1%
ECM	-3.6%	-2.4%	-2.0%	0.8%	3.5%	4.0%	4.3%	4.2%	3.0%	0.7%	0.9%	1.1%	0.7%	0.0%

Sources: Own calcuations based on MEF, BCU and INE.

The results obtained highlight the importance of including further relevant cycles while estimating the structural fiscal balance. If relevant cycles do not fully coincide in timing with the output cycle, the SM will fail to uncover the structural fiscal balance. In the case of Uruguay, the introduction of corrections for absorption cycles seem to be worth taking into consideration, as cycles in output have a smaller amplitude than cycles in absorption.

As in the SM, the use of precisely estimated elasticities while implementing the ECM seems to be of second order importance. Small changes in elasticities only produce significant changes in the structural fiscal balance when the estimated gaps are large. Even though large gaps in absorption were unveiled for some years, as the temporary corrections in the ECM apply to a share, and not all, of the overall Central Government revenues, small changes in the elasticity tend to have small impacts on the structural balances.

IV. Disaggregated Method for the Estimation of the Central Government's Primary Structural Balance[11]

In this section we assess two different disaggregated methods to estimate the primary structural balance. As mentioned above, disaggregated methods correct individual expenditure and revenue items, instead of fiscal aggregates. The first methodology we study was developed by economists at the Organization for Economic Cooperation and Development (OECD) (Van den Noord, 2000, Girouard, and André, 2005). For this reason, the methodology is usually referred to as the OECD Method.[12] The method is similar in nature to the standard methodology, in the sense that it only allows output cycles to affect revenues and expenditures. The main difference is that it allows the output gap to affect different revenues and expenditures items differently, as output elasticities of the different items are allowed differ from one another.

The second method we analyze was developed by a group of economists at the European Central Bank (ECB) (Bouthevillain et al., 2001). This methodology is similar to the OECD method in that it adjusts individual items to produce an estimate of the structural primary balance. The main difference is that it allows the different revenues and expenditure items to be affected by different economic cycles. For example, the method assumes that indirect taxes are mainly affected by consumption cycles while personal income taxes are mainly influenced by cycles in household income. This method is usually praised for its capacity to account for changes in output composition.

Both the OECD and ECB methodologies start by recognizing that fiscal revenues (R) and primary expenditures (E) are an aggregate of different revenue items (R_i) and expenditure items (E_i), so that

$$PB = R - E = OOF + \sum_i R_i - \sum_i E_i \tag{13}$$

[11] As in the previous section, results include social securities related revenues and expenditures, most of them administered by the Banco de Previsión Social (BPS). We decided not to introduce OOF corrections for irregular transfers to the Central Government by the SOEs analyzed in section 5. Even if these irregular transfers distort the CG fiscal results, they do not affect the overall Public Sector fiscal result.

[12] A recent paper by Daude et al. (2011) estimates the primary structural balance for several Latinamerican countries, including Uruguay, using the OECD methodology.

The methodologies then assume that these individual items can be further divided into a temporary or cyclical component (R_i^T and E_i^T) and a structural component (R_i^S and E_i^S), which implies that

$$PB = \sum_i R_i^S - \sum_i E_i^S + OOF + \sum_i R_i^T - \sum_i E_i^T \quad (14)$$

In both methods, the primary structural balance (SPB) and a temporary primary balance (TPB) are defined as:

$$SPB = \sum_i R_i^S - \sum_i E_i^S \quad (15)$$

$$TPB = OOF + \sum_i R_i^T - \sum_i E_i^T \quad (16)$$

The two methodologies analyzed in this section differ on the cycles used to determine the temporary components. The OECD methodology only allows output cycles to affect revenues and expenditures while the ECB methodology allows the different revenues and expenditures to be affected by different cycles.

We now describe these two methods in more detail and present the estimates of the structural primary balances they generate.

IV.1. The OECD Method

As mentioned above, the OECD methodology is very similar in spirit to the standard approach, with the main difference being the aggregation level at which the temporary adjustments are executed. On the revenue side, the OECD methodology groups revenues into four categories: indirect taxes (IT), corporate income taxes (CIT), social security contributions (SSC) and personal income taxes (PIT). There is also a residual category which includes all other income that cannot be included in the four groups above. On the expenditure side, the method groups expenditures into unemployment insurance and all other expenditures.

The OECD method allows different revenue and expenditure items to have different sensitivity with respect to output. If all elasticities were the same and equal to the output elasticity used in the SM, the structural primary balanced estimated with the OECD and SM would coincide. For the estimation of the output gap, the standard OECD method suggests using a production function technique. Having estimated the output gap and the required elasticities one can compute the temporary components of each revenue and expenditure item. These are defined as:

$$\log\left(R_i^{T.OECD}\right) = \varepsilon_{R_iY}^{OECD} \log(Y/Y^*) \quad (17)$$

$$\log\left(E_i^{T.OECD}\right) = \varepsilon_{E_iY}^{OECD} \log(Y/Y^*) \quad (18)$$

The temporary component of the primary fiscal balance is then defined as

$$TPB^{SM} = OOF + \sum_i R_i^{T.OECD} - \sum_i E_i^{T.OECD} \tag{19}$$

For the estimation of the elasticities, the OECD method starts by recognizing that the relevant elasticities ($\varepsilon_{R_iY}^{OECD}$ and $\varepsilon_{E_iY}^{OECD}$) can be defined as the product of the elasticities of the tax bases (B_i) with respect to output (ε_{B_iY}) times the elasticity of revenues and expenditures with respect to the tax base ($\varepsilon_{R_iB_i}$ and $\varepsilon_{E_iB_i}$).[13] That is,

$$\varepsilon_{R_iY}^{OECD} = \varepsilon_{R_iB_i}\varepsilon_{B_iY} \text{ and } \varepsilon_{E_iY}^{OECD} = \varepsilon_{E_iB_i}\varepsilon_{B_iY} \tag{20}$$

To produce the estimates of the output elasticities the OECD uses a mixed method. The elasticities of the tax or expenditure bases with respect to output are usually estimated econometrically. A difficulty faced at this stage is finding good proxies for the tax bases to use in the estimations. Meanwhile, the elasticities of revenues and expenditures with respect to the bases are derived from statutory tax rates and the income distribution in the country. Appendix C describes the OECD method for the estimation of elasticities in more detail. The elasticity estimates we obtained are presented in Table 1 below.

Table 1. Elasticities – OECD Methodology

Indirect Taxes	1.21
Social Security Contribution	0.60
Personal Income Tax	1.73
Corporate Income Tax	1.64
Other Revenues	1.00*
Pension Payments	0.49
Other Expenditures	0.00*
* indicates that values are assumed, not estimated.	

The OECD method has several advantages over the SM. First of all, it has the capacity of producing time-varying output elasticities of revenues and expenditures. The output elasticity of overall revenues can be thought of as a weighted average of the output elasticity of the different tax categories, with the weights given by the shares of the tax category in overall revenues. As the relative importance of the different tax categories changes over time and the elasticities for these categories are different from one another, the output elasticity of overall revenues also varies over time.

Another advantage of the OECD method is that it can provide a more reliable output elasticity estimate in the presence of fiscal reforms (structural changes), as long as the output elasticity of the tax base with respect to output (ε_{B_iY}) does not vary substantially as a consequence of the reform. Since the $\varepsilon_{R_iY}^{OECD} = \varepsilon_{R_iB_i}\varepsilon_{B_iY}$, one can obtain a new estimate

[13] Studies using the standard OECD method usually assume an elasticity of one for the "all other revenues" group and an elasticity of zero for the "all other expenditures" group.

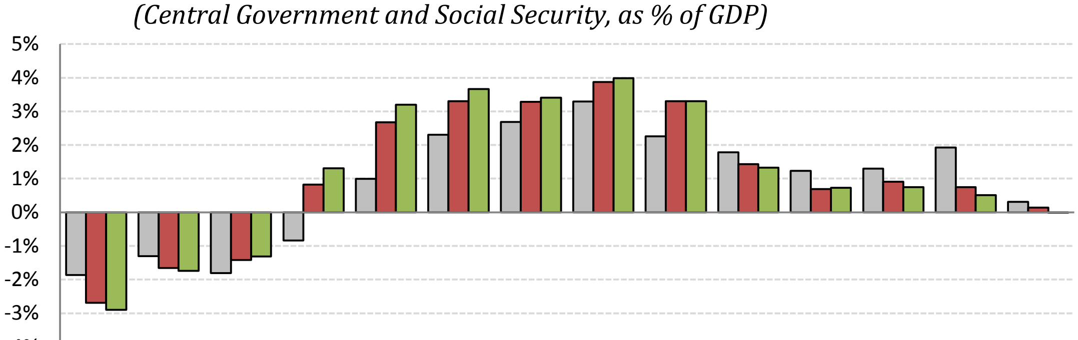
$\varepsilon_{R_iY}^{OECD}$ by modifying the elasticity of revenues with respect to the tax base ($\varepsilon_{R_iB_i}$) to reflect the new statutory tax rates, keeping ε_{B_iY} fixed. This might be a good approximation for the first few years after the reform.[14]

The main drawback of the OECD methodology is that it is more data-intensive than the two disaggregated methods discussed above. In particular, the estimation of the PIT and SSC elasticities requires knowing the income distribution in the country. The estimation of the elasticities also requires using proxies for the tax bases, which in some cases are not ideal. Finally, the adjustments made to revenue and expenditure items are only driven by the cycles in output, not allowing for other cycles to affect the fiscal balance.

The estimates obtained for the Central Government's structural primary balance using the OECD are plotted in graph 10. The difference in absolute terms in the estimates produced by this method and the SM averaged 0.2% of GDP in the period analyzed. The results reveal that the temporary corrections introduced when applying the OECD method to the Uruguayan data are larger than the corrections introduced while using SM. The largest differences between the two methods tend to coincide with periods of large output gaps. Both results are due mainly to differences in the output elasticities of revenues used in the two methods. According to our estimates, the implicit output elasticities of revenues in the OECD method have fluctuated between 1.12 and 1.19, stabilizing at about 1.16 in recent years (see graph 11). These elasticities are higher than the one used in the SM (0.95). In consequence, the estimated effect of the output gap on temporary revenues is always larger in the OECD method.

Graph 10: Estimated Structural Primary Fiscal Balance

(Central Government and Social Security, as % of GDP)

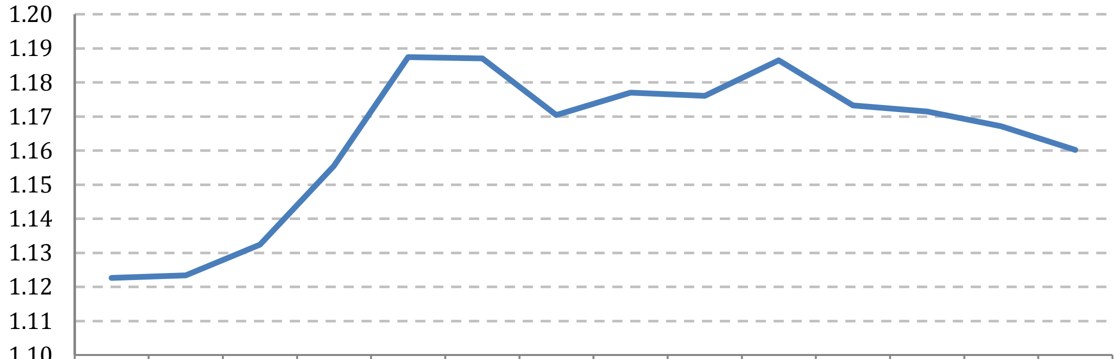


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Primary Balance	-1.9%	-1.3%	-1.8%	-0.8%	1.0%	2.3%	2.7%	3.3%	2.3%	1.8%	1.2%	1.3%	1.9%	0.3%
Standard Method	-2.7%	-1.7%	-1.4%	0.8%	2.7%	3.3%	3.3%	3.9%	3.3%	1.4%	0.7%	0.9%	0.7%	0.1%
OECD	-2.9%	-1.7%	-1.3%	1.3%	3.2%	3.7%	3.4%	4.0%	3.3%	1.3%	0.7%	0.7%	0.5%	0.0%

Sources: Own calcuations based on MEF, BCU and INE.

[14] The assumption that ε_{B_iY} does not change might be reasonable in the short term due to inertia in individual behavior, but it is less likely to hold in the longer run, as individual adapt to the changes in the tax system.

Graph 11: Output Elasticities of Aggregate Revenues



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Elasticity	1.12	1.12	1.13	1.16	1.19	1.19	1.17	1.18	1.18	1.19	1.17	1.17	1.17	1.16

Sources: Own calcuations based on MEF, BCU and INE.

IV.2. The European Central Bank (ECB) Method

As in the OECD method, the ECB methodology corrects individual revenues and expenditures items to produce an estimate of the structural balance. The main difference between both methods is that the ECB methodology relies more directly on changes in tax bases to estimate the structural balance. More specifically, the OECD method uses an indirect approach to calculate the tax base gap. It first estimates the output gap ($\log(Y/Y^*)$) and, using of the elasticity of the tax base with respect to output (ε_{B_iY}), it produces an estimate of the base gap (e.g., $\varepsilon_{B_iY}\log(Y/Y^*)$). This tax base gap is then converted into a gap in revenues, when multiplied by the elasticity of revenues to the tax base ($\varepsilon_{R_iB_i}$). The ECB method produces estimates of the tax base gaps ($\log(B/B^*)$) directly from the original tax bases series, without the use of output gap estimates.

Having computed the different tax and expenditure base gaps, the temporary revenues and expenditures can be calculated using the elasticities of revenues and expenditures with respect to the tax base ($\varepsilon_{R_iB_i}$and $\varepsilon_{E_iB_i}$). These temporary revenues and expenditures are defined as:

$$\log\left(R_i^{T.ECB}\right) = \varepsilon_{R_iB_i}\log(B_i/B_i^*) \quad (21)$$

$$\log\left(E_i^{T.ECB}\right) = \varepsilon_{E_iB_i}\log(B_i/B_i^*) \quad (22)$$

As in the OECD case, four tax revenue categories and one expenditure item are used. The revenue categories are direct taxes on households, direct taxes on enterprises, indirect taxes and social security contributions. In regards to expenditures, only unemployment-related benefits are adjusted. The ECB methodology recommends using compensation of private sector workers as the proxy for the tax base of both direct taxes on households and social security taxes. While estimating the base gap, private-sector worker compensation is further divided into private wages and employment levels. Meanwhile, the ECB method recommends using private consumption as a proxy for the tax base of indirect taxes and gross operating surplus as the proxy for tax base of direct taxes on enterprises. The number of unemployed workers is the base proxy recommended for unemployment-related expenditures. They do not introduce any correction for pension payments.

We introduce some alterations to the standard ECB methodology while implementing it to estimate the primary structural balance of Uruguay. First, we do not adjust unemployment related expenditures, in order to make results comparable to the ones obtained with the other three methods. Instead, we adjust pension payments, using the wage cycle as its base. Second, we use all workers compensation as the tax base of direct taxes and social security taxes, instead of private worker compensation. Finally, as there is no public series on gross operating surplus, we construct a series equal to the difference between GDP and workers compensation, and use it as the proxy for the corporate income tax base.

For the estimation of the base gaps, Bouthevillain et al. (2001) recommend using the Hodrick-Prescott filter with a smoothing parameter of 30.[15] We follow that recommendation. In what respect to the elasticities of revenues and expenditures with respect to the tax base, the ECB method does not recommend any particular estimation methodology. Bouthevillain et al. (2001) either estimates or assumes these elasticities, depending on the country being analyzed. We estimate the elasticities using a methodology described in Appendix C. The estimates obtained are summarized in Table 2.

Table 2. Elasticities – ECB Methodology

Indirect Taxes	1.16
Social Security Contribution	1.47
Personal Income Tax	3.37
Corporate Income Tax	1.89
Other Revenues	1.00*
Pension Payments	1.00*
Other Expenditures	0.00*
* indicates that values are assumed, not estimated.	

One of the main advantages of the ECB method over the OECD one is that it has the potential of accounting for composition effects emerging from differences in the timing of the base cycles. As it was mentioned above, the OECD method estimates expected base gaps by multiplying the output gap by the output elasticity of the tax base. As elasticities can

[15] To avoid the end of sample bias problem of the Hodrick-Prescott filter, we use forecasts of the tax base proxies based on IMF projections and own projections based on historical growth rates. In the case of the output gap, we use the estimates obtained using the production function approach.

differ between the different bases, the OECD method allows the estimated base cycles to differ in amplitude. But since all the base cycles originate on the output cycle, the phases of the base cycle (e.g. the beginning and end of the cycle) are not allowed to differ. This is not the case in the ECB methodology. Since cycles in the different tax bases are estimated individually, the method allows cycles to start and end at different points in time.

One of the main drawbacks of the ECB methodology is that it is more data-intensive than most of the other methods. In particular, it requires the estimation of more gaps. These gaps are estimated using proxies of tax bases instead of actual tax bases, which further increases the uncertainty surrounding the estimates obtained. If structural changes are present in the data, the constancy of the elasticities can also be problematic.

The application of the ECB methodology to the Uruguayan case reveals that allowing base cycles to differ both in amplitude and timing is a desirable feature of a methodology. A way of summarizing the differences in timing is by analyzing the correlations between these cycles. In the OECD methodology, all cycles in tax bases are caused by the output cycles. Therefore, correlations between the different tax base cycles are equal to one by construction. Table 3 summarizes the correlations across the cycles obtained using the ECB methodology. These correlations were estimated over the years 1986 through 2012 and were all different from 1 at a 5% significance level.

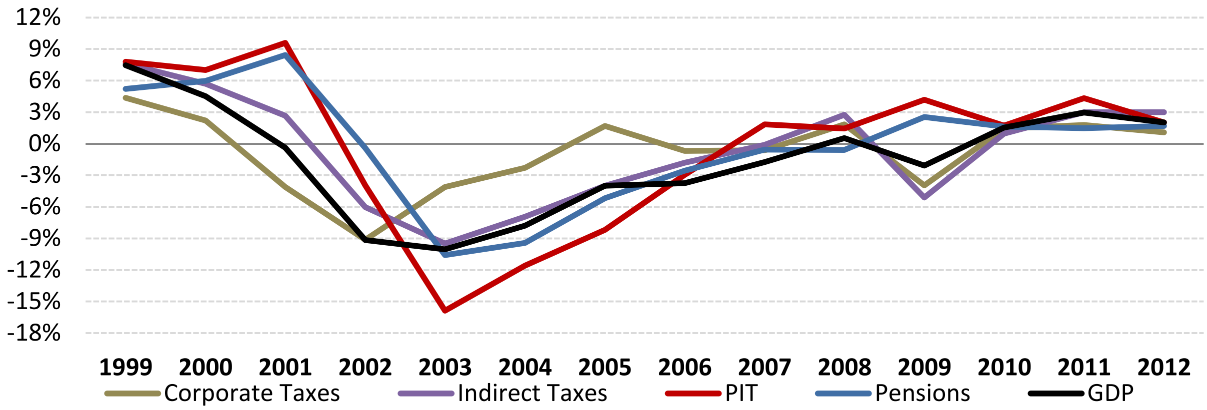
Table 3. Correlations across base gaps

	Output	Employment	Wages	Corporate Profits	Private Consumption
Output	1.00	0.68	0.62	0.80	0.87
Employment	-	1.00	0.60	0.35	0.63
Wages	-	-	1.00	0.22	0.79
Corporate Profits	-	-	-	1.00	0.69
Private Consumption	-	-	-	-	1.00

Source: Own calculations based on MEF.

Graph 12 reveals that allowing for differences in the phase of the base cycle might also be important. The estimates suggests that in 2001 the base for corporate taxes was already below its trend level, while the bases for personal income and indirect taxes were still above its trend level. The base for corporate taxes was also the first to show a positive gap, while the base for indirect taxes only presented a positive gap for the first time after the crisis in 2008. Meanwhile, in the 2009 crisis, the personal income tax base increased the size of its positive gap while the corporate and indirect taxes turned their positive gaps into negative gaps.

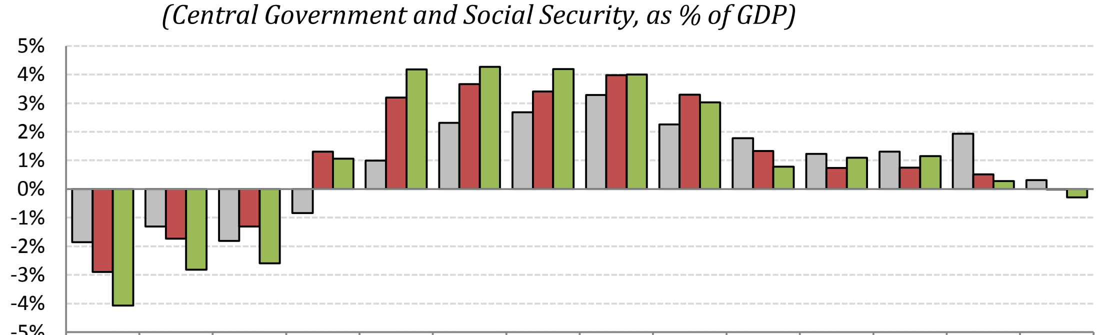
Graph 12: Estimated Base Gaps



Sources: Own calcuations based on MEF, BCU and INE.

Having estimated the different tax base gaps and elasticities, we calculate the structural primary balance (see graph 13). The absolute differences in the estimates produced by the ECB and the OECD methods averaged 0.6% of GDP in the period analyzed. The largest difference appears in the years 2001, at 1.3% of GDP. In that year, the GDP showed a small negative gap while the base of the personal income taxes and social security taxes presented a very large positive gap.

Graph 13: Estimated Structural Primary Balance
(Central Government and Social Security, as % of GDP)



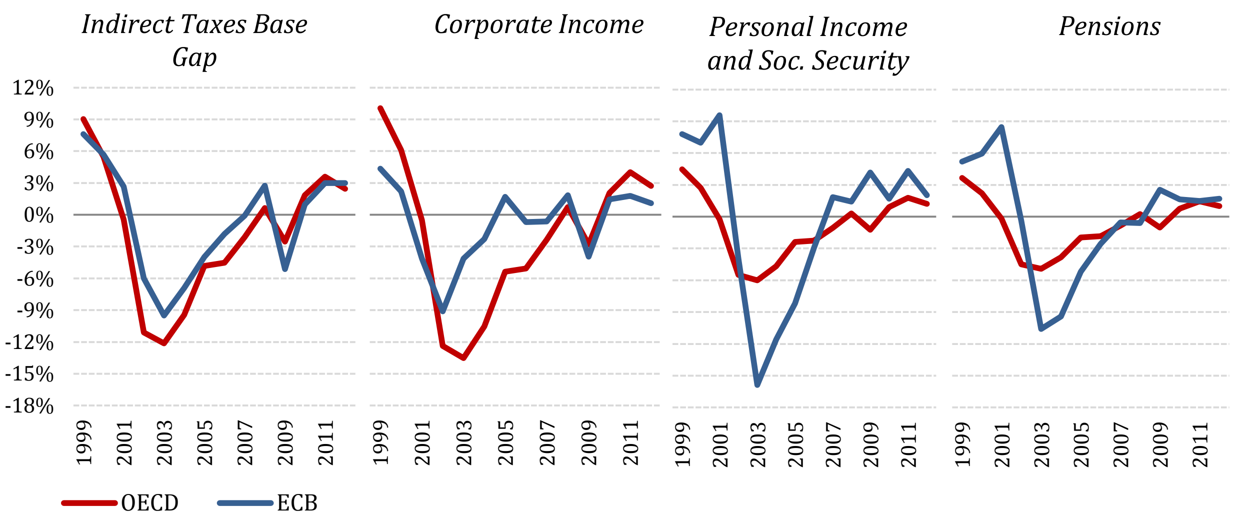
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Primary Balance	-1.9%	-1.3%	-1.8%	-0.8%	1.0%	2.3%	2.7%	3.3%	2.3%	1.8%	1.2%	1.3%	1.9%	0.3%
OECD	-2.9%	-1.7%	-1.3%	1.3%	3.2%	3.7%	3.4%	4.0%	3.3%	1.3%	0.7%	0.7%	0.5%	0.0%
ECM	-4.1%	-2.8%	-2.6%	1.1%	4.2%	4.3%	4.2%	4.0%	3.0%	0.8%	1.1%	1.1%	0.3%	-0.3%

Sources: Own calcuations based on MEF, BCU and INE.

To assess whether the large differences in estimates are due to differences in elasticity estimates or in base cycles estimates, we re-estimated the ECB model using the OECD estimates of the elasticities of tax revenues with respect to the tax base. The results obtained differ from the OECD estimates by an average of 0.6% of GDP in the period under consideration. This implies that about two thirds of the difference in results between the OECD and ECB method is explained by differences in tax base cycles.

Graph 14 plots the time series of the estimated base gaps under the two methods. The main differences in base gaps emerge around the 2002 crisis, especially for the personal income, social security contributions and corporate income taxes. As the ECB method estimates the cycles directly from the bases, it is able to better capture the collapse in employment and real wages, which was much larger than the collapse in output. Meanwhile, the OECD method produces larger fluctuations in the corporate income tax base, consequences of the higher elasticity of corporate income with respect to output.

Graph 14: Differences in Estimated Base Gaps



Sources: Own calcuations based on MEF, BCU and INE.

V. Public Sector Structural Fiscal Balance

As it was mentioned earlier, most of the work related to structural balances has focused on the Central Government. There is relatively little work on further adjustments to produce estimates of the structural balance of the General Government. In what follows we discuss some of the difficulties faced while trying to estimates the structural components of revenues and expenditures outside of the scope of the Central Government. We focus on two items that have the potential of having a large impact on Uruguay's fiscal balance; namely, the primary balance of state-owned enterprises and interest payments.[16]

V.1. State-Owned Enterprises

Most state-owned enterprises have a relatively small impact on Uruguay's public balance in a typical year. The largest public firms in terms of revenues are the state-owned energy company (UTE), the telecommunication company (ANTEL) and the oil company (ANCAP). These three firms are also the ones with the largest variation in profits, as measured by the standard deviation. Of all the SOEs, UTE is the one that contributes the most to the primary public balance in a typical year. It has also been the most volatile SOE in recent years, with a maximum primary balance of 1.8% of GDP and a minimum primary balance of -0.5% (see Table 4).

Table 4. Primary Current Balance (as % of GDP). 1999-2012

	Median	Standard Deviation	Minimum	Maximum
OSE	0.3%	0.1%	0.2%	0.4%
UTE	1.1%	0.6%	-0.5%	1.8%
ANTEL	0.6%	0.2%	0.3%	1.8%
ANP	0.1%	0.0%	0.0%	0.1%
AFE	0.0%	0.0%	0.0%	0.1%
ANCAP	0.1%	0.4%	-0.5%	0.7%
Source: Own calculations based on MEF.				

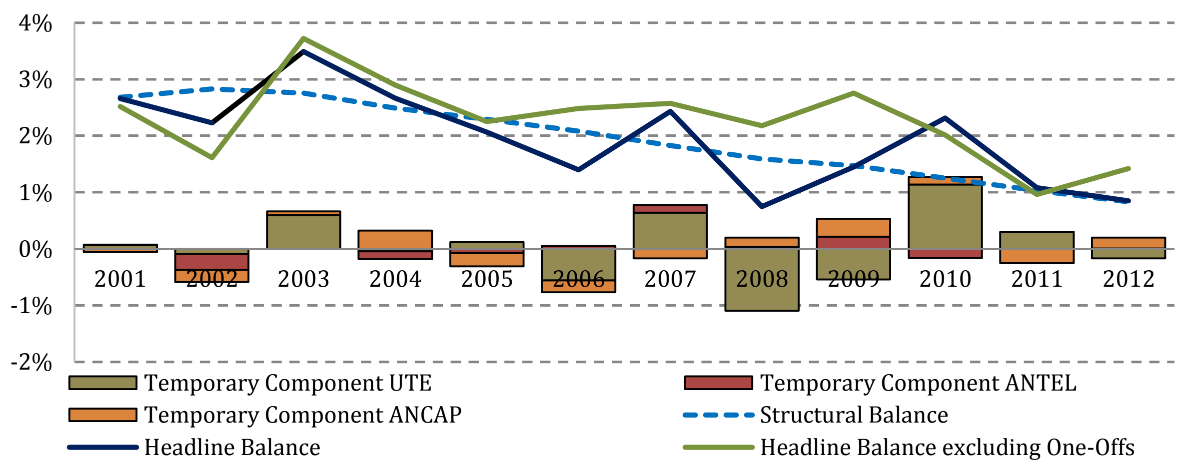
The large differences between the maximum and minimum primary balances of the three largest SOEs suggest that temporary factors affecting these enterprises could have an important effect on the General Government's fiscal balance. In order to assess whether large temporary deviations from normal levels are a regular phenomenon, one needs to produce estimates of the SOE's expected profit levels. This requires the modeling of the determinants of the firms' revenues and expenditures. With such a model in hand, one could then estimate these expected levels using estimates of the structural values of the determinants, provided that such estimates exist. Developping such a model is a highly demanding task as it requires detailed knowledge on both the production process and the demand side of the market.

[16] Results from local governments, the Banco de Seguros del Estado (BSE) and the Central Bank (BCU) are not analyzed due to their small contribution to the headline fiscal balance in normal times. The primary results of each of these entities represented on average less than 0.5% of non-financial public sector revenues in the period under consideration.

As a first approximation for the determination of expected revenues and expenditures levels of the different SOEs, we use a Hodrick-Prescott filter with smoothing parameter of 100. We use the estimated trends as the expected levels of the structural revenues and expenditures. We then produce an estimate of the temporary components of revenues and expenditures, which we define as deviations of the headline figures from their trend values.

The results from this simple exercise reveal that large temporary factors in revenues and expenditures are not unusual. Graph 15 presents the headline figures, the headline figures excluding the OFF (discussed in section 4) and the estimated structural primary balance of SOEs using the HP filter. It also presents a disaggregation of the adjustments introduced to produce the structural figures. Despite its simplicity, the method based on the HP filter is able to detect most of the SOE-related one-off factors identified in section 2. However, it tends to produce corrections that are too small when compared with official estimates. More specifically, for the years 2006, 2008 and 2009, years when UTE's results were affected by droughts, the method estimates temporary losses of 0.6%, 1.1% and 0.6% of GDP, respectively. These figures fall short of the 1%, 1.6% and 1.2% of increases in operating costs estimated by analysts. The method also reveals some large positive shocks affecting UTE. In 2010, year when energy production cost were low, the method estimates that UTE's temporary primary profits of UTE equaled 1.1% of GDP, somehow higher than the 0.9% reported by the MEF.[17] The largest mismeasurement is related to the effects of the 2012 drought. The method estimates a temporary effect of 0.2% of GDP, against a 1% of GDP estimated by the MEF. Finally, the OOF related to ANCAP's losses in 2011 was estimated at 0.3% of GDP. Analyst estimated a smaller impact, at 0.2% of GDP.

Graph 15: Structural SOE's Primary Current Balance and Firm-Specific Adjustments
(% of GDP)



Sources: Own calcuations based on MEF data.

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[17] In 2010 the government decided to create an energy stabilization fund, aimed at smoothing shocks to production cost. The government contribution to the fund equaled 0.4% of GDP that year.

From a fiscal standpoint, temporary deviations of primary current expenditures from their trends levels could be irrelevant if these deviations translate to higher prices and revenues. Graph 16 plots the temporary components of revenues and expenditures of the three largest SOEs. As a rough measure of the firms' propensity to increase the prices of their products when faced with cost shocks, we calculate the correlation between the temporary components of primary current expenditure and the temporary components of revenues. We also calculate the correlation between changes in primary current expenditures and changes in revenues, as this measure does not require the calculation of a trend level. The correlations in Table 5 suggest that ANCAP has a high propensity to translate cost increases to higher prices, as the correlations estimated are all very close to 1. The opposite behavior is obtained for UTE. We obtain a correlation of 0.04 for the measures based on deviations from the trend and a negative correlation of for the change measures.

Graph 16: Estimates of Temporary Revenues and Expenditures (as a % of trend levels)

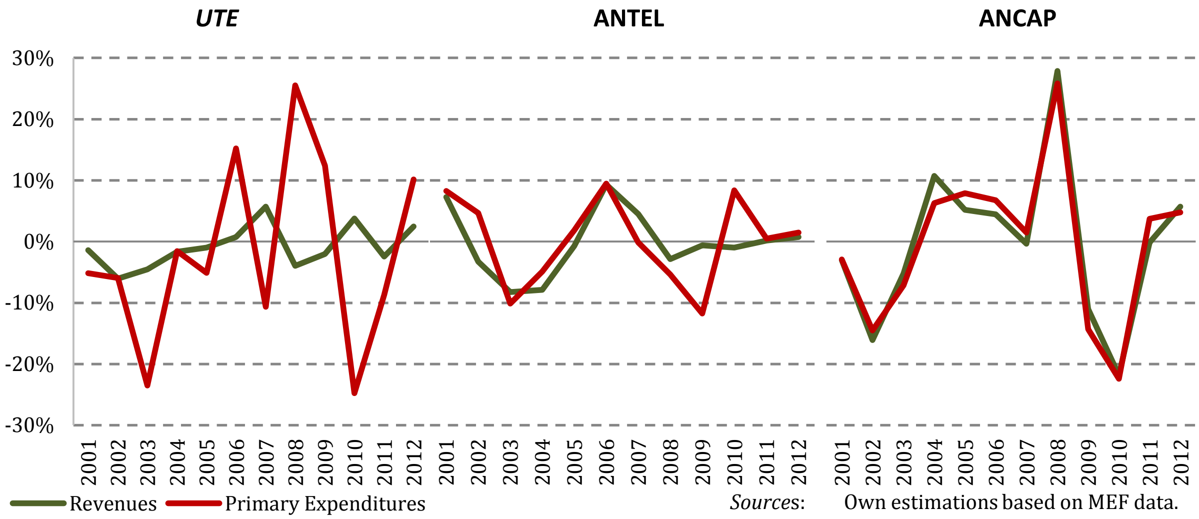


Table 5. Correlations between revenues and expenditures

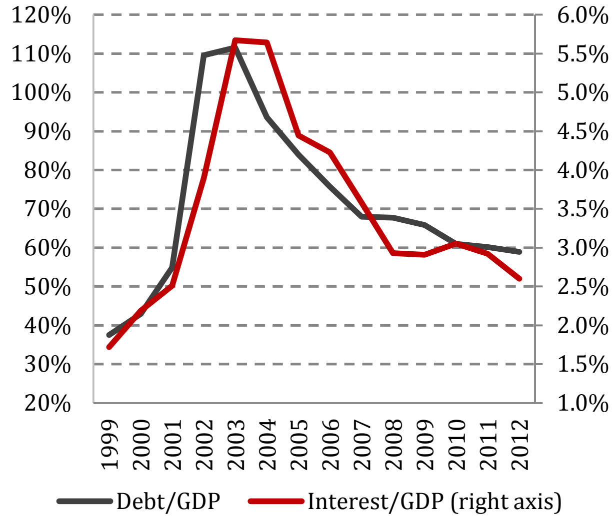
	Real Changes	HP Filter
UTE	-0.42	0.08
ANTEL	0.49	0.64
ANCAP	0.98	0.98
Source: Own calculations based on MEF.		

The decision of transferring cost deviations into prices depends on several factors. A typical factor usually referred to in the industrial organization literature is the amount of competition in the sector. Lower competition environments tend to increase the market power of firms, which facilitates the transferring of costs increases to prices. The consumer side is also relevant. If the product demand is not very sensitive to prices, cost changes can be translated into higher prices with little impact on revenues. In the case of SOEs, one also needs to take into account political constraints. For example, in periods of relatively high inflation, it might be politically harder to increase prices if the good or service being sold by the SOE has a high share in the consumer price index. These considerations suggest that the accurate estimation of the structural primary balance of SOEs is a highly demanding task. A successful model will need to distinguish between temporary and permanent factors affecting the costs and revenues of SOEs. The model will also have to detect the temporary factors affecting the SOEs capacity of transferring costs changes into prices. Given the complexity of building such a model, models of SOE's structural results are bound to suffer from misspecification problems. Results are also likely to be highly dependent on the model specification, turning results unreliable. If structural results are estimated to guide policy discussions, in the absence of a reliable model, it might be preferable to introduce SOE-related adjustments as one-off factors, as these are not model dependent and results are more transparent and easier to communicate.

V.2. Interest Payments

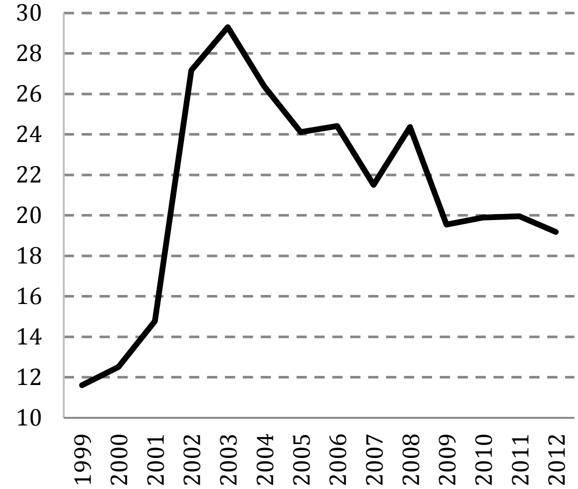
The last adjustments we consider are on interest payments. As it was mentioned earlier, interest payments as a share of GDP have been volatile and highly procyclical. In the years before the economic crisis, interest payments represented 2.5% or less of GDP. They experienced a large increase in 2003 and 2004, years when they surpassed 5.5% of GDP. Since then, interest payments have decreased as a percentage of GDP, to reach 2.6% of GDP in 2012. The evolution of interest payment has been very closely related to the evolution of the nominal exchange rate and the debt/GDP ratio (see graph 15 and 16). During the economic crisis of 2002 the nominal exchange rate overshot, experiencing a depreciation of over 100%. As over 95% of the Uruguayan public debt was denominated in dollars, the nominal exchange rate overshooting also led to an overshooting of the interest payments burden.

Graph 15: Interest Payments and Debt (% of GDP) (end of period)



Sources: MEF, BCU and Bloomberg.

Graph 16: Nominal Exchange Rate (UR$/US$) (end of period)



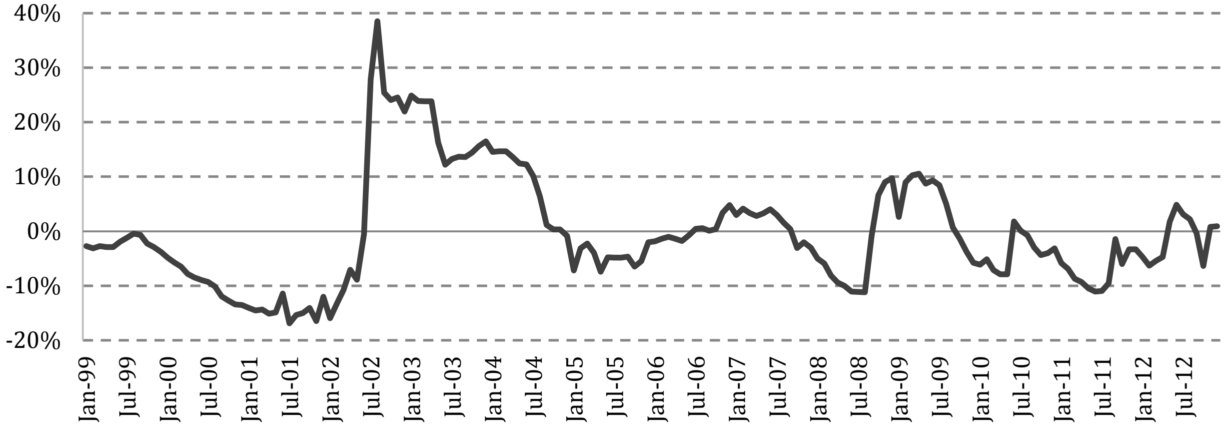
Sources: Bloomberg.

The paragraph above suggests that corrections for misalignments in exchange rates are an important temporary correction to consider in the case of Uruguay. In order to correct for misalignments, one needs to estimate the equilibrium level of the exchange rate. There are different models in the literature for the estimation of the equilibrium exchange rates. However, different models tend to produce different results, so estimates of misalignments are sensitive to model specifications (Edwards and Savastano, 2000). One also needs detailed information on the currency structure of the interest payments, as only payments in foreign currency need to be adjusted.

We use a very simple methodology to produce a first approximation of the impact on interest payments of exchange rate misalignments. As we do not have detailed information on the currency structure of interest rate payments, we assume it has the same as the structure of the public sector debt. As information on the latter is available for Uruguay on a quarterly basis and we correct interest payments on a monthly basis, we further assume that the currency composition of interest payment does not change through the months of any given quarter. In regards to exchange rate misalignments, we use deviations of the real exchange rate from its five year centered moving average as our measure of misalignment.[18] The misalignments unveil by such a model are presented in graph 17.

[18] To avoid a change of methodology at the end of the sample, we use monthly projections based on historical averages.

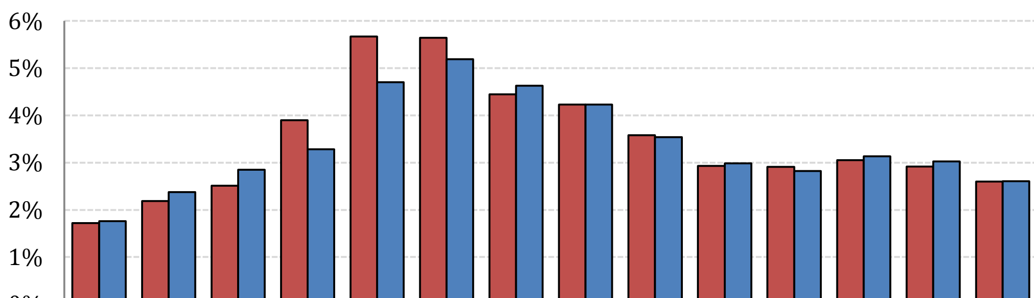
Graph 17: Nominal Exchange Misalignments (as a % of equilibrium levels)



Sources: Own estimations based on BCU, INE.

The estimates of the structural component of interest payments correcting for exchange rate misalignments are presented in graph 18. The results obtained suggest that temporary factors in interest payment have not been large in recent years. This is probably due to two factors. One the one hand, Uruguay has substantially changed that currency composition of its debt. While by the end of the year 2000 about 90% of the debt was denominated in a foreign currency, that proportion was reduced to 43% by the end of 2012. On the other hand, after the 2002 crisis Uruguay allowed the currency to float more freely, which might have prevented the occurrence of long periods of exchange rate misalignments.

Graph 18: Headline and Structural Interest (as a % of GDP)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Headline Interests	1.7%	2.2%	2.5%	3.9%	5.7%	5.6%	4.4%	4.2%	3.6%	2.9%	2.9%	3.1%	2.9%	2.6%
Structural Interests	1.8%	2.4%	2.9%	3.3%	4.7%	5.2%	4.6%	4.2%	3.5%	3.0%	2.8%	3.1%	3.0%	2.6%

Sources: Own calcuations based on BCU and INE.

The results above indicate that the temporary components of the interest payments due to exchange rate misalignments are large only during crisis periods. Taking into consideration that: a) econometric models for the estimation of the equilibrium exchange tend to produce imprecise estimates, b) that the share of foreign-currency denominated debt has been substantially reduced and, c) that a floating exchange rate regime is currently at place in Uruguay; it might not be worthwhile to introduce model-based corrections in interest payments in normal times. For turbulent times, when currency misalignments are likely to emerge, one could introduce the relevant corrections as one-off factors.

Besides the exchange rate, the level of the interest rate paid on Government debt can also have a temporary component. For example, interest rates can be temporarily high due to temporary constraints in international or national credit markets. Interest rates can also be high due to Central Bank monetary policies, particularly in periods of high inflation. The economic literature on the structural levels of interest rates is not well developed. Given the absence of reliable models, it might be preferable to introduce adjustments related to the level of interest rate as one-off factors. These adjustments have the advantage of being easier to communicate and can make use of information available to the policy maker that could fail to be picked up by econometric models.

V.3. Structural Fiscal Balance Estimates

Having produced estimates on the structural primary results of SOEs and the structural components of interest payments, we can compute estimates of the General Government's structural balance.[19] In order to produce these estimates, we need to select which of the Central Government structural primary balance estimates to use. As all the methods have their advantages and disadvantages, we decide to use the average of the four estimates as our final estimate of the Central Government's primary fiscal balance. The estimates below also use the structural levels of interest payments and SOEs profits excluding one-off factors.[20]

Graph 19 plots the estimates of the General Government's structural fiscal balance and compare them to the headline fiscal balance. The estimates indicate that the economy went through a sharp fiscal adjustment process in 2002 and 2003, when the structural balance experienced an adjustment of 2.1 and 2.7 percentage points of GDP, respectively. The structural fiscal figures oscillated around 1.1% of GDP between 2003 and 2007. Since then the structural fiscal balance has deteriorated, reaching a deficit of 2.5% of GDP in 2012.

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[19] As the structural results of the BCU, Local Governments and the BSE were not estimated, we use the headline figures in the computation of the structural balance.

[20] We decided not to use our estimates of the structural primary results of SOEs, as they seem unreliable.

Graph 19: Public Sector's Headline and Structural Fiscal Balance (*as a % of GDP)*

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Headline Balance	-3.2%	-3.3%	-3.4%	-3.7%	-2.6%	-1.8%	-0.4%	-0.5%	0.0%	-1.6%	-1.7%	-1.1%	-0.9%	-2.8%
Structural Balance	-4.8%	-4.4%	-3.9%	-1.8%	0.9%	0.4%	0.7%	1.3%	1.1%	-0.8%	-0.7%	-1.8%	-2.5%	-2.5%

Sources: Own calcuations based on MEF, BCU and INE.

VI. Conclusions and Final Remarks

This paper uses four different methodologies to estimate the structural primary balance of Uruguay's Central Government. It also discusses some extensions that could be used for the calculation of the General Government's structural balance. Despite all methods having their advantages and disadvantages; the recent economic history of Uruguay turns some methods more convenient than others. In particular, the economic crisis of 2002 and the subsequent rapid recovery caused significant changes in the economic structure as well as in the composition of aggregate demand. Due to the structural changes and some policy reforms, the structure of public revenues and expenditures also changed considerably. In consequence, aggregated methods for the estimation of the structural balance become less appealing. Disaggregated methods seem then more appropriate for the estimation of the structural fiscal balance in Uruguay.

Of the two disaggregated methods considered in this paper, the ECB method is theoretically more appealing for the estimation of Uruguay's primary structural balance. Being Uruguay a small open economy in a region characterized by its volatility and unbalanced growth processes; the method's capacity to account for differences in base cycles is a highly desirable feature. However, a refinement of the methodology is needed to produce more reliable estimates. Such a refinement will need to deal with two important aspects of the methodology. First, it will need to address the issue of selection of proxies for the different tax bases, in order to determine which is the more appropriate proxy available for each tax base. Secondly, once the tax basis proxies are selected, it is important to assess whether the HP filter is the most appropriate method to unveil the tax basis cycles.

Regarding the correction of temporary factors beyond the Central Government, given the complexity of the task, one might expect temporary factors in interest payments and SOE profits to be imprecisely estimated. In the case of SOEs, producing estimates of temporary components requires the introduction of econometric models capturing not only the cost determinants but also political restrictions for the transferring of cost shocks to price increases. In the case of interest payments, corrections of temporary components require the estimation of econometric models in order to determine exchange rate misalignments as well as the structural levels of interest rates. These models are known not to be very accurate. In the absence of reliable models, it might be preferable to introduce these adjustments as one-off corrections.

Appendix A – Data Sources

Fiscal Variables

The fiscal data used in this paper comes mainly from the MEF, DGI, BPS and INE. Most of the data used in the different estimations have an annual frequency. Quarterly data was used in some instances, mainly when dealing with series with insufficient annual observations.[21] Real revenues and expenditures were constructed using the INE's consumer price index to deflate nominal figures.

The main dataset on fiscal variables comes from MEF. It spans the years 1999 to 2012 and has a monthly frequency. Annual figures were obtained adding up the monthly figures. This dataset was complemented with that reconstructed by Licandro and Vicente (2006) using BCU's reports. This dataset spans the years 1970-1998.

Disaggregated data on fiscal revenues were obtained from different sources. The indirect tax (IT), corporate income tax (CIT), social security contributions (SSC) and person income tax (PIT) for the years 1999 through 2012 were constructed using the data from MEF. The taxes included in the indirect tax revenues are the value-added tax (VAT), the IMESI (*Impuesto Específico Interno*), taxes related to foreign trade and all other taxes related to transactions. This series was extended to the 1982-1998 using data only for the VAT, as this is the main source of indirect tax revenues. VAT data comes from the DGI. The corporate income tax (CIT) includes the IRIC (*Impuesto a las Rentas de la Industria y Comercio*) revenues for the period before the 2007 tax reform and then IRAE (*Impuesto a*

[21] Quarterly data was used to estimate the elasticity of corporate income tax with respect to corporate profits, the elasticity of the personal income tax with respect to employment and salary, and the income elasticity of employees' compensation.

las Rentas de las Actividades Económicas) for the period after the reform. The series was extended to the 1982-1998 using data from DGI. Regarding SSC, the series includes the disability, old age and survival contributions. The MEF provided us with data for the 1992-1998 period. Finally, the PIT includes the IRP (*Impuesto a las Retribuciones Personales*) revenues for the period before the 2007 tax reform and then IRPF (*Impuesto a la Renta de las Personas Físicas*) for the period after the reform. We used the data available in Licandro and Vicente (2006) to extend the dataset to the 1989-1998 period.

Data on total revenues of BPS were obtained from MEF data for 1992-2012. Data on expenditures related to social security benefits were approximated by unemployment insurance and family allowances. These series were produced by MEF for 1999-2011. For the 1990-1998 period, the unemployment insurance data was produced by INE while the family allowances data was produced by BPS.

Finally, the estimation of the output elasticity of the PIT using the OECD methodology requires the usage of an income distribution. This was approximated using the National Household Survey (*Encuesta Continua de Hogares 2011, Personas*), produced by INE.

Economic Cycles

For the estimation of the economic cycles we mainly use data from the BCU and INE. The GDP figures come from National Accounts data. Data for the 1980-2012 period comes from the BCU. This data was complemented with data from the Economic History database, developed by Universidad de la República's Social Science Department.[22] This extended series was mainly used in the estimation of output elasticities.

For the estimation of potential output, the labor force was calculated as the product of total population and the share of population 15 years of age or older. The data from the 1996-2012 periods comes from INE. Data for the years 1980 through 1995 comes from the World Bank's Word Development Indicators (WDI). Data on participation, employment and unemployment rates also come from INE and are available for the period 1986-2012. This data is representative of cities of 5,000 inhabitants or more. This also is the case of the INE's data on hours worked in the 2004-2012 period. The previous data (1983-2003) is representative of Montevideo city. Data on real salaries is available for the 1980 to 2012 period and comes from INE. The capital stock figures used for the estimation of the output gap were constructed using national accounts data (see appendix B). GDP and investment

[22] The GDP data for the 1970-1980 period comes from Bonino, Román and Willebald.

series were extended to the 2013-2017 period using IMF's Word Economic Outlook (WEO) forecast. INE's forecasts were used for the population series. Forecasts on other employment variables were constructed using historical averages.

For the estimation of the absorption cycle, we mainly use data from the balance of payment produced by the BCU (1999-2012 period), complemented with data from de IMF's WEO. Most variables used to estimate the absorption norm also comes from IMF's WEO. The exceptions are dependency ratio, which comes from the WDI, and the net foreign asset position, which comes from the BCU (2002-2011) and the Lane and Milesi-Ferretti (2007) dataset (1980-2001). Data on 2012 net foreign assets was calculated using 2011 BCU's estimate and 2012 balance of payment data.

Finally, the economic cycles used in the European Central Bank method are cycles in private consumption, labor compensation and corporate profits. The private consumption data comes from National Accounts. The labor compensation series was constructed using the number of employees and the real salary index, rescaling by the nominal salary of the base year. The corporate profit series was obtained as residual, subtracting labor compensation from GDP.

Appendix B – Estimation of the Output Gap

The production function approach used in this paper to estimate the output gap follows closely the methodology presented in Giorno et al. (1995). The method assumes that the economy's output (Y) is a function of labor input (L), physical capital (K) and total factor productivity (A). More specifically, the production function has the following Cobb-Douglas specification:

$$Y = AK^{\alpha}L^{1-\alpha} \tag{B.1}$$

Output can therefore differ from its potential level if either A, K or L are different from their potential levels.

Labor input is assumed to be equal to the product of total employment (E) and hours worked (h).[23] Furthermore, employment depends on the size of the labor force (F)[24], the labor market participation rate (P) and the rate of unemployment (U). That is, E=F*P*(1-U). The potential level of labor input is defined as the level consistent with the trend levels of h,

[23] All the data used for the calculating the labor input comes from the INE. The data refers to urban population (cities with 5,000 people or more). In the case of hours worked, we use the index for Montevideo for the 1983-2003 period. The 2004-2012 refers to urban cities.

[24] The size of the labor force is assumed to be equal to the working age population. That is, the number of people 15 years of age or older.

F and P, as well as with the trend level of the non-acceleration wage rate of unemployment (NAWRU). Trend levels are calculated using a Hodrick-Prescott filter on annual data, with smoothing parameter equal to 100. Following Giorno et al. (1995), the NAWRU in year t is defined as

$$NAWRU_t = U_t - [(U_t - U_{t-1})/(lnW_t - lnW_{t-3})] * (lnW_t - lnW_{t-2}) \qquad \text{(B.2)}$$

where W_t is a salary index.

To the best of our knowledge, there is no time series available on the stock of physical capital in Uruguay. We are therefore forced to construct the capital stock series. To that end, we use the perpetual inventory method, which assumes that the stock of physical capital evolves according to the following equation:

$$K_{t+1} = (1 - \delta)K_t + I_t \qquad \text{(B.3)}$$

where δ is the depreciation rate and I_t in gross fixed capital investment. The depreciation rate is assumed to equal 7% and the investment information comes from the national accounts. For this equation to produce a series, an initial level of capital must be assumed. We set this value equal to $K_{1980} = \overline{i^{ss}}/(\bar{g} + \delta)Y_{1980}$, where i^{ss} is the average ratio of investment to GDP between 1980 and 2012 and $\bar{g}$ is the average growth rate of GDP over the same period. This equation is an approximation to the steady-state level of capital, which is given by $k^{ss} = i^{ss}/(g + \delta)$. For the estimation of potential output, we assume that physical capital is used at its potential level at all point in time.[25]

The TFP component is calculated as a residual, assuming the production function parameter α is equal to 1/3. This parameter is frequently used in the literature (see Klenow and Rodriguez-Clare, 2005). The trend level of TFP is then calculated using a Hodrick-Prescott filter, with smoothing parameter equal to 100.

The potential output level is then defined as:

$$Y^* = A^* K^\alpha [\mathrm{F} * P^* * (1 - NAWRU^*) * h^*]^{1-\alpha} \qquad \text{(B.4)}$$

while the output gap is defined as $Y/Y^* - 1$.

[25] As there is no long series available for the utilization of the physical capital, we cannot control for variation in utilization, which will be captured in the TFP component.

Appendix C – Elasticities

Standard Method

To estimate the output elasticity of revenues, we assume that long-run relation between revenues and GDP is given by: $\log(Revenues_t) = \beta_0 + \beta_1 \log(GDP_t) + u_t$. The relation was estimated using a VEC model, as we find that a cointegration relation exists between these two variables. The selected VEC model includes a constant and one lag both in the long and short run relations, and output was restricted to affect revenues only in the long-run. The relation was estimated over the 1970-2012 period. The results obtained were the following:

TABLE C.1. Vector Error Correction Estimates

Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(Revenues (-1))	1.000000	
log(GDP(-1))	-0.951923	
	(0.04065)	
	[-23.4159]	
C	0.318997	
Error Correction:	**d(log(Revenues))**	**d(log(GDP))**
CointEq1	-0.750313	0.000000
	(0.18202)	(0.00000)
	[-4.12212]	[NA]
d(log(Revenues (-1)))	0.176592	0.114105
	(0.20511)	(0.11006)
	[0.86096]	[1.03679]
d(log(GDP(-1)))	0.605779	0.358726
	(0.36544)	(0.19608)
	[1.65766]	[1.82944]
C	0.005019	0.014841
	(0.01311)	(0.00704)
	[0.38269]	[2.10910]
R-squared	0.424096	0.275723
Adj. R-squared	0.377401	0.216997
Sum sq. resids	0.188009	0.054129
S.E. equation	0.071283	0.038249
F-statistic	9.082257	4.695135
Log likelihood	52.21266	77.73755
Akaike AIC	-2.351837	-3.596954
Schwarz SC	-2.184659	-3.429776

Mean dependent	0.024659	0.026697
S.D. dependent	0.090341	0.043225
Determinant resid covariance (dof adj.)		4.36E-06
Determinant resid covariance		3.55E-06
Log likelihood		139.0920
Akaike information criterion		-6.297173
Schwarz criterion		-5.879229

A similar strategy was followed to estimate the output elasticity unemployment benefits as well as the output elasticity of pension benefits. The results from our most preferred model were the following:

TABLE C.2. Vector Error Correction Estimates

Sample (adjusted): 1992 2012
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(Unemployment benefits(-1))	1.000000	
log(GDP(-1))	-1.317496 (0.32259) [-4.08418]	
C	9.912059	
Error Correction:	**d(log(Unemployment benefits))**	**d(log(GDP))**
CointEq1	-0.444848 (0.10906) [-4.07877]	0.000000 (0.00000) [NA]
d(log(Unemployment benefits(-1)))	0.569316 (0.13558) [4.19898]	-0.007411 (0.03636) [-0.20380]
d(log(GDP(-1)))	2.178535 (1.17025) [1.86159]	-0.007412 (0.31386) [-0.02361]
C	-0.063641 (0.04902) [-1.29832]	0.036599 (0.01315) [2.78392]
d(Level shift 2002)	0.357480 (0.15222) [2.34849]	-0.092652 (0.04082) [-2.26953]
R-squared	0.722214	0.443639

Adj. R-squared	0.652767	0.304549
Sum sq. resids	0.299494	0.021543
S.E. equation	0.136815	0.036694
F-statistic	10.39956	3.189581
Log likelihood	14.82921	42.46585
Akaike AIC	-0.936115	-3.568176
Schwarz SC	-0.687420	-3.319480
Mean dependent	0.047094	0.031625
S.D. dependent	0.232179	0.044000
Determinant resid covariance (dof adj.)		1.16E-05
Determinant resid covariance		6.72E-06
Log likelihood		64.72793
Akaike information criterion		-5.021707
Schwarz criterion		-4.424837

TABLE C.3. Vector Error Correction Estimates

Date: 09/12/13 Time: 10:47
Sample (adjusted): 1987 2012
Included observations: 26 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LOG(PENSIONS(-1))	1.000000	
LOG(PIB(-1))	-0.571980	
	(0.00585)	
	[-97.8427]	
Error Correction:	**D(LOG(PENSIONS))**	**D(LOG(PIB))**
CointEq1	-0.049752	-0.076532
	(0.03370)	(0.02481)
	[-1.47613]	[-3.08516]
D(LOG(PENSIONES(-1)))	0.334192	-0.037648
	(0.17204)	(0.12662)
	[1.94253]	[-0.29733]
D(LOG(PIB(-1)))	0.393799	0.235608
	(0.29768)	(0.21910)
	[1.32289]	[1.07537]
D(FECHA>=2002)	-0.095457	-0.084277
	(0.04752)	(0.03498)
	[-2.00871]	[-2.40955]
R-squared	0.590845	0.420321
Adj. R-squared	0.535051	0.341274
Sum sq. resids	0.045218	0.024495
S.E. equation	0.045336	0.033368
F-statistic	10.58976	5.317355
Log likelihood	45.71435	53.68376
Akaike AIC	-3.208796	-3.821828

Schwarz SC	-3.015243	-3.628274
Mean dependent	0.034106	0.030914
S.D. dependent	0.066487	0.041112

Determinant resid covariance (dof adj.)	2.04E-06
Determinant resid covariance	1.46E-06
Log likelihood	100.9125
Akaike information criterion	-6.993267
Schwarz criterion	-6.509384

European Commission Method

The European Commission method requires the estimation of the output elasticity of all revenues excluding indirect taxes and the absorption elasticity of indirect taxes. To estimate the first elasticity we assume that the long run relation between non-indirect tax revenues and GDP is given by: $\log(Non\ IT\ Revenues_t) = \beta_0 + \beta_1 \log(GDP_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run relation ad lags 1, 3 and 4. Output was restricted to affect revenues only in the long-run. The year 2002 was intervened, modeled as a level shift. The relation was estimated over the 1970-2012 period. The results obtained were the following:

TABLE C.4. Vector Error Correction Estimates

Sample (adjusted): 1994 2012
Included observations: 19 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(Non IT Revenues(-1))	1.000000	
log(GDP(-1))	-1.081326 (0.24270) [-4.45542]	
C	2.872283 (3.14323) [0.91380]	
Error Correction:	**d(log(Non IT Revenues))**	**d(log(GDP))**
CointEq1	-0.337243 (0.07123) [-4.73453]	0.000000 (0.00000) [NA]
d(log(Non IT Revenues(-1)))	-0.253611 (0.26586) [-0.95393]	-0.144390 (0.21379) [-0.67538]

d(log(Non IT Revenues(-3)))	-0.538612	-0.213116
	(0.26141)	(0.21022)
	[-2.06039]	[-1.01378]
d(log(Non IT Revenues (-4)))	0.186377	0.001601
	(0.22496)	(0.18090)
	[0.82850]	[0.00885]
d(log(GDP(-1)))	1.640376	0.734773
	(0.46139)	(0.37103)
	[3.55533]	[1.98037]
d(log(GDP(-3)))	0.627418	0.070829
	(0.54898)	(0.44147)
	[1.14287]	[0.16044]
d(log(GDP(-4)))	0.500823	0.211659
	(0.51901)	(0.41737)
	[0.96496]	[0.50713]
d(Level shift 2002)	-0.065887	-0.084084
	(0.06360)	(0.05115)
	[-1.03593]	[-1.64400]
R-squared	0.722855	0.376924
Adj. R-squared	0.546489	-0.019578
Sum sq. resids	0.035276	0.022812
S.E. equation	0.056629	0.045539
F-statistic	4.098623	0.950622
Log likelihood	32.78562	36.92678
Akaike AIC	-2.609013	-3.044925
Schwarz SC	-2.211354	-2.647266
Mean dependent	0.023887	0.029557
S.D. dependent	0.084091	0.045100
Determinant resid covariance (dof adj.)		2.29E-06
Determinant resid covariance		7.69E-07
Log likelihood		79.74100
Akaike information criterion		-6.393789
Schwarz criterion		-5.449350

For the estimation of the absorption elasticity of indirect taxes and the absorption elasticity of indirect taxes, we assume that the long-run relation between indirect tax revenues and absorption is given by: $\log(IT\ Revenues_t) = \beta_0 + \beta_1 \log(Absorption_t) + u_t$. The relation was estimated using a VEC model, as we find that a cointegration relation exists between these two variables. The VEC model was estimated without using constants or lags, neither in the long run nor in the short run relation. No restrictions were included in the model. The year 2002 was intervened, modeled as a level shift. The relation was estimated over the 1983-2012 period. The results obtained were the following:

<u>Table C.5. Vector Error Correction Estimates</u>
Sample (adjusted): 1983 2012
Included observations: 30 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(IT Revenues(-1))	1.000000	
log(Absorption(-1))	-1.062930 (0.10358) [-10.2620]	
C	2.580179 (1.32789) [1.94307]	
Error Correction:	**d(log(IT Revenues))**	**d(log(Absorption))**
CointEq1	0.262566 (0.09556) [2.74765]	0.369352 (0.07665) [4.81888]
d(Level shift 2002)	-0.100651 (0.07108) [-1.41603]	-0.144123 (0.05701) [-2.52794]
R-squared	0.062419	0.405854
Adj. R-squared	0.028934	0.384635
Sum sq. resids	0.139847	0.089968
S.E. equation	0.070672	0.056685
F-statistic	1.864100	19.12649
Log likelihood	37.95791	44.57430
Akaike AIC	-2.397194	-2.838286
Schwarz SC	-2.303781	-2.744873
Mean dependent	0.034038	0.029620
S.D. dependent	0.071717	0.072260
Determinant resid covariance (dof adj.)		1.19E-05
Determinant resid covariance		1.04E-05
Log likelihood		86.99438
Akaike information criterion		-5.332959
Schwarz criterion		-5.006013

OECD Method

Four output elasticities need to be estimated in the OECD method, one for each revenue group included in the model. To estimate the output elasticity of indirect taxes, we assume that long-run relation between private consumption (a proxy for the tax base of indirect taxes) and GDP is given by: $\log(Cons\ Privado_t) = \beta_0 + \beta_1 \log(GDP_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run and short run relations. The relation was estimated over the 1982-2012 period. The results obtained were the following:

Table C.6. Vector Error Correction Estimates

Sample (adjusted): 1982 2012
Included observations: 31 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(Cons_Privado_Real(-1))	1.000000	
log(GDP(-1))	-1.211532	
	(0.03937)	
	[-30.7761]	
C	-3.853501	
Error Correction:	**d(log(Cons_Privado_Real))**	**d(log(GDP))**
CointEq1	-1.067646	-0.714060
	(0.25057)	(0.17392)
	[-4.26083]	[-4.10577]
C	0.027612	0.024544
	(0.00987)	(0.00685)
	[2.79800]	[3.58339]
R-squared	0.385003	0.367604
Adj. R-squared	0.363796	0.345797
Sum sq. resids	0.087549	0.042176
S.E. equation	0.054945	0.038136
F-statistic	18.15471	16.85736
Log likelihood	46.99075	58.31111
Akaike AIC	-2.902629	-3.632975
Schwarz SC	-2.810114	-3.540460
Mean dependent	0.027612	0.024544
S.D. dependent	0.068886	0.047150
Determinant resid covariance (dof adj.)		8.83E-06
Determinant resid covariance		7.72E-06
Log likelihood		130.1680
Akaike information criterion		-8.010839
Schwarz criterion		-7.733293

We assumed a unitary elasticity of tax revenues with respect to the tax base. Under this assumption, we obtained an output elasticity of indirect taxes of 1.21.

The elasticity of corporate income tax (CIT) with respect to output ($\varepsilon_{CIT\,Y}$) was obtained using the following equation:

$$\varepsilon_{CIT\,Y} = [1 - (1 - PS)\varepsilon_{wL\,Y}]/PS \quad \text{(C.1)}$$

where PS is the profit share in output and $\varepsilon_{wL\,Y}$ is the elasticity of wage bill to output. The profit share was proxied by the average gross exploitation surplus to GDP ratio, using data from the BCU for the 1997-2005. The average was equal to 0.383. The output elasticity of labor income was calculated econometrically, assuming that long-run relation between labor income and GDP is given by: $\log(Labor\ Income_t) = \beta_0 + \beta_1 \log(GDP_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run relation, but not in the short run one. The model includes the first two lags and output was restricted to affect revenues only in the long-run. The relation was estimated over the 1989-2012 period. The results obtained were the following:

Table C.7. Vector Error Correction Estimates

Sample (adjusted): 1989 2012
Included observations: 24 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LOG(Retr_trabajo(-1))	1.000000	
LOG(Producto(-1))	-0.603185	
	(0.18139)	
	[-3.32542]	
C	-17.67629	
	(2.34158)	
	[-7.54888]	
Error Correction:	**D(LOG(Retr_trabajo))**	**D(LOG(Producto))**
CointEq1	-0.256474	0.000000
	(0.05786)	(0.00000)
	[-4.43263]	[NA]
D(LOG(Retr_trabajo(-1)))	-0.373678	-0.265794
	(0.18174)	(0.17783)
	[-2.05612]	[-1.49468]
D(LOG(Retr_trabajo(-2)))	-0.063740	-0.271178
	(0.14672)	(0.14356)
	[-0.43444]	[-1.88895]
D(LOG(Producto(-1)))	1.324039	0.605910
	(0.22861)	(0.22369)
	[5.79175]	[2.70874]
D(LOG(Producto(-2)))	0.864788	0.704215
	(0.33919)	(0.33189)
	[2.54959]	[2.12186]

R-squared	0.744190	0.309576
Adj. R-squared	0.690336	0.164224
Sum sq. resids	0.028766	0.027541
S.E. equation	0.038910	0.038072
F-statistic	13.81848	2.129832
Log likelihood	46.66505	47.18728
Akaike AIC	-3.472087	-3.515607
Schwarz SC	-3.226660	-3.270179
Mean dependent	0.017799	0.029702
S.D. dependent	0.069922	0.041645
Determinant resid covariance (dof adj.)		1.74E-06
Determinant resid covariance		1.09E-06
Log likelihood		96.59537
Akaike information criterion		-6.966281
Schwarz criterion		-6.328168

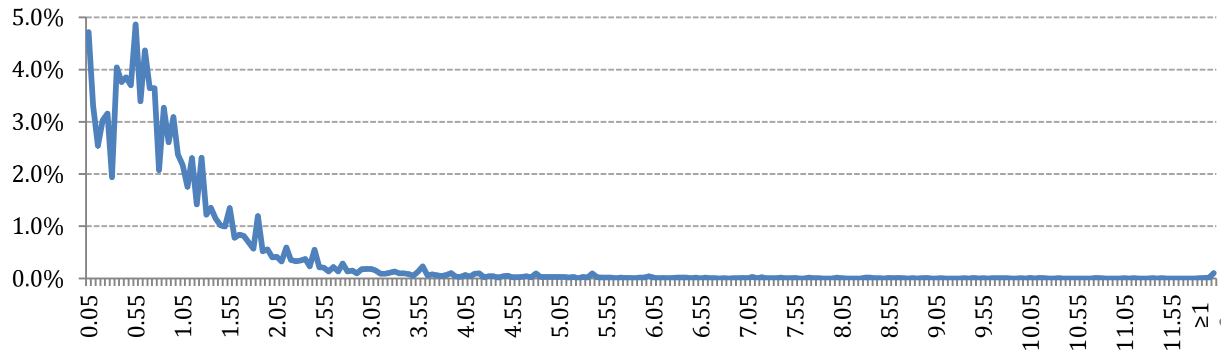
Using the results above, (C.1) implies that the output elasticity of the CIT is 1.64.

The elasticities of personal income tax (PIT) and social security contributions (SSC) with respect to the bases are derived from statutory tax rates and the income distribution in the country. The income distribution was divided into 187 groups ranging from 0.05 to 12 times the income of an average worker. Graph C.1 presents the labor income distribution obtained. The marginal and average tax rates for at mid-points of each of the income groups were calculated. Finally, the overall elasticities of PIT and CIT with respect to tax base (ε_{R_iB}) were calculated as the weighted ratios of marginal and average tax rates:

$$\varepsilon_{R_iB} = (\sum_{i=1}^{n} \gamma_i MA_i)/(\sum_{i=1}^{n} \gamma_i AV_i) \qquad \text{(C.2)}$$

where $\gamma_i$is the share of earners i in the income distribution, MA_i is the marginal income tax rate or social security contribution rate at earning level i, and AV_i stands for the corresponding average rate.

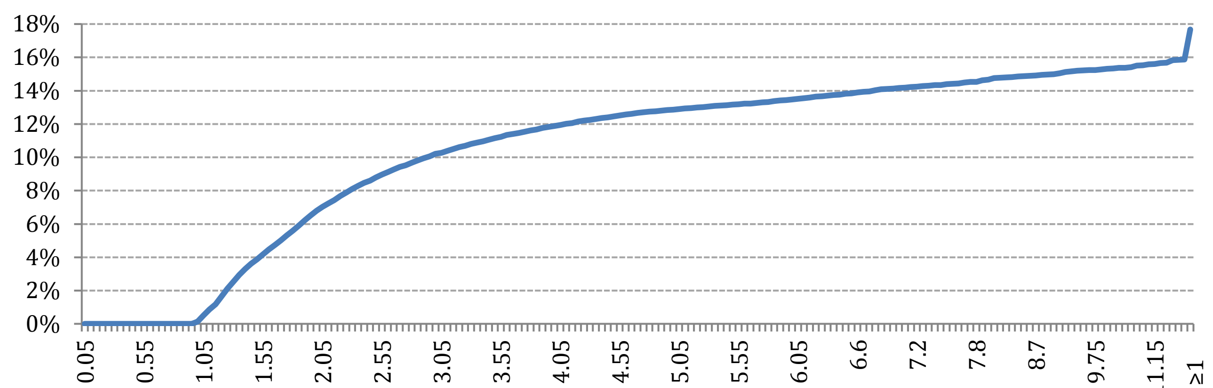
Graph C.1. Labor income distribution in Uruguay (%)



Note: Percentage of people by individual labour income level. 1 represents the national average.
Source: Author's calculations based on 2011 National Household Survey.

The average and marginal personal income and social security tax rates at the different points in the distribution were calculated based on the legislation in place during 2011, incorporating therefore the new personal income tax established by the tax reform of 2007. Although the fiscal legislation allows individual and household declaration since 2009, we chose the individual one, as it is the broadly used alternative[26]. Graphs C.2 and C.3 show the effective marginal and average personal income tax rates we obtained for the different income levels. Graph C.4 show the effective average rates of social security contributions we obtained for the different income levels.

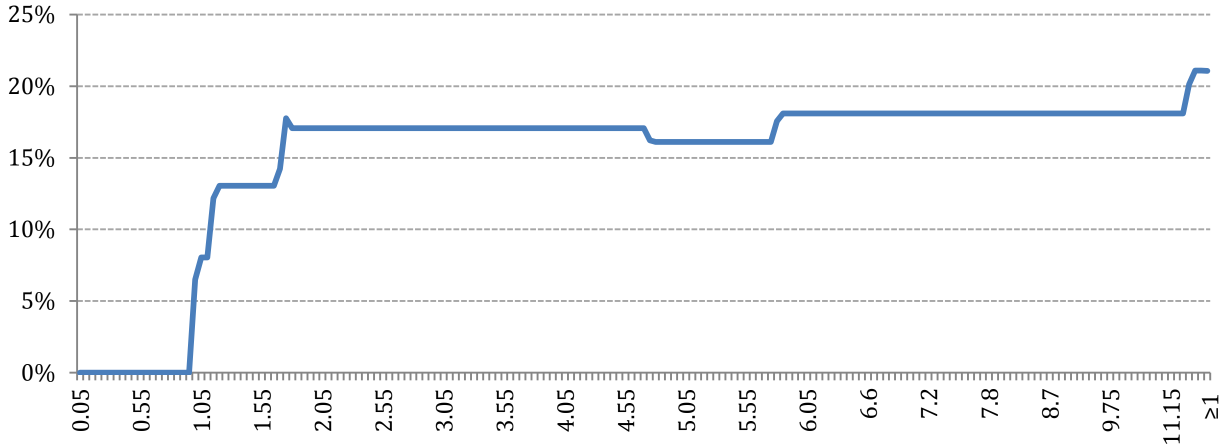
Graph C.2. Average personal income tax by income levels (%)



Note: Percentage of people by individual labour income level. 1 represents the national average.
Source: Author's calculations based on 2011 National Household Survey.

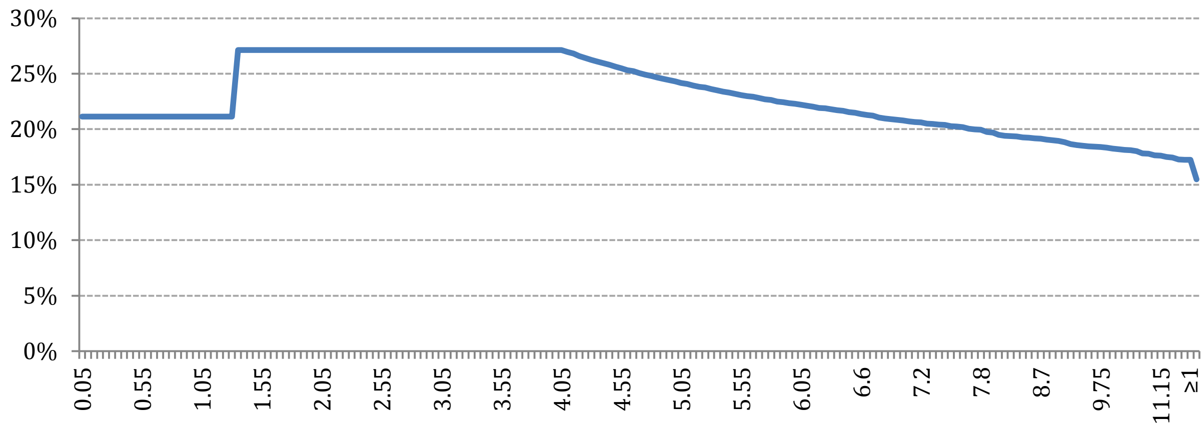
Graph C.3. Marginal personal income tax by income levels (%)

[26] In 2011, the PIT revenues under the individual declaration totalized 287 billion *pesos* while the revenues under the household modality totaled 11 billion *pesos*, according to DGI.



Note: Percentage of people by individual labour income level. 1 represents the national average.
Source: Author's calculations based on 2011 National Household Survey.

Graph C.4. Average social security contribution by income levels (%)



Note: Percentage of people by individual labour income level. 1 represents the national average.

Having approximated the income distribution and estimated the marginal and average personal income and social security effective tax rates, we are able to compute the overall output elasticities using the formula in (C.2). The estimated elasticities are:

Table C.8. Weighted marginal and average tax rates

	Marginal	Average	Real wage elasticity
	A	***B***	***A/B***
PIT	0.05	0.02	2.89
SSC	0.22	0.22	0.99

Source: Own calculations based on National Households Survey.

Concerning the output elasticity of pension payments, the OECD methodology does not include corrections for this item. To estimate the structural level of pension payments we make use of the fact that total pension payments (T) can be defined as the product of the average pension per pensioner (P) and the number of pensioners (N). Therefore, the output elasticity of pension payments can be expressed as the sum of the output elasticities of the average pension and the output elasticitiy of the number of pensioners. We estimate these two elasticities using vector error correction models. The implied output elasticity of pension payments we obtain is 0.49.

Table C.8. Vector Error Correction Estimates

Sample (adjusted): 1991 2012
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1, A(2,1)=0
Convergence achieved after 7 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 1):

Chi-square(1)	3.617537
Probability	0.057173

Cointegrating Eq:	CointEq1
LOG(PENSIONERS(-1))	1.000000
LOG(PIB(-1))	-0.181467
	(0.03267)
	[-5.55454]
C	-9.189324

Error Correction:	D(LOG(PENSIONERS))	D(LOG(PIB))
CointEq1	-0.395202	0.000000
	(0.08110)	(0.00000)
	[-4.87296]	[NA]
D(LOG(PENSIONERS(-1)))	0.983989	0.810732
	(0.12491)	(0.47407)
	[7.87773]	[1.71017]
D(LOG(PIB(-1)))	-0.109993	0.022375
	(0.05694)	(0.21612)
	[-1.93163]	[0.10353]
C	0.004302	0.029846
	(0.00260)	(0.00986)
	[1.65664]	[3.02801]
D(FECHA=1997)	0.018915	0.007253
	(0.00646)	(0.02451)
	[2.92839]	[0.29585]

D(FECHA>=2002)	-0.000713	-0.094267
	(0.00986)	(0.03742)
	[-0.07229]	[-2.51940]
R-squared	0.832676	0.523063
Adj. R-squared	0.780387	0.374020
Sum sq. resids	0.001282	0.018472
S.E. equation	0.008953	0.033978
F-statistic	15.92452	3.509484
Log likelihood	76.03440	46.69142
Akaike AIC	-6.366764	-3.699220
Schwarz SC	-6.069207	-3.401663
Mean dependent	0.007669	0.031769
S.D. dependent	0.019104	0.042945
Determinant resid covariance (dof adj.)		8.89E-08
Determinant resid covariance		4.70E-08
Log likelihood		121.5259
Akaike information criterion		-9.775081
Schwarz criterion		-9.080781

Table C.9. Vector Error Correction Estimates

Sample (adjusted): 1991 2012
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LOG(AVERAGE_PENSION(-1))	1.000000	
LOG(PIB(-1))	-0.303947	
	(0.12437)	
	[-2.44390]	
C	7.785199	
Error Correction:	**D(LOG(AVERAGE_PENSION))**	**D(LOG(PIB))**
CointEq1	-0.334686	-0.232862
	(0.07870)	(0.08588)
	[-4.25284]	[-2.71145]
D(LOG(AVERAGE_PENSION(-1)))	0.461388	-0.049522
	(0.14282)	(0.15586)
	[3.23060]	[-0.31775]
D(LOG(PIB(-1)))	0.226733	0.295537
	(0.20151)	(0.21990)
	[1.12518]	[1.34394]
C	0.005163	0.023920
	(0.00857)	(0.00936)
	[0.60219]	[2.55668]

R-squared	0.738103	0.429923
Adj. R-squared	0.694454	0.334910
Sum sq. resids	0.018540	0.022079
S.E. equation	0.032093	0.035023
F-statistic	16.90979	4.524895
Log likelihood	46.65103	44.72916
Akaike AIC	-3.877366	-3.702651
Schwarz SC	-3.678995	-3.504279
Mean dependent	0.021890	0.031769
S.D. dependent	0.058060	0.042945
Determinant resid covariance (dof adj.)		1.23E-06
Determinant resid covariance		8.23E-07
Log likelihood		91.68088
Akaike information criterion		-7.425535
Schwarz criterion		-6.929606

European Central Bank Method

Four output elasticities need to be estimated in the OECD method, one for each revenue group included in the model. In the case of indirect taxes, aggregate consumption is used a proxy for the tax base. We assume that long-run relation between IT revenues and consumption is given by: $\log(IT\ Revenues_t) = \beta_0 + \beta_1 \log(Cons_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run and short run relations. The model includes a second and third lag. Taxes were restricted to affect consumption only in the long run. The years 1987, 1989 and 2002 were intervened, modeled as a level shift. The relation was estimated over the 1970-2012 period. The results obtained were the following:

Table C.10. Vector Error Correction Estimates

Sample (adjusted): 1986 2012
Included observations: 27 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:	
B(1,1)=1, A(1,1)=0	
Convergence achieved after 3 iterations.	
Restrictions identify all cointegrating vectors	
LR test for binding restrictions (rank = 1):	
Chi-square(1)	0.313931
Probability	0.575278

Cointegrating Eq:	CointEq1
log(IT Revenues(-1))	1.000000
log(Consumption(-1))	-1.159612 (0.09089)

	[-12.7586]	
C	11.34060	

Error Correction:	d(log(IT Revenues))	d(log(Consumption))
CointEq1	0.000000	0.404452
	(0.00000)	(0.10323)
	[NA]	[3.91794]
d(log(IT Revenues(-2)))	-0.297963	-0.280996
	(0.20072)	(0.16502)
	[-1.48447]	[-1.70284]
d(log(IT Revenues (-3)))	-0.004706	-0.540140
	(0.17216)	(0.14154)
	[-0.02733]	[-3.81625]
d(log(Consumption(-2)))	-0.098461	0.510200
	(0.19758)	(0.16243)
	[-0.49834]	[3.14095]
d(log(Consumption(-3)))	-0.097745	0.248264
	(0.20926)	(0.17204)
	[-0.46710]	[1.44308]
C	0.061843	0.049115
	(0.01285)	(0.01056)
	[4.81297]	[4.64941]
d(Level shift 1987)	0.119110	0.170910
	(0.05314)	(0.04369)
	[2.24131]	[3.91187]
d(Level shift 1989)	-0.059807	-0.111155
	(0.05963)	(0.04902)
	[-1.00303]	[-2.26751]
d(Level shift 2002)	-0.155457	-0.152673
	(0.05185)	(0.04263)
	[-2.99814]	[-3.58150]
R-squared	0.558801	0.740858
Adj. R-squared	0.362712	0.625684
Sum sq. resids	0.039153	0.026463
S.E. equation	0.046639	0.038343
F-statistic	2.849734	6.432507
Log likelihood	49.92621	55.21446
Akaike AIC	-3.031571	-3.423293
Schwarz SC	-2.599625	-2.991348
Mean dependent	0.039831	0.039724
S.D. dependent	0.058422	0.062671
Determinant resid covariance (dof adj.)		3.13E-06
Determinant resid covariance		1.39E-06
Log likelihood		105.2816
Akaike information criterion		-6.317158

Schwarz criterion	-5.357279

In the case of social security contribution, workers compensation was used a proxy for the tax base. We assume that long-run relation between SSC and workers compensation is given by: $\log(SSC\ Revenues_t) = \beta_0 + \beta_1 \log(WComp_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run relation, but not in the short run one. The model includes a first lag. Worker compensation was restricted to affect SSC only in the long run. The year 2002 was intervened, modeled as a level shift. The relation was estimated over the 1970-2012 period. The results obtained were the following:

Table C.11. Vector Error Correction Estimates

Sample (adjusted): 1991 2012
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(SSC Revenues(-1))	1.000000	
log(Workers compensation(-1))	-1.474353	
	(0.28564)	
	[-5.16166]	
C	27.21953	
	(7.31306)	
	[3.72204]	
Error Correction:	**d(log(SSC Revenues))**	**d(log(Workers compensation))**
CointEq1	-0.281397	0.000000
	(0.06515)	(0.00000)
	[-4.31926]	[NA]
d(log(SSC Revenues (-1)))	0.203077	0.279133
	(0.18498)	(0.12815)
	[1.09782]	[2.17819]
d(log(Workers compensation (-1)))	0.516228	0.234473
	(0.27123)	(0.18790)
	[1.90328]	[1.24787]
d(Level shift 2002)	-0.231191	-0.129159
	(0.07276)	(0.05040)
	[-3.17756]	[-2.56249]
R-squared	0.609225	0.564703
Adj. R-squared	0.544096	0.492154
Sum sq. resids	0.091274	0.043804
S.E. equation	0.071210	0.049331
F-statistic	9.354112	7.783708

Log likelihood	29.11755	37.19303
Akaike AIC	-2.283414	-3.017548
Schwarz SC	-2.085042	-2.819177
Mean dependent	0.010906	0.022436
S.D. dependent	0.105463	0.069224
Determinant resid covariance (dof adj.)		4.77E-06
Determinant resid covariance		3.19E-06
Log likelihood		76.19973
Akaike information criterion		-5.927248
Schwarz criterion		-5.381727

In the case of the PIT, workers compensation was also used a proxy for the tax base. We assume that long-run relation between PIT revenues and workers compensation is given by: $\log(PIT\ Revenues_t) = \beta_0 + \beta_1 \log(WComp_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run and short run relations. The model includes the first four lags. No restrictions were introduced to the model. The year 1998, 2002 and 2003 were intervened, modeled as a aditive outliers in the first and last case, while the 2002 was modeled as a level shift. The relation was estimated over the 1970-2012 period. The results obtained were the following:

Table C.12. Vector Error Correction Estimates

Sample (adjusted): 1994 2012
Included observations: 19 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(PIT Revenues(-1))	1.000000	
log(Workers compensation (-1))	-3.373620 (2.34217) [-1.44038]	
C	77.46588	
Error Correction:	**d(log(PIT Revenues))**	**d(log(Workers compensation))**
CointEq1	-0.157082 (0.10311) [-1.52347]	0.050699 (0.01224) [4.14156]
d(log(PIT Revenues(-1)))	0.522103 (0.33101) [1.57729]	0.083191 (0.03930) [2.11686]
d(log(PIT Revenues(-2)))	-0.581886 (0.38482) [-1.51209]	-0.147513 (0.04569) [-3.22872]

d(log(PIT Revenues(-3)))	-0.018211	0.120940
	(0.24406)	(0.02898)
	[-0.07462]	[4.17387]
d(log(PIT Revenues(-4)))	-0.062297	-0.055914
	(0.20994)	(0.02492)
	[-0.29674]	[-2.24332]
d(log(Workers compensation (-1)))	0.310076	0.649622
	(0.68925)	(0.08183)
	[0.44988]	[7.93869]
d(log(Workers compensation (-2)))	1.371485	0.097322
	(0.84021)	(0.09975)
	[1.63231]	[0.97563]
d(log(Workers compensation (-3)))	-0.765353	-0.086347
	(0.94763)	(0.11251)
	[-0.80765]	[-0.76748]
d(log(Workers compensation (-4)))	0.697156	-0.015730
	(1.09929)	(0.13051)
	[0.63419]	[-0.12052]
C	0.087147	0.013408
	(0.06927)	(0.00822)
	[1.25809]	[1.63039]
d(Aditive Outlier1998)	0.223001	0.106506
	(0.13155)	(0.01562)
	[1.69517]	[6.81934]
d(Level shift 2002)	0.094069	-0.153675
	(0.21135)	(0.02509)
	[0.44509]	[-6.12448]
d(Aditive Outlier 2003)	-0.009534	-0.113113
	(0.14087)	(0.01672)
	[-0.06768]	[-6.76331]
R-squared	0.866579	0.980927
Adj. R-squared	0.599738	0.942780
Sum sq. resids	0.133106	0.001876
S.E. equation	0.148944	0.017683
F-statistic	3.247545	25.71482
Log likelihood	20.17011	60.65829
Akaike AIC	-0.754749	-5.016662
Schwarz SC	-0.108554	-4.370467
Mean dependent	0.103505	0.018721
S.D. dependent	0.235424	0.073925
Determinant resid covariance (dof adj.)		3.63E-06
Determinant resid covariance		3.62E-07
Log likelihood		86.96877
Akaike information criterion		-6.207239
Schwarz criterion		-4.815434

Finally, corporate profits were used a proxy for the tax base of CIT revenues. We assume that long-run relation between CIT revenues and corporate profits is given by: $\log(CIT_t) = \beta_0 + \beta_1 \log(Profits_t) + u_t$. The relation was estimated using a VEC model, as we find a cointegration relation exists between these two variables. The selected VEC model includes a constant in the long run and short run relations. The model includes a first lag. Corporate profits were restricted to affect CITs revenues only in the long run. The relation was estimated over the 1970-2012 period. The results obtained were the following:

Table C.13. Vector Error Correction Estimates

Sample (adjusted): 1988 2012
Included observations: 25 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
log(CIT Revenues(-1))	1.000000	
log(Profits(-1))	-1.885707 (0.10197) [-18.4929]	
C	40.34006	
Error Correction:	**d(log(CIT Revenues))**	**d(log(Profits))**
CointEq1	-1.025992 (0.24998) [-4.10433]	0.000000 (0.00000) [NA]
d(log(CIT Revenues (-1)))	0.452850 (0.20586) [2.19978]	0.032890 (0.07500) [0.43854]
d(log(Profits (-1)))	-0.155642 (0.77202) [-0.20160]	-0.111205 (0.28126) [-0.39538]
C	0.030867 (0.03479) [0.88725]	0.038442 (0.01267) [3.03304]
R-squared	0.534911	0.045695
Adj. R-squared	0.468469	-0.090634
Sum sq. resids	0.373357	0.049555
S.E. equation	0.133338	0.048578
F-statistic	8.050876	0.335183
Log likelihood	17.07773	42.32077
Akaike AIC	-1.046218	-3.065661
Schwarz SC	-0.851198	-2.870641

Mean dependent	0.055761	0.036628
S.D. dependent	0.182889	0.046515
Determinant resid covariance (dof adj.)		3.51E-05
Determinant resid covariance		2.48E-05
Log likelihood		61.07150
Akaike information criterion		-4.085720
Schwarz criterion		-3.598170

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