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WORKING PAPER SERIES

NO 763 / JUNE 2007

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THE CASE OF THE NETHERLANDS

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1 The author would like to thank the Dutch Ministry of Finance for kindly providing data on tax receipts and on revenue effects of tax measures, and colleagues at an ECB seminar for their comments, in particular M. Mohr. The views expressed are those of the author and do not necessarily represent those of the ECB.

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ISSN 1561-0810 (print)
ISSN 1725-2806 (online)

CONTENTS

Abstract

This paper provides estimates for the base elasticities of Dutch taxes, paying particular attention to differences between short-and long-term elasticities, and allowing for asymmetric adjustment. Estimates are presented for five tax categories for the period 1970-2005, after making appropriate corrections for effects of discretionary tax measures. The empirical results indicate that short-term elasticities often are lower than long-term ones, notably when taxes are subdued. Consequently, shocks to tax revenues tend to be aggravated by the dynamics of short-term elasticities. Ignoring differences between short- and long-term elasticities contributes to revenue 'surprises' and an incorrect assessment of the fiscal stance.

Keywords: Tax revenue, income elasticity, fiscal indicators, The Netherlands
JEL classification: H2, H62, H68

Non-technical summary

The responsiveness of government tax revenues to macroeconomic developments is an important variable in forecasting tax revenues in preparation of next year's fiscal budget. It is also a key input for cyclically-adjusting budgetary variables. In the European context, cyclically-adjusted balances are used frequently for assessing whether countries progress sufficiently quickly towards a sound budgetary position or have already reached such level. The relevance of accurate tax elasticities was recently highlighted when tax receipts in many European countries improved by much more than could be accounted for by combining economic growth rates with standard tax elasticities.

Tax elasticities usually are considered constant over time although there are good grounds to expect it to fluctuate over time. As an example, short-term fluctuations in household income may have a more-than-proportional effect on consumption of luxury items (being highly-taxed), which would be reflected in higher VAT-revenues. The short-term elasticity, measuring the percentage change in tax receipts in case of a 1% change in the tax base, in that case would exceed the long-term one. Short-term elasticities may not only vary over time but may also behave in an asymmetrical manner.

This paper considers short- and long-term elasticities of tax revenues with regard to their bases, a distinction usually ignored in European tax research. In estimating long-term elasticities, we take into account possible sources of bias and inconsistency in estimating co-integrated relations in levels, via DOLS-estimation and Newey-West correction. As to the short-term elasticities, which are estimated in changes-in-logs form, we include error-correction terms reflecting deviations of actual tax receipts form the long-term equilibrium level. In doing so, we allow for asymmetries in the tax revenue response to the base.

Estimates refer to the Netherlands, being one of the very few countries to publish long series on discretionary tax measures. This allows for deriving tax

revenue series that are cleaned of discretionary measures, and thus reflect endogenous tax revenue growth. This proves to be important as discretionary measures over the estimation period of 1971-2005 on balance increased indirect tax receipts and lowered direct tax receipts. Not correcting the series would result in biased estimates of the elasticities. We not only take account of the impact of such measures on tax receipts in the current year but also in other years.

The outcomes for the 5 central government tax categories distinguished confirm differences between short-term and long-term tax elasticity values, especially for direct taxes (personal income tax, corporate income tax, and other direct taxes). Differences are especially large in “bad times” (tax receipts below the long-run equilibrium). The outcomes in most cases also indicate asymmetry in tax-to-base elasticities. When tax receipts are above the long-term value, elasticities tend to be higher, likely indicating shifts in consumption patterns towards more luxury (higher-taxed) goods and services, reduced possibilities for corporations to compensate profits with past losses, and less cautious dividend pay-out policies. The error-correction term is significant in all short-term equations, but there is only evidence of an asymmetric effect of the error-correction term for VAT-receipts. While error-correction terms may not be interpreted directly as cyclical indicators, some correlation seems to be in place, pointing to pro-cyclical elasticities.

Failure to distinguish between short-term and long-term revenue elasticities therefore add to ‘budget surprises’, which in fact rather reflect forecast inadequacies. Such appears to be the case particularly in times of negative surprises (tax receipts being below the long-term value), especially for direct taxes. Ignoring such aspects may also contribute to inaccurate calculations of the (cyclically-adjusted) fiscal indicators on which policy actions or recommendations are often based in Europe.

1. Introduction

The responsiveness of government tax revenues to macroeconomic developments is a key variable for fiscal policy, used for instance by governments in forecasting revenue growth when preparing budgets. In the European context, the tax elasticity plays a role in setting minimum benchmarks for budget balances that reduce chances of deficits surpassing the 3% of GDP limit in cyclical downturns. It also is used in estimating cyclically-adjusted balances, which in the European context are used intensively, e.g. for assessing progress towards sound public finances. The relevance of accurate tax elasticities was demonstrated in 2005 and 2006 when tax receipts in many European countries improved more than could be accounted for by combining economic growth rates with standard elasticities.

The tax elasticities used for the purposes above is often a constant over time although there are good grounds to expect it to fluctuate over time. For instance, short-term household income fluctuations may affect luxury consumption items, being highly-taxed, more than proportional, causing a higher short-term elasticity. Another example could be that firms attempt to avoid cuts in distributed dividend in economic downturns to uphold shareholders' confidence, with changes in dividend policies and thus in tax revenues mainly occurring in good economic times. The latter example not only shows that short-term elasticities may vary over time, but also that asymmetries can be at play.

Ignoring short-term behaviour of elasticities leads to biased fiscal indicators. It may be a source of systematic over- and underestimation of tax receipts[2], which may induce unwarranted fiscal policy responses, e.g. government overspending in case of tax overestimation. In addition, using incorrect

[2] Such applies in particular if in the short-run elasticities are pro-cyclically, thus reinforcing the tax revenue effect of a positive growth shock via a higher value of the elasticity.

elasticity values can lead to an inaccurate assessment of the fiscal stance.[3] Finally, from a longer-term perspective, differences in short- and long-term elasticities allow circumventing a trade-off between tax revenue growth and stability of tax revenues: in principle, high (long-term) growth rates can be combined with short-term stability in taxes, and vice versa. An appropriate selection of taxes may deliver a tax portfolio closer to the tax frontiers, taking account of preferences regarding tax revenue growth and stability (see Seyfried and Pantuosco, 2003, for an application to US state taxes).

This paper focuses on both long- and short-run elasticities for the Netherlands. Apart from paying attention to long-term elasticities that measure the growth of tax receipts over time, we focus on estimating short-term elasticities, being an ignored aspect in European tax-research. Another contribution of this paper is that we take into account possible sources of bias and inconsistency in long-run estimates of co-integrated relations. In the short-run estimates, apart from including error-correction terms, we allow for asymmetries in the tax revenue response to the base. This is applied to the Netherlands, being one of the very few countries publishing long series on discretionary tax measures. This series allows for deriving tax revenue series that are cleaned of discretionary measures, and thus reflect endogenous tax revenue growth.

The outline of this paper is as follows. Section 2 sets out the importance of distinguishing between short-term and long-term elasticities of tax receipts. Furthermore, it highlights the merits of correcting tax series for discretionary tax measures to avoid biased estimates. Section 3 describes main features of the tax system in the Netherlands. Section 4 contains the estimation outcomes, while the final section contains our conclusions.

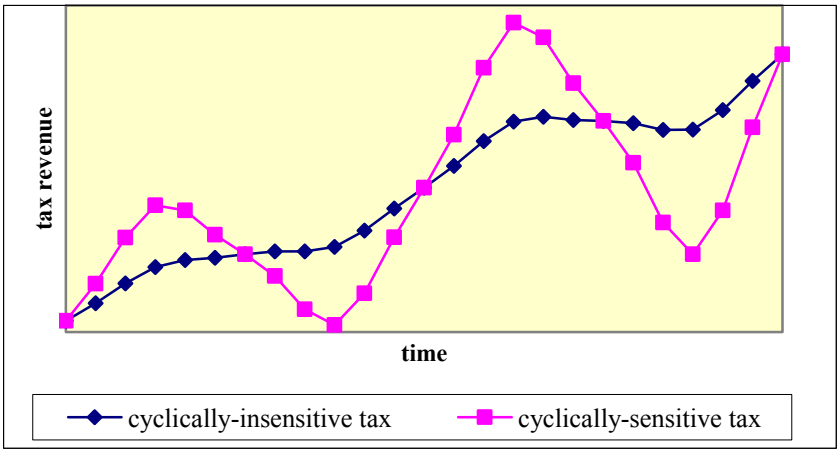
[3] The fiscal stance usually is measured by the change in the cyclically-adjusted primary balance. Using too low a value of the elasticity would lead to underestimating the cyclical budgetary component, with too large a part of the budgetary outcome being allocated to the structural or "policy-related" part of the fiscal change.

2. Defining the elasticity of taxes

We focus in this paper on the base elasticity of taxes, measuring the endogenous growth in tax receipts following a 1% change in the tax base. Two key elements in this definition requiring further elaboration are the time-period over which the 1% change in the base is measured, and the concept of endogenous tax growth.

As to the time-frame, figure 1 shows two hypothetical tax series that co-move with long-term growth of the base and with the business cycle.[4] Regressions of tax receipt levels on the tax base will deliver the same value for the (long-term) elasticity, given identical trends. However, their short-run responses differ, the cyclically-sensitive one fluctuating much more in line with the business cycle or, in other words, acting more strongly as an automatic stabiliser. The short-term elasticity measures the immediate change in tax receipts if the tax base changes by 1 percent.

Figure 1. Long- and short-run base elasticities of taxes



Views on whether high or low values of the short-term tax revenue elasticities are preferable seem to differ across the Atlantic. US-oriented literature points to large cyclical tax variability as a nuisance for complying with state fiscal rules which often require annual balanced (current) budgets. In such a

[4] The example is close to the one shown in Sobel and Holcombe (1996).

context, countercyclical elasticities are preferred, giving rise to relatively stable tax revenue growth (Fox and Campbell, 1984).[5] In Europe, however, swaying tax receipts with the cycle is regarded as an important macroeconomic stabilisation tool as countries in the euro area face centralised monetary policy, limitations on the size of the budget deficit, no European cyclical cross-country transfer system, and limited price and wage flexibility. This is recognised in the Stability and Growth Pact which commits countries to aim for small deficits or even surpluses so that there is room for the automatic stabilisers to operate freely without surpassing the 3% of GDP deficit threshold in a 'normal' downturn.

Derivation of elasticity values is most commonly done via macroeconomic models, via theoretical considerations regarding income elasticities, and via time-series analysis (Van den Noord, 2000).[6] Our approach focuses on the latter given the emphasis we want to give to the time-varying properties of the elasticities. Apart from standard fixed coefficient regression analysis, time-series approaches can also include the random coefficient approach (Otsuka and Braun, 1999) and the variable elasticity approach (Fox and Campbell, 1984). However, doing so requires more detailed data over a long period than are available in the Dutch case at hand.

Time-series analysis also allows for econometrically taking into account the analytical distinction between long- and short-term elasticities. Many tax revenue series have a unit root and require differencing once to obtain stationarity. Long-term elasticities then can be estimated as follows:

$$\log T_{05,t} = \theta + \delta \log B_t + \gamma_t \qquad [1]$$

With $T_{05,t}$ = tax revenue in year *t* adjusted for discretionary measures

θ = intercept

B_t = tax base in year *t*

[5] Many US states have rainy day-funds in place to further reduce the impact of tax variability on the budget.

[6] See Creedy and Gemmell, 2004, for a good example for the UK.

γ = error

while for the short-term elasticity, a difference-equation is taken to arrive at stationary series:

$$\Delta \log T_{05,t} = \alpha + \beta.\Delta \log B_t + \varepsilon_t \qquad [2]$$

Making this distinction is a correct procedure provided the levels of tax receipts and the bases are co-integrated, and the difference equation is stationary. The error-correction term derived from long-term equation [1], i.e. the one-year lagged difference between the actual tax revenue and the longer-run equilibrium value of taxes, then can be added to the short-term equation, reflecting that deviations from the long-run path may have an impact on short-term tax receipts:

$$\Delta \log T_{05,t} = \alpha + \beta.\Delta \log B_t + \lambda.\ \gamma_{t-1} + \varepsilon_t \qquad [3]$$

with λ referred to as the adjustment parameter, indicating the percentage of last year's deviation being corrected in the current period.

Short-term changes in tax revenues thus may come from two channels: directly, via changes in the tax base, and indirectly, via deviations from the longer-term path. This can lead to a situation where the tax base declines but, due to the effect of the error-correction, tax revenues nevertheless increase. Ignoring the error-correction term may result in rather poor estimation results and biased coefficients.

A further refinement allows for the strength of the attraction to be different on both sides of the attractor in the short-run tax response. One way of testing this is to distinguish between positive and negative values of the error-correction term (Granger and Lee,1989).

$$\Delta \log T_{05,t} = \alpha + \beta.\ \Delta \log B_t + \lambda_1.\ \gamma_{t-1}^{+} + \lambda_2.\ \gamma_{t-1}^{-} + \varepsilon_t \qquad [4]$$

This is equivalent to including a dummy variable, taking value 1 in case of a positive error-correction term and zero else, and interact it with the error-correction term. In addition, asymmetric responses can also stem from the base-elasticity varying. This can be tested by interacting the dummy with the tax base variable as shown in equation 5.

$$\Delta \log T_{05,t} = \alpha + \beta.\Delta \log B_t + \sigma.\, D_{ec}.\Delta \log B_t + \lambda.\, \gamma_{t-1} + \pi.\, D_{ec,\,t-1}.\, \gamma_{t-1} + \varepsilon_t \quad [5]$$

With $D_{ec,}$ = Dummy with value 1 if the error-correction term is positive, and 0 otherwise.

Thus, if tax receipts are below equilibrium, the coefficient on the base is β, while above equilibrium (when D_{ec} is 1) it is β +σ. The coefficient σ should normally be positive as tax revenues above equilibrium result from above-average elasticity values. Similarly, the adjustment parameter on the error-correction term is λ when taxes were below-equilibrium in the previous period and λ + π when they were above. This approach, akin to Bruce et al. (2006), will be applied in section 4. It has the advantage of allowing both the base and the adjustment parameter to respond asymmetrically depending on actual receipts being above or below equilibrium, but a potential drawback is that outcomes are less transparent while the ease of application is smaller as elasticity-values are state-dependent (Dye, 2004).

Properly measuring of *endogenous* growth of tax receipts requires removing the effects of discretionary measures on tax revenues. In particular, correction is required for any policy-decisions regarding tax rates, the tax base or the efficiency or timing of collecting taxes to avoid biased estimates for the elasticities.

One way of dealing with discretionary changes is derive tax revenue elasticities from “theoretical” approaches, as done by many international organisations. For instance, base elasticities of indirect taxes often are set at value 1, assuming no shifts in the pattern of consumption between the products and services in categories with different tax rates. Short-term

fluctuations in the tax elasticities therefore are not taken into account. Another approach is to ignore or circumvent the issue. An example of the first is given by Ginebri et al. (2005), estimating tax buoyancy rather than a tax elasticity, while the second one is often applied in US-related literature (e.g. Sobel and Holcombe, 1996), focussing on the tax base-to-GDP elasticity rather than the base elasticity of tax receipts .

The tax series used in this paper are cleaned for discretionary measures using the proportional adjustment method (see Prest, 1962). Mathematically, the proportional adjustment method can be expressed as follows:

$$T_{05,05} = T_{05} \qquad [6]$$

$$T_{05,04,} = \frac{T_{04} * T_{05}}{T_{04,05}} \qquad [7]$$

$$T_{05,t} = \frac{T_t * T_{t+1} * \ldots\ldots * T_{05}}{T_{t,t+1} * \ldots . * T_{04,05}} \qquad [8]$$

with $T_{05,t}$ = tax revenue in year *t* if tax structure of year 2005 would prevail

T_t = actual tax revenue in year *t*

$T_{t,t+1} = T_{t+1} - D_{t+1}$

D_t = amount of discretionary measures taken in year *t*

We set the base-year at the most recent year in our sample, 2005, so that derived elasticities reflect recent tax structures. Equation 8 gives the more general formula. One advantage of using this approach is that in principle it results in a constant long-term elasticity, which facilitates the estimation process.

The usefulness of applying this method depends crucially on the availability and quality of estimates of revenue losses or gains from discretionary measures. We use estimates from the Dutch ministry of finance, which refer to ex-ante forecasts of the effect of measures on tax receipts in the year of implementation. This series has the advantage of going back relatively far (1970) and of being consistent but some drawbacks should also be listed. Lacking ex-post adjustments, it inevitably includes forecast errors.

Furthermore, endogenous behavioural responses are usually not taken into account as are cross-tax effects (the effect of a tax rate increase for one tax category for the revenue of another tax). Finally, the focus on revenue losses or gains in the initial year in some cases may imply that only part of the total effect is captured, e.g. if it takes time for measures to really take off. Despite such limitations, it is an indispensable source of information for time-series analysis.

3. Tax revenues in the Netherlands

The tax revenues taken into account in our study refer to Dutch central government tax receipts, excluding social security contributions and other current revenues as data on discretionary measures for these latter categories were not available.[7] Data on tax revenues and on revenue effects of discretionary measures refer to accrual-based revenues. Annex 1 contains details on characteristics of the series and their sources.

We separate the three main taxes, being value-added tax (VAT), personal income tax (PIT) and corporate income tax (CIT). The PIT includes the wage tax, which is a withholding tax for the personal income tax, taxation of non-wage income of individuals, as well as business income from retail business. The corporate income tax includes profits from all (large) corporations, including those from natural gas-exploitation. In 2005, the VAT, the PIT and the CIT accounted for 32, 26 and 16% of total central government tax revenues respectively. All other central government taxes are included in 'other indirect taxes' (22% of total tax receipts, mainly excise and stamp duties, a special tax on new cars, environmental taxes and taxes on judicial matters) and 'other direct taxes' (4% of total tax receipts, mainly dividend withholding tax and inheritance tax).

[7] Central government tax revenues account for around 50% of total general government, the other items being social security contributions, regional and local tax receipts, and non-tax receipts, representing about 30%, 15% and 5% of total general government income, respectively.

Figure 2 shows that the overall tax burden has remained fairly stable over time in the Netherlands, hovering around 24% of GDP. Its composition has changed, however, with indirect taxes gaining weight and personal income taxes becoming less important in the tax mix. Such reflects discretionary decisions as well as, more recently, the endogenous growth of personal income tax allowances and deductions (e.g. deductibility of mortgage interest payments and of private pension premiums).

Figure 2. Tax level and composition in the Netherlands, 1971-2005
As % of GDP

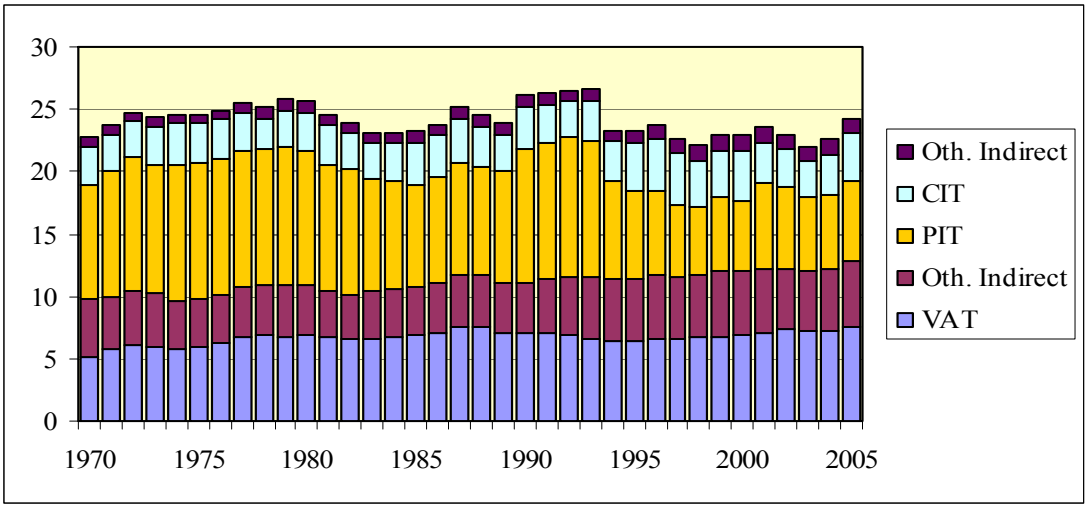


Table 1 presents information on the sources of growth of tax receipts as percentage of GDP over the sample 1971-2005, decomposed in the effect of discretionary measures and the effect of growth, the latter calculated residually. At the aggregate level, revenue effects of discretionary measures have been relatively limited over the years 1971-2005. For indirect taxes, the revenue-raising measures more than compensated the endogenous decrease in tax receipts as percentage of GDP. The picture for direct taxes is distinctively different, with the tax-to-GDP ratio increasing without measures, but discretionary measures on average lowering tax receipts. Only in the case of the personal income taxes did the combination of measures and endogenous growth on balance result in a (much) lower tax-to-GDP ratio.

Table 1. 1971-2005 tax revenue growth: endogenous and discretionary effects, % (-point) of GDP

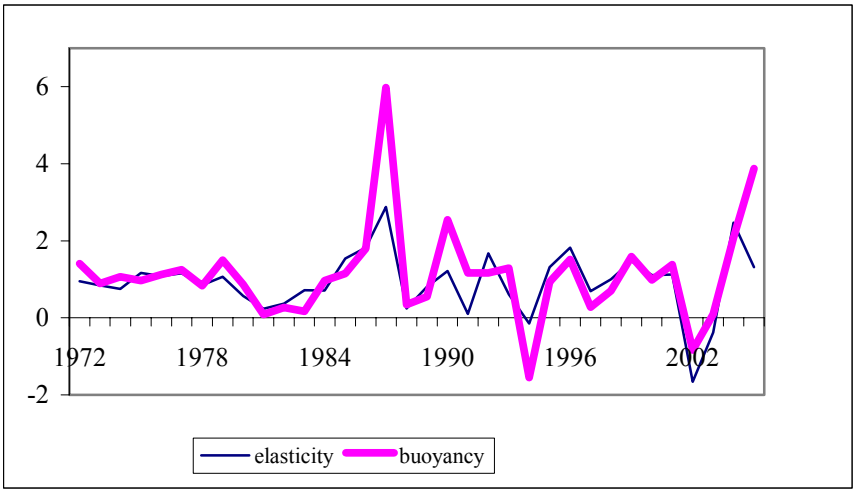
	1971 tax ratio level (1)	Effect of measures* (2)	Endogenous growth effect (3)	2005 tax ratio level (1)+(2)+(3)= (4)
Value-added tax	5.8	3.3	-1.5	7.6
Other indirect taxes	4.2	8.1	-7.1	5.2
Personal income tax	10.1	-6.2	2.4	6.4
Corporate income tax	2.8	-0.1	1.1	3.9
Other direct taxes	0.8	-0.2	0.6	1.2
Total	23.7	5.0	-4.4	24.3

* Including the effect of economic growth on the revenue changes from discretionary measures.

Specifically as to the discretionary measures, these boosted VAT receipts on average by some 1¼% of the VAT revenue (rather than as percentage of GDP as in the table), and increasing excise duties and higher special car taxation made other indirect taxes even rise faster. On the other hand, changes to direct taxes on net had a revenue-decreasing effect, especially as regards the PIT (-3% of PIT receipts). These changes reflect a shift from taxation of labour to indirect taxation and environmental levies (indirect tax), as well as income tax reforms (e.g. to simplify the tax code) and income tax reductions introduced to soften adverse income consequences of structural reform measures.

The nominal GDP elasticity of total taxes, also labelled the macroeconomic progression factor, on average equals around 1.1. Annual numbers are shown in Figure 3. For comparison, we also included the buoyancy, i.e., overall tax growth not corrected for discretionary measures, divided by nominal GDP growth. The figure shows that correcting for discretionary measures on average tends to reduce volatility of the tax series by adjusting for most of the 'extreme' values.

Figure 3. Overall buoyancy and income elasticity of Dutch taxes to GDP, 1972-2005



A noteworthy feature of the tax-to-GDP elasticity is its more volatile behaviour since the middle of the 1980s, and especially towards the end of the period. This may reflect increases in the number of major tax reforms, where effects are hard to forecast. In addition, higher volatility may reflect that GDP nowadays is less an indicator for the overall tax base than it used to be. Asset price developments (bonds, equity, real estate) play an increasingly important role in determining tax receipts, e.g. via stamp duties and deduction of mortgage interest payments (see Wolswijk, 2006).[8] The relatively high 1987-value of the overall elasticity reflects the very low nominal GDP growth in that year (just above 1%).

4. Estimation results

All tax variables, which are in log-form, were tested for unit roots using the Augmented Dickey-Fuller (ADF) test (see annex 2). For the majority of tax categories, stationarity was achieved after first-differencing. For two tax categories, this was only the case after shortening the sample, namely for the

[8] See Eschenbach and Schuknecht (2002) for an analysis of these effects, Tujula and Wolswijk (2007) for empirical evidence on the deficit impact, and Morris and Schuknecht (2007) for the impact of asset prices on tax receipts in a number of OECD countries.

VAT (1980-2002) and the PIT (1975-2005). This finding supports making a distinction between long-term and short-term elasticities.

As regards the long-run tax elasticity estimates, we start with OLS-estimations with all data transformed to logs as is standard in this field of research. As levels of tax revenues and bases often are non-stationary, estimating the long-run equations in levels can give rise to biased estimates and inconsistent standard errors. Following Stock and Watson (1993), adding leads and lags of the change in the independent variables, leading to Dynamic OLS estimates (DOLS), corrects the coefficient bias.

$$\log T_{05,t} = \theta + \delta \log B_t + \Sigma^{1}_{j=-1} \text{ø } \Delta \log B_{t+j} + \gamma_t \qquad [9]$$

Furthermore, Newey-West correction (Newey and West, 1987) was applied to reduce inconsistency of the estimates of the standard errors. Thus, as regards the long-run estimations, besides results on the basis of OLS we also present results using DOLS in combination with the Newey-West technique, which we take to be more informative.[9] Generally, we use the current value and one lead and one lag of the change in the independent variables to save on degrees of freedom. Endogeneity of the tax base should not be problematic in this set-up as the tax receipts have been corrected for discretionary measures that could have an impact on the tax bases.

After estimating the long-term relation, we tested whether non-stationary variables are integrated by a stationarity test on the residuals from the long-term equations. Results as reported in annex 2 broadly confirm the existence of co-integrating relationships.

The results of our estimates for the long-term and the short-term base elasticities are presented below for the five tax categories. Where available, we also add information on estimated values of elasticities from other sources. This relates in particular to the OECD (Van den Noord, 2000), the

[9] For applications of these methods on US tax series, see Sobel and Holcombe (1996) and Bruce et al (2006).

ECB (Bouthevillain, C., et al., 2001), the Netherlands Bureau for Economic Policy Analysis (CPB, 2004) and the IMF (2004).

Value-added tax

The log of endogenous VAT receipts first was related to private consumption, government investment and private residential investment, being the main expenditure items on which VAT is levied. While it could make sense to distinguish real from purely nominal developments,[10] the ADF-stationarity test on inflation gave unsatisfactory results (see Annex 2), so this path was not pursued further. Government investment was included but was not significant. Private consumption entered the equation for the 1980-2002 sample with coefficient 0.82, somewhat below the (theory-based) assumptions of the OECD, ECB and CPB. The below-unity elasticity could partially reflect the upward effect of higher excise duties levied on some products on inflation. While these increases are fully reflected in the price index, consumption may decrease in response, leading to less VAT receipts. Estimating with DOLS and the Newey-West correction results in a higher coefficient on private consumption (0.90) but still significantly different from unity, while residential investment seizes to be significant.

<table 2a>

As regards short-term effects (table 2b), the error-correction term was included as an explanatory variable, which proved to be significant with a coefficient of 0.77. Thus, actual revenues deviating from their long-run value are corrected for ¾ in the next period.[11] The coefficient on private consumption is only 0.69. In the final column, we allow for an asymmetric response, by including the dummy taking value 1 when the error-correction term is positive and interacting it with private consumption, and by splitting the error-correction terms in positive and negative values. Results indicate that

[10] Ginebri et al (2005) show this to be relevant in the case of Italy.
[11] Correlations with OECD and Commission estimates of the output gap and the errors from this and following equations for other taxes range between 0.20 and 0.65. Correlations between the errors all being positive with one exception gives some but no decisive support to a cyclical interpretation of the error-correction term.

when revenues are below equilibrium, the elasticity with regard to real consumption is 0.56, while when it is above the elasticity rises to 1.01. Such pattern could reflect a shift in the consumption pattern towards more basic, low-taxed goods and services when consumption and VAT revenues are depressed.[12] Thus, short-term shortfalls in VAT receipts are aggravated by a low elasticity.[13]

In addition, responses of the adjustment term prove to be asymmetrical, as witnessed by coefficients differing according to whether the error-correction term is positive or negative. These differences are not only significantly different from zero but also from each other. In combination with the high adjustment coefficient, this could point to consumption of luxury goods and services, being higher taxed by VAT, being postponed temporarily. Information from the Dutch Central Bureau of Statistics, with the share of medium- and high-taxed goods and services in total consumption decreasing in recessions, are in line with this idea.[14]

<table 2b>

Results for the VAT also confirm the crucial role of correcting tax receipts for discretionary measures in estimating elasticities. Re-estimating the OLS-equation for the level of tax receipts (2nd column of table 2a) without any correction for discretionary measures delivers markedly different results, the elasticity with regard to consumption being 1.15 instead of 0.82, and the coefficient on residential investment turning -0.07 instead of 0.16, although remaining insignificant.

[12] For the US, a number of studies also conclude rising income elasticities for durable goods in case of economic expansions (see Fox and Campbell, 1984, and Otsuka and Braun, 1999).
[13] An additional factor that could help explain this result is that in recessions the number of bankruptcies increases, resulting in the tax office not being able to collect all VAT due.
[14] Between 2000 and 2005, the economy went from a positive to a negative output gap according to most estimates. In that period, the share of normally-taxed (6%) and highly-taxed (19%) goods and services in total consumption declined both by 3 percent-point, to 21 and 40% respectively, while the share of exempted goods and services increased by 6 percentage points, to 39%.

Indirect taxes other than VAT

Indirect taxes other than VAT nowadays mainly includes taxes on new cars, excises on mineral oils and tobacco, legal taxes (e.g. stamp duties) and environmental levies. Private consumption was used as a rough tax base for these taxes, which resulted in a coefficient of 0.43. Given the heterogeneous nature of the taxes involved, no a priori expectation of the value of the elasticity can be formulated. In addition, the results show that house prices exert a significant effect on indirect tax revenues, reflecting stamp duties (3.5% of total tax receipts in 2005) increasing when activity on the housing market increases. This is in line with findings of the CPB (CPB, 2004). We also included oil prices in view of excise duties on mineral oil products (5.5% of total tax receipts in 2005) but this did not produce satisfactory results. The same equation was estimated with DOLS and the Newey-West correction, with the coefficient on private consumption going up (0.55), and the coefficient on the housing price effect going down (0.10).

<table 3a>

In the short-run equations, adding the error-correction term produces strong and statistically satisfactory results, indicating that around half of the error-correction is adjusted in the next period. Results also show a relatively weaker effect of private consumption and a stronger effect of house prices than in the long-run. The IMF (2004) also finds indications of a short-term impact of house prices on tax receipts.[15] In the final equation, we included the dummy taking value 1 in case actual receipts of other indirect taxes are above the long-run value and zero otherwise. This has an impact on the coefficient on private consumption, being around 0.3 if taxes are below-equilibrium and 0.6 if taxes are above-equilibrium. The higher responsiveness when above-equilibrium presumably could reflect car purchases increasing more rapidly, being taxed by a special levy. The error-correction term indicates that some 2/3 of the long-term disequilibrium is removed in the next period. No

[15] The IMF estimates an increase in the base elasticity of total indirect taxes from 1.0 to 1.3 from 1970-1989 to 1990-2003, which it connects to a larger impact of boom-bust cycles in asset prices.

significant difference in response of the error-correction term when being above- or below-equilibrium values is found.

<table 3b>

Personal income tax (PIT)

As to personal income taxes, which include wage taxation, we use wages as a base.[16] While a decomposition of the wage-sum into in real wage per employee, the number of employees, and inflation in principle would be preferable[17], the results form the stationarity-test for inflation did not allow this. The OLS results for the period 1975-2005 (table 4a) show an overall elasticity of 1.4 with regard to the wage-sum income taxation due to increasing marginal rates as household wage income increases. House prices have been included in view of the deductibility of mortgage interest payments from the tax base, and show the expected negative effect. A 2001 dummy measures ex-post corrections of revenues lost on account of the 2001 tax reform. Results with DOLS and Newey-West correction indicate a somewhat larger elasticity of the wage-sum (1.6). Stock market growth had no significant impact on the personal income tax revenue, although it is part of the base of the personal income tax since 2001. We also did not find satisfactory results for the 1990 tax reform having a downward effect on the elasticity (Caminada and Goudswaard, 1996).

<table 4a>

Comparing the outcomes with estimates from others is complicated by the fact that the latter usually distinguish between the effects of employment and of wage per employee, and may also include general insurance contributions

[16] Income of self-employed is also taxed via the personal income tax. As income of self-employed is not available for a long period, it was approximated by multiplying the number of self-employed by average wage income. However, estimations where imputed income of self-employed was taken out of corporate profits and allocated to the personal income tax base did not materially deviate from those mentioned in the main text and therefore are not reported here.

[17] Inflation and the number of employees usually are assumed to have unity elasticity, while the elasticity of real wages per employee should be much higher reflecting the progressive nature of income taxation.

that nowadays are collected simultaneously by the tax collector. Commonly, these studies impose a unitary elasticity with regard to employment (ECB, OECD, and CPB). The elasticity with regard to income per employee (of the private sector) ranges form 1.9 by the CPB to 2.6 by the ECB and the OECD. The IMF reports a rather low elasticity of 1.1 to the nominal wage sum over the period 1970-2003 but does not correct for (overall revenue-decreasing) discretionary measures, which depresses the estimated elasticity value.

In the short-run equation, the coefficient on wage per employee is higher than in the long-run equation (2.0 against 1.57), which could reflect that employment in the short run is less flexible than in the long-run.[18] Short-term adjustment thus falls more than proportionally on earned wage per person, which has a progressive impact on tax receipts. The error-correction term proved marginally significant, at close to 50%, while no evidence of asymmetry was detected.

<table 4b>

Corporate income tax (CIT)

Analysing and forecasting corporate income tax receipts is complicated because of lags in the effect of corporate profits on tax receipts, possibilities for carrying back and forward losses, fiscal profits only being very roughly approximated by profits in national accounts[19,] and – specific to the Netherlands - sizeable tax receipts from natural gas-exploitation (see De Boer, 1996). In our OLS estimation, one-year lagged corporate profits gave unity elasticity, which is in line with the findings of OECD, the ECB and the CPB, the latter allowing for lags up to 2 years. Estimates using DOLS and Newey-West correction indicate a value 1.07, significantly different from one, which could well reflect its slightly progressive nature resulting from somewhat

[18] Short-term economic fluctuations may have relatively little effect on employment, e.g. due to complex dismissal procedures or because employers use natural attrition. The standard deviation of the log of employment being about 4 times as low as that of the log of wage per person could support this view.

[19] For instance, profits in the national accounts are defined on a net basis (profits minus losses) while for estimating corporate tax receipts gross profits matter as losses do not immediately lead to negative tax assessments.

lower rates for small companies. Oil prices – to which the natural gas prices are linked – capture corporate tax receipts from the natural-gas sector but do not turn out to be significant.[20]

<table 5a>

The short-term elasticity with regard to lagged profits is 0.74. The IMF (2004) estimates the elasticity at 0.9 but notices an upward trend, possibly related to boom-and-bust periods. The coefficient on the error-correction term is around 0.5. Finally, we tested for asymmetric behaviour (last column), and indeed found evidence that profits spur taxation in case profit taxation is above its equilibrium, likely reflecting a strong reduction in possibilities to carry-back or carry-forward losses in good times. The lack of a significant effect in case of below-equilibrium tax receipts could reflect the possibilities for loss compensation.

< table 5b>

Other direct taxes

Other direct taxes, finally, have been related to corporate profits as dividend withholding taxes are the main component. Results indicate a rather strong progression effect, the long-term elasticity value being around 1.4, which could reflect exemption thresholds. A dummy for the tax reform in 2001 was added to reflect a change in dividend pay-out policies towards more cash but this did not prove successful. The same applies to the stock market index that was included as explanatory variable as other direct taxes included capital taxation until 2000. No direct comparison with other estimates is around as these taxes usually are lumped together with corporate taxes.

<table 6a>

[20] Although this approach foregoes many other elements that may have an impact on corporate tax receipts, adding more detail does not always deliver better results. In this respect, it can be noted that the CPB a few years ago switched back to a simple equation for predicting corporate tax receipts rather than trying to capture many of the factors described above (CPB, 2004).

The error-correction term was included in the short-term equation but apart from the intercept, none of the variables turned out to be significant. Improved results were obtained when including the interaction of the dummy for positive error-correction terms and profits. Results indicate above-unity elasticity with regard to profits in case of positive errors, which may reflect corporations' practice of short-term stabilisation of dividend pay-outs, resulting in stable dividend taxes. Only when long-term revenues are above trend do corporate profits translate into higher distributed dividend and thus more tax receipts.[21] However, given the poor fit of the equation, results should be interpreted with great caution.

<table 6b>

Table 7 summarises the results as discussed before, showing the elasticity of the five tax categories with regard to the main base element, thus foregoing other factors that impact on tax revenues.

Table 7. Summary of base elasticities of tax categories¶

		VAT	Other indirect taxes	Personal Income tax	Corporate income tax	Other direct taxes
Long-term elasticity		0.90	0.55	1.57	1.07	1.43
Short-term elasticity	Below equilibrium	0.56	0.33	2.01	0.12¶	-0.52¶
	Above equilibrium	1.01	0.61		0.90	1.24
Adjustment parameter	Below equilibrium	-0.80	-0.67	-0.49	-0.49	-0.31
	Above equilibrium	-0.92				

¶ Not significant at the 10%-level.

The table shows that long-term elasticities are within the range for the short-term elasticities except for the corporate income tax. Noteworthy is the high value of the short-term elasticity of the personal income tax, above the long-term value, which can be explained by slow employment adjustment. Short-term elasticities differ markedly from long-term values. Another conclusion

[21] Brav et al (2003) confirm this dividend payout policy for the US.

from his overview is that adjustment parameters for indirect taxes are relatively high compared to those for direct taxes.

5. Conclusions

This paper considered the short- and long-term base elasticity of taxes in the Netherlands. Apart from showing the importance of correcting tax revenue series for discretionary policy changes in estimating tax elasticities, it presents evidence that short-term elasticities deviate from long-term ones, especially for direct taxes. Differences are especially large in "bad times" (tax receipts below the long-run equilibrium), which may indicate cautious or lagged responses of economic agents, taking short-term developments less-than-fully into account on a real-time basis. The outcomes in most cases also indicate asymmetry in tax-to-base elasticities. When tax receipts are above the long-term value, elasticities tend to be higher, likely indicating shifts in consumption patterns towards more luxury (higher-taxed) goods and services, reduced possibilities for loss-compensation and less cautious dividend pay-out policies. The error-correction term is significant in all short-term equations, but there is only evidence of an asymmetric effect of the error-correction term for VAT-receipts. While error-correction terms may not be interpreted directly as cyclical indicators, some correlation seems to be in place, pointing to pro-cyclical elasticities.

Ignoring that short-term tax elasticities may differ from long-term tax elasticities adds to creating 'budget surprises' which in fact reflect forecast inadequacies. Such appears to be particularly important in times of negative surprises (tax receipts being below the long-term value), notably for direct taxes where the adjustment path is relatively flat. Ignoring such aspects may also contribute to inaccurate (cyclically-adjusted) fiscal indicators on which policy actions or recommendations may be based, although it needs to be realised that errors in forecasting actual or potential output on average appear to be bigger source of forecasting errors.

The gradual shift in Dutch taxes towards more indirect taxation (especially VAT) and less personal income taxation implies a shift to a lower short-term and long-term elasticity, implying more short-run stability in receipts and – as a counterpart – some decrease in the automatic stabilisation function of the tax system, which brings it more in line with the European average.

While this paper has provided insight in the question of short-term and long-term elasticities, and of asymmetrical short-term elasticities for the case of the Netherlands, further work in this area could be foreseen. Open issues that deserve attention in follow-up research include possibilities for application of this approach to other countries, notably in the EU where cyclically-adjusted balances play a major role in the policy debate. Another topic where additional work would be beneficial is on ways to turn the analytical tool developed in this paper into a forecasting tool that allows an ex-ante calculation of the cyclical component of the tax elasticity.

Tables

Table 2a. Long-term elasticity of VAT in the Netherlands, 1980-2002

Estimation method	OLS	DOLS + Newey-West
Intercept	2.39 (33.3)***	2.32 (15.8)***
Private consumption	0.82 (12.5)***	0.90 (6.2)***
Residential investment	0.16 (2.8)**	0.07 (0.5)
Adj. R2	0.99	0.99
s.e. of regression	0.0067	0.0071
Observations	23	23

Table 2b. Short-term elasticity of VAT, 1981-2002

Estimation method	OLS	OLS
Intercept	0.00 (0.6)	0.00 (0.5)
Δ Private consumption	0.69 (2.9)***	0.56 (2.9)***
Δ Private consumption * D_{resid}		0.45 (3.3)***
Δ Residential investment	0.13 (1.5)	0.09 (1.2)
Error-correction term (-1)	-0.77 (-3.2)***	
Positive error-correction term (-1)		-0.92 (-2.0)*
Negative error-correction term (-1)		-0.80 (-2.3)**
Adj. R2	0.51	0.67
s.e. of regression	0.0078	0.0063
Observations	22	22

Table 3a. Long-term elasticity of other indirect taxes, 1970-2005

Estimation method	OLS	DOLS + Newey-West
Intercept	3.01 (144.5)***	2.88 (83.3)***
Private consumption	0.43 (21.6)***	0.55 (17.8)***
House prices	0.18 (8.7)***	0.10 (3.8)***
Adj. R2	0.99	0.99
s.e. of regression	0.0148	0.0099
Observations	36	33

Table 3b. Short-term elasticity of other indirect taxes, 1973-2005

Estimation method	OLS	OLS
Intercept	-0.00 (-0.5)	-0.00 (-0.9)
Δ Private consumption	0.43 (3.9)***	0.33 (2.9)***
Δ Private consumption * D_{resid}		0.28 (2.6)**
Δ House prices	0.24 (5.7)***	0.26 (6.7)***
Error-correction term(-1)	-0.54 (-2.9)***	-0.67 (-3.9)***
Adj. R2	0.67	0.74
s.e. of regression	0.0090	0.0081
Observations	33	32

Table 4a. Long-term elasticity of personal income taxes, 1975-2005

Estimation method	OLS	DOLS + Newey-West
Intercept	1.54 (21.0)***	1.40 (11.0)***
Wage-sum	1.41 (22.3)***	1.57 (16.0)***
House price	-0.20 (-4.3)***	-0.33 (-5.4)***
2001 tax reform dummy	0.09 (3.6)***	0.08 (9.5)***
Adj. R2	0.99	0.99
s.e. of regression	0.016	0.020
Number of observations	31	30

Table 4b. Short-term elasticity of personal income taxes, 1976-2005

Estimation method	OLS
Intercept	-0.02 (-1.9)*
Wage-sum	2.01 (4.8)***
House price	-0.08 (-0.6)
2001 tax reform dummy	0.08 (3.3)***
Error-correction term(-1)	-0.49 (-1.9)*
Adj. R2	0.59
s.e. of regression	0.022
Observations	30

Table 5a. Long-term elasticity of corporate income tax, 1971-2005

Estimation method	OLS	DOLS + Newey-West
Intercept	2.11 (40.3)***	2.00 (27.7)***
Corporate profits (-1)	1.00 (23.8)***	1.07 (21.4)***
Oil prices	0.07 (1.8)*	0.03 (0.6)
Adj. R2	0.97	0.97
s.e. of regression	0.046	0.045
Number of observations	35	35

Table 5b. Short-term elasticity of corporate income tax, 1972-2005

Estimation method	OLS	OLS
Intercept	0.01 (0.7)	0.01 (1.4)
Δ corporate profits (-1)	0.74 (2.9)***	0.12 (0.4)
Δ corporate profit (-1) * D_{resid}	-	0.90 (2.6)***
Δ oil price	0.15 (3.0)***	0.11 (2.3)**
Error-correction term (-1)	-0.43 (-3.1)***	-0.49 (-3.8)***
Adj. R2	0.46	0.55
s.e. of regression	0.034	0.031
Number of observations	34	34

Table 6a. Long-term elasticity of other direct taxes, 1971-2005

Estimation method	OLS	DOLS + Newey-West
Intercept	0.80 (9.5)***	0.74 (4.5)***
Corporate profits	1.40 (28.7)***	1.43 (16.1)***
Adj. R2	0.96	0.96
s.e. of regression	0.075	0.074
Number of observations	36	35

Table 6b. Short-term elasticity of other direct taxes, 1972-2005

Estimation method	OLS	OLS
Intercept	0.03 (3.0)***	0.03 (3.1)***
Δ Corporate profits	0.13 (0.4)	-0.52 (-1.4)
Δ Corporate profits * D_{resid}		1.24 (2.8)***
Error-correction term (-1)	-0.15 (-1.5)	-0.31 (-2.9)***
Adj. R2	0.01	0.19
s.e. of regression	0.041	0.037
Number of observations	34	34

Annex 1: Data sources and methods

Data on discretionary measures (cash basis) and on tax receipts (cash basis, partly accrual basis) have kindly been obtained from the Ministry of Finance in the Netherlands. We have derived tax series on an approximated accrual basis as follows:

- For indirect taxes, tax receipts and discretionary measures on a cash basis are taken, given limited delay in paying these taxes (nowadays usually one month).
- As for corporate taxes, we have used available accrual-based receipts data and half a year lagged cash data on discretionary measures.
- Regarding personal income tax, data refer to accrual-based data as far as possible, supplemented by half-a-year lagged cash data where necessary. Cash data on discretionary measures have been lagged by half a year.
- For other direct taxes, both revenue series and the series on measures have been lagged by one year.

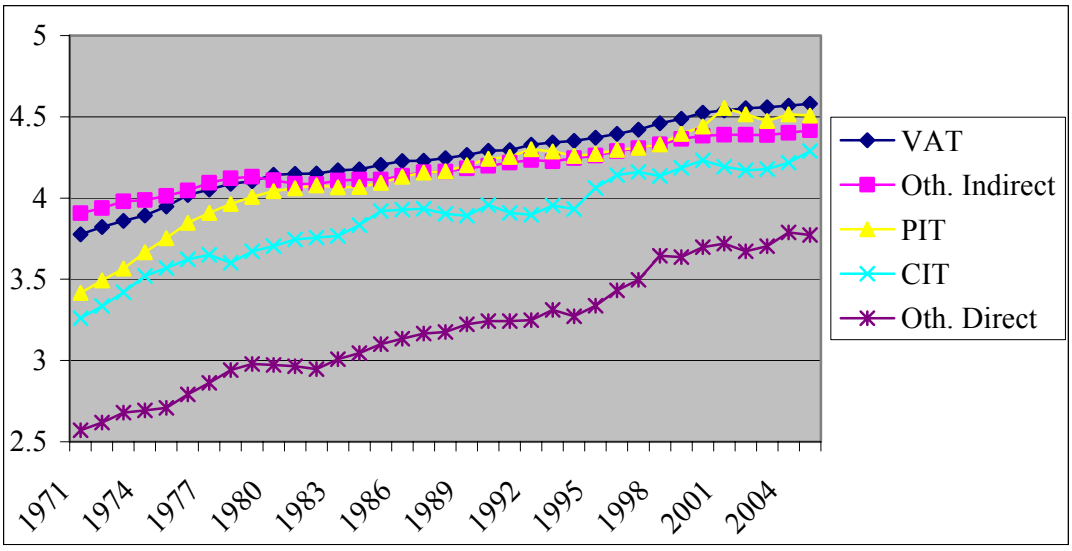
- Tax base for wage and personal income tax: wage income for government and business employees.
- Tax base for corporate income tax: net exploitation income of the business sector
- Long-term interest rate, exchange rate Dutch guilder/euro vs. US dollar; OECD Main Economic Indicators.
- Dutch stock market index: Global Financial Data
- Oil price: OECD Economic Outlook
- National accounts data: nominal and real gross domestic product, private consumption, wage compensation, private consumption, government investment, private residential investment, employment: CPB.
- Consumer price index: Dutch Central Bureau for Statistics (CBS)
- Housing prices: ECB and BIS
- Output gap: Commission AMECO database and OECD Main Economic Indicators.

Annex 2: Unit root test results

Graph A1 below shows the endogenous development of the log of the 5 tax categories distinguished in the main text. Noteworthy developments include:

- a change in the trend in VAT-receipts and in other indirect taxes around the end of the 1970s, and possibly again towards the beginning of the new century.
- peaks in personal income taxes and other direct taxes around 2001-2002.
- corporate income taxes behaving most volatile, and indirect taxes least.

Graph A1: Log of endogenous tax receipts of 5 main tax categories, 1971-2005



The table below shows the results from the Augmented Dickey-Fuller (ADF) test on unit roots. The VAT-series initially was not stationary but after taking into account a change in trend at the end of the 70s and at the end of the period results were satisfactory. Personal income taxes also were found to be difference-stationary when taking a shorter sample. Results for the other tax categories point to tax series being stationary over the entire sample (1971-2005) after differencing once.

Table A2.1 Augmented Dickey-Fuller tests for endogenous tax levels, 1971-2005

	Level	Level with trend	First difference
VAT[#]	1.08	-1.18	-5.04***
Other indirect taxes	-0.98	-3.13	-3.43**
Corporate income tax	-2.13	-3.33*	-4.89***
Personal income tax[§]	-2.90*	-3.76**	-3.96***
Other direct taxes	-0.54	-2.29	-5.51***

*, **, *** = significant at 10%, 5%, and 1% level respectively.
All estimates include an intercept.
1980-2002.
§ 1975-2005.

As to the explanatory variables, most exhibited stationarity after first differencing. Inflation is the notable exception, possible related to a trend-break around the start of the 1980s. Indeed, using shorter time periods delivered more satisfactory results, although it reduces the power of the ADF-test.

Table A2.2 Augmented Dickey-Fuller tests for independent variables

	Level	Level with trend	First difference
Private consumption[#]	1.18	-1.48	-2.79*
Residential investment[#]	0.95	-1.75	-4.28***
Inflation	-3.44**	-4.18**	-1.37
Government investment[#]	2.34	0.52	-3.88***
Corporate profits	-2.05	-2.27	-4.42***
Wages[§]	-0.98	-3.89***	-2.94**
House price	2.40	-1.83	-2.92*
House price[§]	-0.54	-1.61	-3.48**
Oil price	-1.97	-2.07	-5.35***
Long-term interest rate	-1.48	-3.48*	-4.67***
Stock market index	-0.47	-2.68	-3.84**

Over the sample 1980-2002.
§ Over the sample 1975-2005.

The errors from the long-run equations were tested for stationarity using the ADF-test, which revealed satisfactory results (see table below). In view of the limited size of our sample and possible non-linear adjustment that are known to reduce the power of the test (see e.g. Endes and Siklos, 2001), we did not opt for the Johansen cointegration test. Instead, there is a strong theoretical presumption of cointegration by the fact that the equations, while including behavioural elements, mostly are of an arithmetic nature as there is only limited possibility to avoid taxation if the taxable event that increases the tax base occurs.

Table A2.3 Augmented Dickey-Fuller tests on residuals from long-term DOLS equations with Newey-West correction.

	Level
Value-added tax	-3.12***
Other indirect taxes	-4.73***
Personal income tax	-5.34***
Corporate income tax	-4.08***
Other direct taxes	-1.98**

Results without intercepts (all insignificant)

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ISSN 1561081-0