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# Projections of Potential Output and Structural Fiscal Balance for Cyprus

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# Projections of Potential Output and Structural Fiscal Balance for Cyprus

**Stephan Haroutunian and Panos Pashardes***

***Abstract***

This policy paper provides calculations of the projections of the potential level of output and the structural fiscal balance of the Cypriot economy for the period 2002 to 2008. The calculation of projections of the potential level of output is important since the difference in value with the projections of real GDP, gives projections of the size of the output gap. The latter in turn is a vital component for the calculation of the projections of the structural fiscal balance, which provides a clearer picture of the underlying fiscal situation in an economy by abstracting from the impact of the business cycle. The entry of Cyprus into the EU has increased the importance of the calculation of the projections of these two economic variables since they provide valuable information used in the EU surveillance procedures such as the Stability and Growth Pact.

A major conclusion that can be drawn is that the potential growth rate of the Cypriot economy is projected to be at lower levels than those which existed during the 1980s and 1990s. This can be interpreted as indicating the convergence of the Cypriot economy with the economies of the economically more advanced countries of the EU. The projected values of the elasticities of the various categories of the tax revenue with respect to the level of output are in line with what one would expect from economic theory, the tax structure of Cyprus and the changes in the tax structure in the first half of the current decade. The "budget sensitivity" is projected to be equal to 0.32.

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# ΠΕΡΙΛΗΨΗ

Το Δοκίμιο αυτό παρουσιάζει τους υπολογισμούς των προβλέψεων του δυνητικού ΑΕΠ και του δομικού δημοσιονομικού ελλείμματος της Κυπριακής οικονομίας για την περίοδο 2002 μέχρι 2008. Το δυνητικό ΑΕΠ είναι το επίπεδο παραγωγής όπου όλοι οι συντελεστές παραγωγής βρίσκονται σε πλήρη απασχόληση. Οι αποκλίσεις των προβλέψεων του δυνητικού ΑΕΠ από τις προβλέψεις του ΑΕΠ σε πραγματικούς όρους μας δίνουν μια ένδειξη για την αναμενόμενη κυκλική θέση της οικονομίας. Αυτά με τη σειρά τους χρησιμοποιούνται στον υπολογισμό των προβλέψεων του δομικού δημοσιονομικού ελλείμματος, οι οποίες μας δίνουν μια πιο καθαρή εικόνα της δημοσιονομικής κατάστασης της οικονομίας με την αφαίρεση των κυκλικών επιδράσεων. Η είσοδος της Κύπρου στην Ευρωπαϊκή Ένωση και η αναμενόμενη είσοδος της στην ευρωζώνη έχει αυξήσει κατακόρυφα τη σημαντικότητα του υπολογισμού των προβλέψεων αυτών των δυο οικονομικών μεταβλητών, αφού μας δίνουν χρήσιμες πληροφορίες οι οποίες χρησιμοποιούνται στις διαδικασίες επιτήρησης της Συμφώνου Σταθερότητας και Ανάπτυξης.

Ένα κύριο συμπέρασμα που βγαίνει από την ανάλυση είναι ότι, προβλέπεται πως ο δυνητικός ρυθμός ανάπτυξης της Κυπριακής οικονομίας θα είναι σε χαμηλότερα επίπεδα από αυτά που επικρατούσαν κατά τη διάρκεια των προηγούμενων δυο δεκαετιών. Η κύρια ερμηνεία που μπορεί να δοθεί σε αυτή την προβλεπόμενη πορεία είναι η σύγκλιση της Κυπριακής οικονομίας με τις οικονομίες των πιο αναπτυγμένων χωρών της Ευρωπαϊκής Ένωσης. Επιπρόσθετα οι προβλεπόμενες αξίες των ελαστικοτήτων των διάφορων κατηγοριών εσόδων ως προς το ΑΕΠ συνάδουν με αυτά που θα αναμέναμε βάσει της οικονομικής θεωρίας, της φορολογικής δομής της Κύπρου αλλά και των φορολογικών μεταρρυθμίσεων στο πρώτο μισό αυτής της δεκαετίας. Ο βαθμός δημοσιονομικής ευαισθησίας (budget sensitivity) προβλέπεται να είναι 0.32. Αυτό σημαίνει πως μια απόκλιση κατά 1% του πραγματικού ΑΕΠ από το δυνητικό, θα αλλάξει το δημοσιονομικό έλλειμμα κατά 0.32%.

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## I. INTRODUCTION

The potential level of output and the structural fiscal balance are two vital economic indicators that have gained increased importance for Cyprus after entry into the European Union due to the desire and obligation[1] of entry into the Economic and Monetary Union (EMU). Cyprus's entry into the Exchange Rate Mechanism 2 (ERM 2) in the Spring of 2005, has put Cyprus even closer to its target of joining the eurozone, which at the earliest can take place in 2007.

Entry into the EMU does not allow the member states to pursue an independent monetary policy and to use the exchange rate at the national level in order to aid the stabilisation of their economies in the event of asymmetric shocks. This automatically assigns a greater role to fiscal policy and automatic stabilisers in the economic stabilisation process. As a result the structural fiscal balance, and consequently the potential level of output[2] which is a vital component in the calculation of the structural fiscal balance, can and does play an important role in the EU surveillance procedures, especially in the Stability and Growth Pact.

As is well known the criteria for budgetary discipline of the Stability and Growth Pact states that the ratio of government deficit to gross domestic product (GDP) must not exceed 3%. Although the official criteria for budgetary discipline refers to the ratio of actual rather than the structural budget deficit, the structural fiscal balance can provide valuable extra information for the fiscal position of governments and because of this it has started playing a more prominent role in the EU surveillance procedures. In October 2002 the Eurogroup decided to commit itself to a reduction in the level of budget deficit by 0.5% of GDP annually starting from 2003. The reasoning behind this move was the achievement of a budgetary position close to balance or in surplus, which would then allow the Eurozone countries to respond to asymmetric recessions by fiscal expansion (even if just through automatic stabilisers) without violating the Pact's conditions. In March 2003, the ECOFIN Council recommended that the achievement of and

[1] Countries joining the EU no longer have the right to opt out from the EMU as did countries like the UK who had joined the EU earlier.

[2] Defined as the level of output that can be produced in an economy without inducing inflationary pressures.

the progress towards budgetary positions of close to balance or in surplus should be assessed in structurally adjusted terms.

The evolutionary process characterising the Stability and Growth Pact has continued in 2005, with recent developments indicating the controversies concerning the terms and the enforcement of the Pact. In March 2005, the EU Council introduced reforms to the Stability and Growth Pact following criticisms that the Pact had been insufficiently flexible and that it needed to be applied over the economic cycle rather than in any one year. Moreover, experience has shown that the pact has proved not to be enforceable against big countries such as France and Germany. Reforms have been introduced to both the preventive and the corrective arms of the Pact. According to Papademos (2005), some of the changes introduced into the preventive arm strengthen the economic underpinnings of the Pact. These changes include: (i) country-specific medium-term objectives that take into account factors such as the level of potential growth and debt levels; (ii) the benchmark of a 0.5% annual adjustment in the budget balances of Member States, with more fiscal consolidation being required in "good" times but also possibly less in "bad" times; (iii) the definition of the medium-term objectives and the adjustment path in cyclically adjusted terms; and (iv) the netting of temporary measures.

Change (iii) above indicates the increasingly important role that structural budget balances are playing in the monitoring and implementation of the Pact. As regards the corrective arm, which is concerned with the adoption and implementation of the Excessive Deficit Procedure (EDP) for countries violating the budgetary and debt criteria, the original Pact aimed to strike a balance between the quasi-automatic application of the EDP and the allowance of some discretion in the procedures and in the role of the ECOFIN Council. The recent reform of the Pact's corrective arm makes decisions on the existence of excessive deficits and on the setting of deadlines for correcting them less automatic and more reliant on discretion in the assessments of the underlying economic and budgetary situations. The reform has also softened the exceptional circumstances clauses and has introduced more discretion in the list of "other relevant factors", which a country can use to justify cases where it has an excessive deficit. It is beyond the scope of this paper to discuss the issue of whether these reforms will lead to a better implementation of the Pact, but it is

more important, for the scope of the paper, to understand the increasingly central role assigned to the cyclically adjusted budget balance figures in the Pact.

The aim of this paper is to obtain projections for the level of potential output of Cyprus for the period 2002 to 2008, which in turn are used to obtain projections of the path expected to be followed by the structural fiscal balance figures. These figures will provide some useful information on how the projected path of these indicators for Cyprus compare with the criteria of the Stability and Growth Pact concerning the budget deficit.

Different approaches have been developed for the calculation of the structural fiscal balance. The methodology of the European Commission, the IMF and the OECD concentrates on firstly determining the cyclical position of the economy through the calculation of the output gap and then calculating the structural fiscal balance by adjusting the different categories of fiscal incomes and expenditures by their sensitivity to the cyclical position of the economy. A disadvantage of this methodology stems from the fact that the aggregate output gap in the economy can be made up from various components (there can be different partial gaps stemming for example from export and consumption shortages), each of which can have different effects on the economy and the budget. The methodology of the European Central Bank, presented in Bouthevillain et al. (2001), proposes a disaggregated approach which differs from the above, mainly in the sense that in order to obtain an estimate of the effects on the budget of the macroeconomic environment, the latter is not solely defined by the GDP but by five macroeconomic variables whose impact on public finances they argue is more direct. Moreover, whereas the Commission's methodology bases the measurement of the output gap on the production function methodology, the European Central Bank methodology makes use of the Hodrick-Prescott filter. The European Central Bank approach has also been criticised on the grounds that it makes use of the Hodrick-Prescott filter which is considered as not being based on economic theory, but also because of the violation of the aggregation constraint. The latter refers to the problem that the aggregated partial gaps do not equal the output gap. In a recent presentation, Kiss and Vadas (2005) attempt to develop a more refined disaggregated approach.

It is clear from the above that there is still no agreement on a single methodology for the measurement of the structural fiscal balance. The current paper is along

the lines of the European Commission, IMF and OECD methodologies. The methodology used for obtaining the projections of the potential level of output is that suggested by Denis et al. (2002) and is based on the Cobb Douglas production function. The methodology used for obtaining the projections of the structural fiscal balance is similar to that developed by Giorno et al. (1995). This approach involves the estimation of the elasticities with respect to output for the various government revenue and expenditure categories. These elasticities along with the gap between the potential and actual output levels are then used to obtain the structural components of tax revenues and expenditures.

The structure of this paper, which is a continuation of earlier work[3] for the calculation of the potential level of output and structural fiscal balance for Cyprus for the period 1985-2001, is as follows. Section 2 presents the methodology used to obtain the projections of both the potential level of output and the structural fiscal balance. Section 3 provides a description of the data. Section 4 provides the empirical results and section 5 draws the main conclusions of the paper.

## II. METHODOLOGY

The structural or cyclically adjusted budget balance, as its name implies, indicates what the level of the fiscal balance would be if the level of output in the economy coincided with the potential level of output, where the potential output provides an indicator of the aggregate supply capacity of the economy. This means that the components of the budget balance that are affected by the cyclical position of the economy have to be adjusted so as to remove these cyclical components and obtain the underlying structure of the budget balance. As a first step, therefore, it is necessary to calculate, in this case project the potential level of output. This is done here by applying the methodology presented in Dennis et al. (2002). Using projections of the real GDP, which are obtained from the Ministry of Finance in Cyprus, the output gap values are projected. As a second step, the elasticities of the various categories of revenues and expenditure with respect to the value of the real GDP are projected using regression analysis. As a final stage the projected elasticities are used to adjust

[3] Haroutunian et al. (2003), Haroutunian and Pashardes (2004).

the projected values of the various categories of public revenue and expenditure so as to obtain the structural fiscal balance. This second part of the analysis is roughly based on the method proposed by Giorno et al. (1995).

### II.1. Projections of the level of potential output[4]

The potential level of output is defined as that level of output that the economy can produce if all its factors of production are fully employed. It is thus a measure of the aggregate supply capacity of the economy. The production function used for the projections of the potential level of output is a Cobb-Douglas one shown in equation (1):

$$Y_p = (TFPS) L_p^{\alpha} K^{1-\alpha} \quad (1)$$

where total potential output ($Y_p$) is produced using potential labour force ($L_p$) and capital stock (K). Under the assumption of constant returns to scale and perfect competition, output elasticities with respect to labour and capital, given by $\alpha$ and $(1-\alpha)$ respectively equal their respective factor shares.

The capital stock is defined as the net capital stock at constant 1995 prices. The potential level of capital is achieved when the entire amount of the capital stock in the economy is fully utilised.

Total Factor Productivity (TFP) is defined as that change of output which cannot be accounted for by changes in inputs of labour and capital and is measured by the trend component of the Hodrick Prescott filtered Solow residual.

The potential labour force is defined as that level of employment which is consistent with non-accelerating inflation rate. The potential labour force is given by equation (2):

$$L_p = POPW \times PARTS \times (1 - NAIRU) \quad (2)$$

[4] The description of the methodology for the calculation of the projections of the potential level of output draws heavily on Denis et al. (2002).

where POPW is the population of working age, PARTS is the smoothed (HP filtered) participation rate and NAIRU is the non-accelerating inflation rate of unemployment. The latter is defined as that level of unemployment which is consistent with constant inflation.

Earlier work[5] has indicated that the value of $\alpha$ is around 0.59. It is assumed that the output elasticities with respect to the factor inputs remain unchanged over time.

It can be seen from the above that in order to obtain projections of the level of potential output there is the need to obtain projections of each of the components that enter equation (1). The projected time series for each of the components is provided in Appendix A. The projections are done in the following way:

**1.** Population of Working Age. Projections for the size of the population of working age for the period 2002 to 2008 are compiled by the Statistical Service of Cyprus. These projections however had to be modified due to the fact that the actual figure of the population of working age for the year 2003 differs significantly from the projected one. This is because for that particular year actual net migration was 12,300 which is more than double the assumed value of 6000 used for the compilation of the projections. As a result it was considered necessary to adjust all the projections upwards in order to incorporate this positive population shock. A simple approach was used in this case, whereby the population projection figures for the years 2004 to 2008 were adjusted upwards through the addition of a constant figure. The value of this constant was calculated using an assumption about the proportion of the 6300 extra immigrants would fall in the 15-64 age group. More precisely it was assumed that this proportion would be equal to the average of the corresponding figure for the years 2002 and 2003 for which data is available[6]. The average value of the proportion of immigrants who are in the 15-64 age group for the years 2002 and 2003 is 94.65%. Therefore the

[5] For a more detailed description of the production function approach as applied to the case of the calculation of the potential level of output of Cyprus, the reader is referred to Haroutunian et al. (2003).

[6] Demographic Report 2003, Statistical Service of Cyprus

figure 5963 was added to every single projection for the period 2004-2008 of the population of working age.

**2.** Participation Rate. The projected values of the participation rates for the period 2002 to 2008 were obtained by using an Autoregressive (AR) function with two lags. Various specifications of AR functions were estimated for the period 1975 to 2001 and the one that best described the process generating the time series of the participation rate was the AR(2). This specification was used to obtain projections for the participation rate up to the year 2010 and then the series was filtered using the Hodrick-Prescott filter, the trend components of which were used as the projections for the participation rate. The end point bias problem is overcome with the values of the participation rate projected for two years beyond the time period of interest.

**3.** Non-Accelerating Inflation Rate of Unemployment. The projected values of the NAIRU are obtained using equation (3), which is adopted directly from the Dennis et al. (2002) paper.

$$NAIRU_{t+1}=NAIRU_t+0.5*(NAIRU_t - NAIRU_{t-1}) \quad (3)$$

This specification indicates that the one period ahead projected value of the NAIRU equals the current value of the NAIRU to which an adjustment term is added. The adjustment term is given by half of the deviation of the current period NAIRU from that of the preceding period. The adjustment term can be considered to be an error correction term where the size of the adjustment is given by the 0.5 coefficient. This specification can be considered as modelling hysteresis effects since once the difference term is positive the NAIRU time series ends up increasing continuously unless external measures such as supply side policies reverse this process.

**4.** Total Factor Productivity. The trend TFP is modelled as the Hodrick-Prescott filtered Solow residual. For the period 2002 to 2013 the TFP forecast is generated with a simple AR model, where the log of current TFP is explained by a constant and a time trend. Many different specifications were estimated using various lags of the log of TFP but none of these lags appeared statistically significant in the regression and they were dropped out. The projected values of the TFP were then Hodrick-Prescott filtered, with the

trend component in each case giving the value of the projected TFP that was included in the calculations of the projections of the potential level of output.

**5.** Net Capital Stock. The manner in which the capital stock enters the projection procedure is given by equations,

$$I = R \times Y_p \tag{4}$$

$$K_t = I + (1-\delta) \cdot K_{t-1} \tag{5}$$

where: R = ratio of fixed investments at constant 1995 prices to potential output

$\delta$ = depreciation.

It can be seen that investment and hence the capital stock are endogenous, since their values themselves depend on the level of potential output. Moreover it has to be noted that while it is the net capital stock at constant 1995 prices that is used in the calculations there is no need to include the depreciation term, $\delta$, in equation (5). This is because the net capital stock of the previous period (t-1) depreciates further during the current period (t). The depreciation rate used in the study was 3%[7].

To project the values of the R series, an AR process is used where the ratio R is explained by a constant, a time trend and the first lag of R.

The incorporation of all the above information and projections of the various components into equation (1) along with the use of the Taylor series expansion[8] allows the calculation of the projections for the value of the potential level of output. It has to be noted that the Taylor expansion used was only up to the term including the first derivative and as initial condition the values of the variables at

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[7] The 3% depreciation rate was obtained from the Statistical Service of Cyprus.

[8] The Taylor expansion about the point $x = a$ is represented by the equation below where $f^n(x)$ is the n[th] derivative of $f(x)$ with respect to $x$:

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + .... + \frac{f^n(a)}{n!}(x-a)^n + ...$$

time t-1 were used. The actual equation that was solved numerically in each case to obtain the projections of potential output is:

$$Y_{p,t} = (A_t)\left[[R_t Y_{p,t-1} + (1-\delta)K_{t-1}]^{(1-\alpha)} + (1-\alpha)[R_t \cdot Y_{p,t-1} + (1-\delta)K_{t-1}]^{-\alpha}(R_t)[Y_{p,t} - Y_{p,t-1}]\right] \quad (6)$$

Where,

$$A_t = L_{p,t}^{\alpha}.TFPS_t .$$

These projections along with the projected value of R then allow the projections of the net capital stock figures to be obtained.

### II.2. Projections of the level of the structural fiscal balance[9]

The structural fiscal balance is defined as that level of fiscal balance that would prevail when the level of output inside the economy coincides with the potential level of output and therefore not including the effects on the budget of the cyclical position of the economy. The structural or cyclically adjusted budget balance is therefore given by

$$B^* = \sum T_i^* - G^*, \quad (7)$$

where: B* = structural fiscal balance;

$T_i$* = structural tax revenues for the ith category of tax;

G* = structural government expenditures.

For the estimation of the components of the structural fiscal balance, each component of the budget, that is the actual government expenditures and tax revenues are adjusted proportionately to the ratio of potential output to actual output as determined by its elasticity. This can be observed in equation

[9] The description of the methodology for the calculation of the structural fiscal balance in this section draws heavily on Giorno et al. (1995). For a more detailed description of the application of the methodology to the case of Cyprus the reader is referred to Haroutunian and Pashardes (2004).

$$\frac{T_i^*}{T_i} = \left[\frac{Y^*}{Y}\right]^{\alpha_i}, \qquad \frac{G^*}{G} = \left[\frac{Y^*}{Y}\right]^{\beta}, \tag{8}$$

where: $T_i$ = actual tax revenues for the ith category of tax;

G = actual government expenditures;

Y = level of actual output at constant 1995 prices;

Y* = level of potential output at constant 1995 prices;

$\alpha_i$ = elasticity of the $i^{th}$ tax category with respect to output; and

β = elasticity of current government expenditures with respect to output.

It follows that the structural fiscal balance is given by equation (9).

$$B^* = \sum_{i=1}^{4} T_i \left[\frac{Y^*}{Y}\right]^{\alpha_i} - G\left[\frac{Y^*}{Y}\right]^{\beta}, \quad \text{where} \quad \alpha_i>0, \beta<0. \tag{9}$$

It is evident from the above that in order to obtain the projected values of the structural fiscal balance it is necessary to have the following three sets of information for the period 2002 to 2008: i) projections of the potential level of output as well as the projections of the level of output at constant 1995 prices, ii) projections of the actual tax revenues and government expenditures and iii) projections of the values of the elasticities.

As far as the projections of the values of the elasticities is concerned, it is not possible to use those estimated for the period 1985 to 2001, because the tax structure of Cyprus underwent major changes during the period 2002 and 2003[10] modifying the values of the elasticities. The projections of the values of the government revenue elasticities with respect to output were obtained using regressions of the form,

$$LogT_t = c + \alpha LogY_t + \beta D^*(LogY_t) + D7475 + \gamma LogT_{t-1} + \varepsilon_t \tag{10}$$

[10] For more details of the actual changes in the tax structure of Cyprus refer to appendix 1 of Nearchou and Pashardes (2003).

where *c* is an intercept term, $T_t$ is tax revenue in period t, $Y_t$ is nominal GDP in period t, *D* is a step dummy variable that takes the value of zero initially and after a specific point in time (depending on the type of taxation) takes the value of 1 for the remainder of the period, *D7475* is an intercept dummy that takes the value 1 in the years 1974 and 1975 (the years that government receipts and expenditures were affected by the Turkish invasion) and 0 otherwise. Various lags of the dependent variable are included to account for autoregressive behaviour in the data. The error term $\varepsilon_t$ is assumed to be normally and independently distributed with zero mean and constant variance. The average short-run elasticity of the specific tax revenue with respect to output for the whole period is given by $\alpha$ whereas the short run elasticity for the period that the step dummy takes the value of unity will be given by $\alpha+\beta$ provided that $\beta$ is significant. The long-run elasticity, which is what interests us most, is given by $\alpha/(1-\gamma)$ and $(\alpha+\beta)/(1-\gamma)$ respectively.

For each of the four categories of tax revenue the value of which is considered to have both a cyclical and structural component (these are corporate taxation, direct taxation excluding corporate taxation, indirect taxation and social security contributions), a regression of the form of equation (10) was estimated for the period 1970 to 2008. For the period 1970 to 2003 actual figures whereas for the remainder of the period projections of the various categories of tax revenues were used. In the case of direct taxation revenues (excluding corporate tax revenue) the step dummy took a value of one from the year 2002 onwards to account for the changes in the structure of direct taxation took place in this year. In the case of indirect taxation revenues, the step dummy took the value of one from 1992 onwards. This is because the structure of indirect taxation changed since 1992 due to the introduction of VAT. Moreover 1992 is the middle year of the period 1987-1996 during which tariffs were gradually harmonised with the EU as part of the Customs Union agreement with the EU.

In the case of the elasticity of government expenditure with respect to the level of output, it is assumed that this takes the value of zero. This is because unemployment benefits, which is the category of government expenditure that is generally most responsive to the cyclical position of the economy, appears to be unaffected by the cyclical position of the economy since the unemployment rate in Cyprus is more or less stable and close to the NAIRU.

## III. DATA

For the projections of the level of potential output the Statistical Service of Cyprus kindly provided us with the projections of the population of working age for the period 2002 to 2008. The other inputs required for these projections were obtained from past data using the methodology outlined in section II.1.

The actual and projected values for the various categories of tax revenues and government expenditures as well as the projected values of the level of GDP at constant 1995 prices for the period 2002 to 2008, required for obtaining the projections of the structural fiscal balance, were provided to us by the Ministry of Finance. It should therefore got be noted that these projections are conditional on the assumptions employed by the Ministry of Finance and the Planning Bureau. The variables included in the data are corporate tax revenues, social security contribution revenues, non-tax revenues, capital revenues, grants, net lending, current government expenditure and capital expenditure.

## IV. EMPIRICAL RESULTS

In this section the empirical results of the projections of the potential level of output and the projections of the structural fiscal balance are presented and discussed.

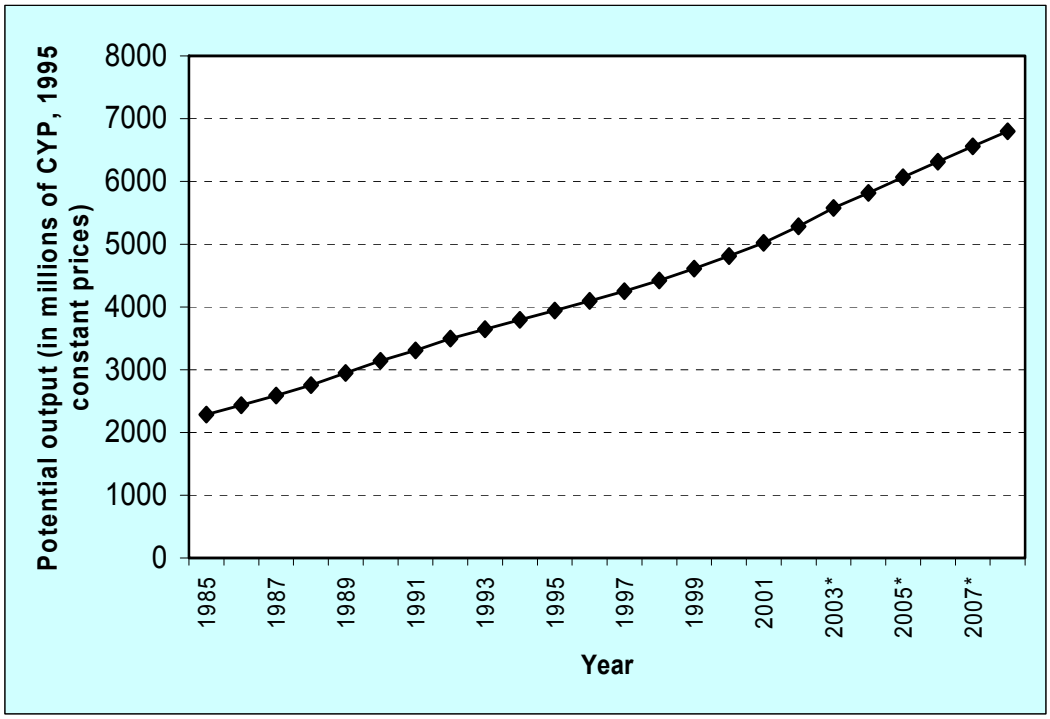
### IV.1 Projections of the Potential Level of Output

Table 1 presents the values of the potential level of output and the net capital stock, calculated using the production function approach, along with their growth rates for the projection period 2002 to 2008. Graph 1 presents the values of the calculated and projected values of the potential level of output for the period 1985 to 2008. Graph 2 presents the values of the calculated and projected values for the net capital stock for the same period. The values of the potential output and the net capital stock for the period 1985 to 2001 are based on actual figures, whereas the values for the period 2002 to 2008 are the projected values of the potential level of output and the net capital stock based on the projections of the components that enter the calculation of the potential level of output. The projected values of the various components that are used in order to obtain the projected values of the potential output and the net capital stock are given in Appendix A.

**Table 1: Projected values of the potential level of output and the net capital stock**

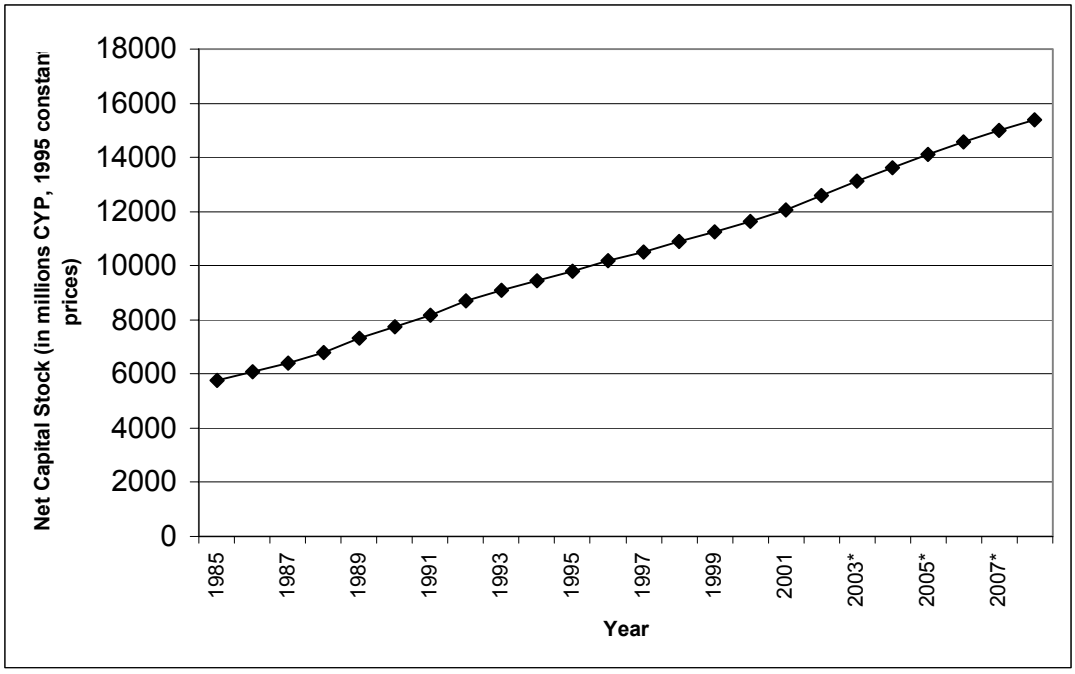
| Year | Potential output calculated using the production function approach (in CYP million, 1995 prices) | Potential growth rate (annual % change) | Net Capital Stock (in CYP million, 1995 prices) | Net Capital Stock growth rate (annual % change) |
|---|---|---|---|---|
| 2002 | 5283.9 | 5.2 | 12598.4 | 4.5 |
| 2003 | 5579.8 | 5.6 | 13122.1 | 4.2 |
| 2004 | 5819.8 | 4.3 | 13623.4 | 3.8 |
| 2005 | 6065.9 | 4.2 | 14102.8 | 3.5 |
| 2006 | 6311.7 | 4.1 | 14558.3 | 3.2 |
| 2007 | 6557.3 | 3.9 | 14987.5 | 3 |
| 2008 | 6802.1 | 3.7 | 15387.9 | 2.7 |

**Graph 1: Potential output calculated using the production function approach**[11]




[11] An asterisk next to a year indicates that the value for that year is a projection. So in the case of graphs 1 and 2, for the years 1985 to 2001 the values of the variables are calculations based on actual values whereas for the period 2002 to 2008 the values are projections.

**Graph 2: Net capital stock**




The results indicate that the projections of the potential level of output and the capital stock appear to be reasonable continuations of the corresponding series. The upward surge in the values of the growth rates of the potential level of output and the net capital stock at the beginning of the projection period (2002-2003) appears to be caused by the sharp increase in the potential labour force in those years. The sharp increase in the potential labour force for the year 2003 was due to a positive shock in net inward migration. Due to the fact that the potential level of output enters the calculation of the projected value of the net capital stock, the higher value of the potential output also drives up the value of the net capital stock. The economic interpretation of this could be that as the size of the potential labour force rises, the economic agents can be encouraged to invest more in capital so as to maintain an optimum labour to capital ratio. The values of the projected growth rate of the potential level of output at the end of the projection period returns to levels similar to those that prevailed in the mid nineties. In the case of the net capital stock, the values of the growth rate also drop during the end of the projection period to levels that are lower than those which existed during the mid nineties. These reductions in the potential output growth rate, as well as the growth rate of the net capital stock can be an

indication of the convergence of Cyprus with the economies of the more advanced European Union countries.

### IV.2 Contributions to potential growth

A better understanding of the processes driving potential output growth in the economy can be obtained by considering the contributions to potential growth of the various components that enter the production function, that is labour, capital and total factor productivity. Labour and capital contributions for each year are defined as the labour and capital growth rates multiplied by the respective factor shares. The contribution of TFP to potential growth is then defined as the component of potential growth that cannot be attributed to the growth of labour and capital. This means that labour, capital and TFP contributions add up to potential growth. The conclusions derived from the previous section are verified by the contribution figures.

The high potential growth rates for the years 2002 and 2003 in Table 2 can be explained by the especially high contributions of labour to potential growth, which were the result of the increase in the potential labour force due to the increase in inward migration mentioned earlier. The contribution of capital to potential growth also appears to be higher in the years 2002 and 2003 indicating that the net capital stock also rose by a higher than usual margin in those years. An interesting conclusion can also be drawn by comparing the projected contributions to potential growth of labour, capital and TFP with the average contributions of these factors to potential growth for the period 1985 to 2001. The average contributions of labour, capital and TFP to potential growth for the period 1985 to 2001 are 1.29, 1.89 and 1.87 respectively[12]. It can be seen that the contributions to potential growth of each of these components of the production function has a downward trend with the exception of the 2002 to 2003 period. This is due to the fact that whereas the average potential growth rate of the economy was 5.06% for the period 1985 to 2001, the projected average for the period 2002 to 2008 stands at 4.42% and that for the period 2004 to 2008 is projected to be 4.04%. This downward trend in the projected potential growth

[12] The figures are obtained from table 2 of Haroutunian et al. (2003).

rate can be an indication of the convergence of the Cypriot economy with the economies of the more economically advanced countries of the European Union.

**Table 2: Contributions to potential growth**

| Year | Potential Growth rate (%) | Contributions to potential growth (%) | | |
|---|---|---|---|---|
| | | Labour | Capital | TFP |
| 2002 | 5,16 | 1,59 | 1,83 | 1,74 |
| 2003 | 5,6 | 2,16 | 1,70 | 1,74 |
| 2004 | 4,3 | 1,04 | 1,57 | 1,69 |
| 2005 | 4,23 | 1,10 | 1,44 | 1,69 |
| 2006 | 4,05 | 1,05 | 1,32 | 1,68 |
| 2007 | 3,89 | 1,01 | 1,21 | 1,67 |
| 2008 | 3,73 | 0,98 | 1,10 | 1,65 |

### IV.3 Projections of the Structural Fiscal Balance

Table 3 presents the values of the elasticities of the various categories of the tax revenues with respect to the level of output obtained from the estimation of equations of the form (10). The full set of estimation results and diagnostic tests of the equations used in the calculation of the elasticities are given in Appendix B. The changes in the tax structure of Cyprus during the period 2002 to 2003, along with the addition to the dataset of the projected values of the various categories of tax revenues for the period 2002 to 2008 means that the values of the elasticities obtained from the previous study could not be used and hence were reestimated.

The values of the elasticities that are obtained in general conform to expectation, given the tax system in Cyprus. For a more detailed explanation of the values of these elasticities one can refer to Haroutunian and Pashardes (2004). At this point we concentrate more on the changes in the values of the elasticities compared to the values from the previous study and we explain the effects of the changes in the tax structure of Cyprus on these values.

The value of the corporate taxation elasticity does not differ much between the two studies. The fact that the elasticity is greater than one despite the fact that

Cyprus has a flat corporate taxation could be an indication that corporate profits are more cyclical than the level of output.

**Table 3: Estimated government revenue elasticities with respect to output**

| Government revenue category | Estimates of output elasticities | Estimates of elasticities in Haroutunian and Pashardes (2004) |
|---|---|---|
| Corporate tax | 1.37 | 1.40 |
| Direct tax (excluding Corporate tax):<br>up to and including 2001<br>from 2002 onwards | <br>1.14<br>1.07 | 1.12 |
| Social security contributions | 1.13 | 1.17 |
| Indirect tax: up to and including 1991<br>from 1992 onwards | 0.99<br>1.02 | 1.05<br>1.07 |

An interesting observation can be made concerning the values of the elasticity of direct taxation (excluding corporate tax) revenues with respect to the level of output. That is the value of this elasticity drops from 1.13 prior to 2002 to 1.07. This can be attributed to the change in the income taxation structure in Cyprus, which became less progressive the amount of tax-free income was increased from 6000 to 10000 Cyprus Pounds and the marginal rates of income taxation were also reduced.

The elasticity of indirect taxation with respect to output, as expected, is very close to unity. It can be observed that prior to 1992, the year that Value Added Tax was introduced in Cyprus, the elasticity was smaller indicating that the system was more regressive than after 1992. This is expected since Value Added Tax discriminates in favour of the poor as it is not charged on “necessities” such as food. In contrast excise taxes and duties that were prominent prior to 1992 were mostly charged on luxury goods imported from abroad.

Using the values of the estimated elasticities, the projected values of the potential level of output as well as the projected values of the various categories of government tax revenues and expenditures, the structural fiscal balances were calculated. These are presented in Table 4, where they are expressed as a percentage of nominal GDP. It can be seen from the overall budget balance figures that Cyprus violates the condition of the Stability and Growth Pact concerning budget deficits since the level of budget deficits as a percentage of

nominal GDP exceed the 3% mark. It is expected however that with fiscal consolidation, by 2005 the overall budget deficit as a percentage of nominal GDP will return to below 3% of GDP.

Using the elasticities presented in Table 3, the projected budget sensitivity to the output gap can be calculated. This sensitivity indicates the percentage change in the budget balance as a percentage of GDP when the output gap changes by 1%. Given the assumption that the elasticity of government expenditures with respect to the level of output is zero the budget sensitivity is given by the overall revenue elasticity which in turn is the weighted average of the four revenue elasticities. The weights are given by the average value of the ratio of each category of revenue to GDP for the period 2002 to 2008. The projected value of the budget sensitivity to the output gap for Cyprus is 0.32, which means that when the output gap changes by 1% then the budget balance changes by 0.3%. The above can be seen in Table 4 below, where the multiplication of the output gap as a percentage of potential output with 0.32 gives us approximately the difference between the overall and structural budget balances expressed as a percentage of nominal GDP. This is lower than the 0.5 average budget sensitivity of the EU-15 for the 1980 to 1998 period.

**Table 4: Projected values of the Structural fiscal balance and the Overall budget balance expressed as percentages of nominal GDP**

| Year | Output Gap as a % of potential output | Structural Budget Balance as % of nominal GDP | Overall Budget Balance as % of nominal GDP |
|---|---|---|---|
| 2002 | 0.44 | -4.42 | -4.29 |
| 2003 | -3.07 | -5.13 | -6.12 |
| 2004 | -3.60 | -3.03 | -4.24 |
| 2005 | -3.82 | -1.57 | -2.87 |
| 2006 | -3.49 | -0.50 | -1.70 |
| 2007 | -2.97 | -0.31 | -1.33 |
| 2008 | -2.26 | 0.22 | -0.54 |

## V. CONCLUSION

In this paper we have calculated projections of the potential level of output for the Cypriot economy for the period 2002 to 2008 using the production function methodology of the European Commission which involves the projection of the various components that enter the production function. The results have indicated that the potential growth rate for Cyprus is projected to reach levels that are lower than those which existed during the second half of the 1980s and the 1990s. This most likely is an indication of the convergence of the Cypriot economy with the economies of the more advanced countries of the EU.

As a second stage the values of the elasticities of the various categories of tax revenues with respect to the level output were projected using regressions involving the projected values of the nominal GDP and the projected values of the various categories of tax revenues. These projection data were obtained from the Ministry of Finance of Cyprus, therefore the regression results and hence the projected values of the elasticities and consequently the values of the projected structural fiscal balances are conditional on the assumptions employed by the Ministry of Finance. The values of the projected elasticities conform to expectation, as formed by economic theory, the tax structure of Cyprus and the changes in the tax structure of Cyprus.

The projected values of the elasticities along with the projected values of the potential level of output are then used in order to obtain projections of the structural fiscal balance. Moreover the projected values of the elasticities of the various categories of tax revenue with respect to the level of nominal GDP indicate that the projected budget sensitivity figure for Cyprus is 0.32, which is relatively low compared to the budget sensitivity figures of other EU countries. This can be attributed to the fact that the government expenditure elasticity with respect to output is taken to be close to zero due to the persistently low unemployment level.

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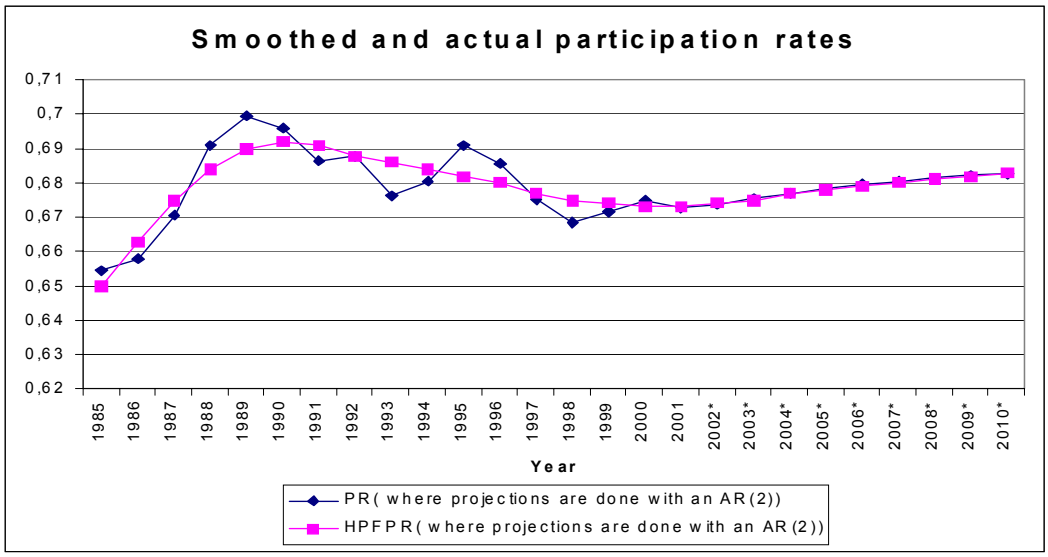
## APPENDIX A: PRODUCTION FUNCTION COMPONENTS

### Participation Rate

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent variable is **PR** | | | |
| 25 observations used for estimation from 1977 to 2001 | | | |
| **Regressor** | **Coefficient** | **Standard Error** | **T-Ratio (Prob)** |
| INPT | 0.082244 | 0.018032 | 4.5611 [.000] |
| PR(-1) | 1.1106 | .14709 | 7.5504 [.000] |
| PR(-2) | -0.23058 | 0.13704 | -1.6826 [.107] |
| R-Bar-Squared | 0.97806 | | |
| **Diagnostic Tests** | | | |
| **Test Statistics** | **LM Version** | | **F Version** |
| A:Serial Correlation | CHSQ( 1)= .36566[.545] | | F( 1, 21)= .31171[.583] |
| B:Functional Form | CHSQ( 1)= 1.2141[.271] | | F( 1, 21)= 1.0719[.312] |
| C:Normality | CHSQ( 2)= .68760[.709] | | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 1.3059[.253] | | F( 1, 23)= 1.2677[.272] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values



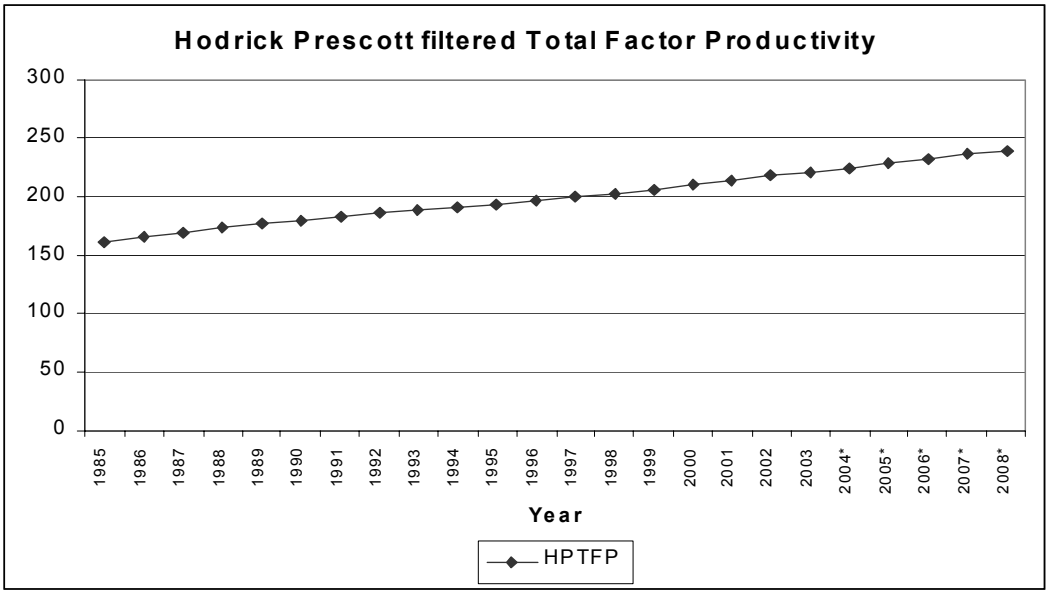
## Total Factor Productivity

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent variable is **LTFP** | | | |
| 16 observations used for estimation from 1985 to 2001 | | | |
| **Regressor** | **Coefficient** | **Standard Error** | **T-Ratio (Prob)** |
| INPT | 5.0855 | 0.0066215 | 768.0378 [.000] |
| T | 0.016356 | .6462E-3 | 25.3107 [.000] |
| R-Bar-Squared | 0.97560 | | |

**Diagnostic Tests**

| **Test Statistics** | **LM Version** | **F Version** |
|---|---|---|
| A:Serial Correlation | CHSQ(1)=1.1910[.275] | F(1, 14)= 1.0547[.322] |
| B:Functional Form | CHSQ(1)= 2.3054[.129] | F(1, 14)= 2.1965[.160] |
| C:Normality | CHSQ(2)= 1.3148[.518] | Not applicable |
| D:Heteroscedasticity | CHSQ(1)= 2.1171[.146] | F(1, 15)= 2.1337[.165] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residual
D:Based on the regression of squared residuals on squared fitted values



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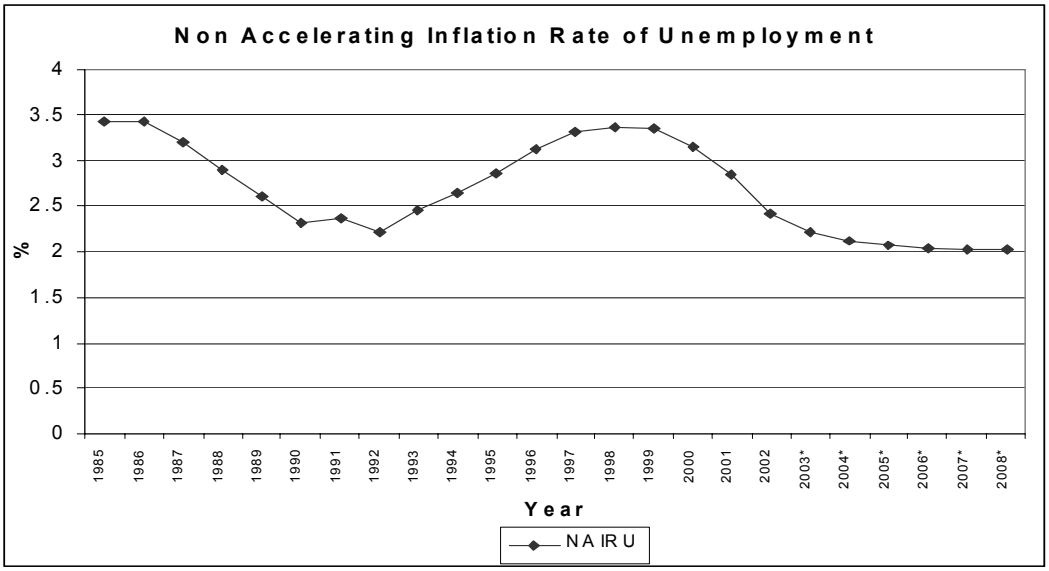


**Ratio of Investment to potential output**

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent variable is $\mathbf{IY_P}$<br>16 observations used for estimation from 1986 to 2001 | | | |
| **Regressor** | **Coefficient** | **Standard Error** | **T-Ratio (Prob)** |
| INPT | .17446 | .080047 | 2.1795 [.048] |
| T | -.0042587 | .0022029 | -1.9332 [.075] |
| $IY_P(-1)$ | .39911 | .25731 | 1.5511 [.145] |
| R-Bar-Squared | 0.80693 | | |
| **Diagnostic Tests** | | | |
| **Test Statistics** | **LM Version** | | **F Version** |
| A:Serial Correlation | CHSQ( 1)= 1.4475[.229] | | F( 1, 12)= 1.1936[.296] |
| B:Functional Form | CHSQ( 1)= .12844[.720] | | F( 1, 12)= .097108[.761] |
| C:Normality | CHSQ( 2)= 1.7976[.407] | | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 2.8505[.091] | | F( 1, 14)= 3.0348[.103] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residual
D:Based on the regression of squared residuals on squared fitted values

## APPENDIX B

### Corporate Tax Elasticity

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent Variable is LNCT<br>38 observations used for the estimation from 1971 to 2008 | | | |
| Regressor | Coefficient | Standard Error | T-Ratio (Prob) |
| INPT | -1,8929 | 0,63060 | -3,0017 (0,005) |
| LNY | 0,38559 | 0,11775 | 3,24747 (0,002) |
| DLASTLNY | 0,0071072 | 0,012357 | 0,57516 (0,569) |
| D7475 | -0,25219 | 0,15807 | -1,5954 (0,120) |
| LNCT(-1) | 0,71909 | 0,090218 | 7,9706 (0,000) |
| R-Bar-Squared 0.98863 | | | |
| Diagnostic Tests | | | |

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ( 1)= .60352[.437] | F( 1, 32)= .51643[.478] |
| B:Functional Form | CHSQ( 1)= .35580[.551] | F( 1, 32)= .30245[.586] |
| C:Normality | CHSQ( 2)= 1.5062[.471] | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 1.5264[.217] | F( 1, 36)= 1.5066[.228] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

The above estimated equation passes all the diagnostic tests.

Key: LNCT=log of corporate tax revenues
INPT= intercept
LNY= log of output
Dummy= dummy variable that takes the value one in the years 2000 to 2008
DLASTLNY= Dummy*LNY
D7475= intercept dummy that takes the value of 1 in 1974 and 1975
LNCT(-1)= 1 period lag of LNCT

**Direct Tax (excluding corporate tax) Elasticity**

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent Variable is LNDTXCT<br>38 observations used for the estimation from 1971 to 2008 | | | |
| Regressor | Coefficient | Standard Error | T-Ratio (Prob) |
| INPT | -0,71420 | 0,58209 | -1,2270 (0,229) |
| LNY | 0,23549 | 0,13379 | 1,7601 (0,088) |
| D02ONWLNY | -0,014305 | 0,0068351 | -2,0928 (0,044) |
| D7475 | 0,024380 | 0,081816 | 0,29799 (0,768) |
| LNDTXCT(-1) | 0,79348 | 0,097237 | 8,1603 (0,000) |
| R-Bar-Squared 0.99525 | | | |
| Diagnostic Tests | | | |

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ( 1)= 2,5928[.107] | F( 1, 32)= 2,3433[.136] |
| B:Functional Form | CHSQ( 1)= 2,6449[.104] | F( 1, 32)= 2,3939[.132] |
| C:Normality | CHSQ( 2)= 12,2134[.002] | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 5,9134[.015] | F( 1, 36)= 6,6346[.014] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

The above estimated equation does not pass the Normality of residuals and heteroscedasticity tests. The presence of heteroscedasticity will not bias the estimates of the parameters but it will underestimate the standard errors of the coefficients which in turn will mean that the standard statistical tests will be misleading. Since we are at this point more interested in the value of the estimated elasticity, we do not worry much about the problems of non normality and heteroscedasticity of residuals.

Key: LNDTXCT=log of direct tax revenues excluding corporate tax revenues
INPT= intercept
LNY= log of output
Dummy= dummy variable that takes the value one in the years 2002 to 2008
D02ONWLNY= Dummy*LNY
D7475= intercept dummy that takes the value of 1 in 1974 and 1975
LNDTXCT(-1)= 1 period lag of LNDTXCT

**Indirect Tax Elasticity**

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent Variable is LNIT<br>37 observations used for the estimation from 1972 to 2008 | | | |
| Regressor | Coefficient | Standard Error | T-Ratio (Prob) |
| INPT | -0,80181 | 0,48861 | -1,6410 (0,111) |
| LNY | 0,37679 | 0,14380 | 2,6202 (0,013) |
| D92ONWLNY | 0,011308 | 0,0050911 | 2,2211 (0,034) |
| D7475 | -0,28417 | 0,084144 | -3,3772(0,002) |
| LNIT(-1) | 0,78401 | 0,13314 | 5,8887 (0,000) |
| LNIT(-2) | -0,16372 | 0,10081 | -1,6239 (0,115) |
| R-Bar-Squared 0.99738 | | | |
| Diagnostic Tests | | | |

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ( 1)= 1,4806 [.224] | F( 1, 30)= 1,2506[.272] |
| B:Functional Form | CHSQ( 1)= 9,2716[.002] | F( 1, 30)= 10,0312[.004] |
| C:Normality | CHSQ( 2)= 1,3479[.510] | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 0,70695[.400] | F( 1, 35)= 0,68176[.415] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

The above estimated equation does not pass the Ramsey Reset test suggesting that some misspecification in the functional form may be present.

Key: LNIT=log of indirect tax revenues
INPT= intercept
LNY= log of output
Dummy= dummy variable that takes the value one in the years 1992 to 2008
D92ONWLNY= Dummy*LNY
D7475= intercept dummy that takes the value of 1 in 1974 and 1975
LNIT(-1)= 1 period lag of LNIT
LNIT(-2)= 2 period lag of LNIT

**Social Security Contributions Elasticity**

| Ordinary Least Squares Estimation | | | |
|---|---|---|---|
| Dependent Variable is LNSSC<br>38 observations used for the estimation from 1971 to 2008 | | | |
| Regressor | Coefficient | Standard Error | T-Ratio (Prob) |
| INPT | -0,61853 | 0,83653 | -0,73940 (0,465) |
| LNY | 0,19412 | 0,17094 | 1,1356 (0,264) |
| DLASTLNY | -0,0018994 | 0,0083277 | -0,22808 (0,821) |
| D7475 | -0,25542 | 0,10597 | -2,4103(0,022) |
| LNSSC(-1) | 0,82891 | 0,11193 | 7,4055 (0,000) |
| R-Bar-Squared 0.99388 | | | |
| Diagnostic Tests | | | |

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ( 1)= 2,8396 [.092] | F( 1, 32)= 2,5843[.118] |
| B:Functional Form | CHSQ( 1)= 12,0729[.001] | F( 1, 32)= 14,9007[.001] |
| C:Normality | CHSQ( 2)= 461,6709[.000] | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 1,6415[.200] | F( 1, 36)= 1,6253[.211] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

The above estimated equation does not pass the Normality of residuals and Ramsey Reset tests suggesting that some misspecification in the functional form may be present.

Key: LNSSC=log of social security contribution revenues
INPT= intercept
LNY= log of output
Dummy= dummy variable that takes the value one in the years 2000 to 2008
DLASTLNY= Dummy*LNY
D7475= intercept dummy that takes the value of 1 in 1974 and 1975
LNSSC(-1)= 1 period lag of LNSSC

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