DOKUZ EYLÜL UNIVERSITY
FACULTY OF BUSINESS
DEPARTMENT OF ECONOMICS

PERSONAL INCOME TAX ELASTICITY IN TURKEY: 1975-2005

Yeşim Kuştepeli
Onur Şapçı

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Yeşim Kuştepeli

Dokuz Eylül University, Faculty of Business, Department of Economics,

Kaynaklar Yerleşkesi, Buca 35160 İzmir-Turkey

yesim.kustepeli@deu.edu.tr

Onur Şapçı

Dokuz Eylül University, Faculty of Business, Department of Economics

Kaynaklar Yerleşkesi, Buca 35160 İzmir-Turkey

onur.sapci@deu.edu.tr

Abstract

The estimation of tax elasticity; the response of tax revenues to changes in income, is important for at least three reasons: i) formulating government budgets and monitoring tax collections (Sen, 2002), ii) the specification of tax functions, iii) the automatic stabilizing properties of the tax system and the public sector deficit (Hutton, Lambert; 1980, 1982).

Among the various approaches to tax elasticity calculation in literature (Tanzi, 1969, 1976; Greytak and McHugh, 1978; Hutton and Lambert, 1980; Ehdaie, 1990), the most famous approach is Tanzi's Method due to its simplicity and the consensus about its correctness of elasticity estimates.

Johansen cointegration tests for the period 1975 - 2005 show that personal income tax elasticity in Turkey is around 0.95, indicating almost unit elasticity. Increasing income can be considered as insurance to maintain an equivalent increase in tax revenue; however it doesn't seem to be the way to obtain higher tax revenues.

Key words: personal income tax, tax elasticity, Tanzi method

JEL Classification: E62, H24

1. INTRODUCTION

The estimation of the likely response of tax revenues to changes in income is a central empirical issue in applied public economics. This estimate is important for at least three reasons: i) for formulating the government budgets and monitoring the progress of tax collections (Sen, 2002), ii) for the specification of tax functions in terms of macroeconomic policymaking, iii) for the automatic stabilizing properties of the tax system and for the public sector deficit during periods of growth in nominal income (Hutton, Lambert; 1980, 1982).

In terms of the first reason, in the 1980s, supply-side economists argued that high marginal tax rates were reducing the incentives of people to work, and cutting tax rates by stimulating people to work harder and to earn more income could actually raise revenue. If tax cuts lead to large behavioral responses by individuals, the implications are quite important for the tax policy. The greater the behavioral response, the less revenue is raised by high tax

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rates. This is because high tax rates lead people to shift their income out of taxable form (Goolsbee, Hall and Katz, 1999: 2)

The analysis of the tax system and its effects on the economy is crucial also because the tax system does not only alter the relative prices of real variables; but it also provides incentives to misreport income, restructure financial claims, time transactions, and change the legal form of organization. For this reason, one may encounter low tax elasticities due to either low elasticities of substitution or the fact that tax policy changes opportunity sets in complex ways. Disentangling these explanations requires an emphasis on the transaction based nature of the tax system and the administration and enforcement of tax laws. Because most taxes apply to transactions, their impact on real variables can be adequately understood only by simultaneously considering their impact on the transaction behavior whose terms are directly affected by the tax system (Slemrod, 1992: 250, 255).

The second reason why knowing tax elasticity is important relies on the fact that one of the policy tools for developing countries as well as developed counties for achieving real and sustainable economic growth with price stability and balance of payments viability is fiscal deficit reduction. In this framework, projections need to be made of the additional revenues within the existing tax system as GDP grows. These projections indicate the need to activate additional means of revenue generation (Ehdaie, 1990:1). In this sense, estimating income tax elasticity becomes essential. The theory of optimal taxation requires that the path of tax rates be chosen to minimize the deadweight burden of taxation, given an initial level of government debt and an expected future path for government expenditures. The over-identifying restrictions suggest that the uniform tax model may be too simplistic with regards to its treatment of business cycle conditions (Hess, 1993:712).

For further macroeconomic issues such as obtaining a substantial rate of growth for the economy will require periodic income tax reductions unless some reforms are enacted in tax legislation that automatically introduce the necessary adjustments. The measurement of the elasticity and the flexibility of individual income tax have more than academic value, having relevance for decisions in the field of tax policy in particular and stabilization policy in general.

Finally, as a third concern, income tax is considered as the most commonly discussed automatic stabilizer, which reduces the multiplier effects of demand shocks through the marginal taxation of income fluctuations. A progressive income tax with high marginal tax rates could substantially reduce fluctuations in after-tax income and therefore private spending without the need for any explicit policy changes. In terms of tax elasticity, a proportional income tax has an elasticity of 1.0 while progressive tax systems whose tax-income ratios increase with income have an elasticity greater than 1.0. This elasticity then serves as an indicator of the tax system's overall progressivity. For a given level of taxes, the higher the elasticity the smaller will be the change in after-tax income that results from a given change in before-tax income (Auerbach and Feenberg, 2000: 40).

The most common measure of the responsiveness of tax revenues to changes in income for analytical applications is the "tax elasticity" or "built-in flexibility" (Prest, 1962). Tax elasticity is generally related with the personal income tax. Various approaches to its calculation are found in literature (Tanzi, 1969, 1976; Singer, 1970; Greytak and McHugh, 1978; Hutton and Lambert, 1980; Ehdaie, 1990). Tax elasticity is the ratio of the percentage change in (income) tax revenue to the percentage change in national income with a given tax structure (Rosen, 2005). It can also be thought as the indicator of the sensitivity of the tax system to the changes in national income.

A direct measure of the potential stabilization effect of the tax system is the ratio of the change in taxes with respect to a change in before-tax income (built-in flexibility). This can be calculated in two ways:

1) $V_1 = \frac{\frac{T_1}{I_1} - \frac{T_0}{I_0}}{I_1 - I_0}$ where T = tax liabilities and I = income. This measure would be best for estimating progressivity (Rosen, 2005:277)

2) $V_1 = \frac{\frac{T_1 - T_0}{T_0}}{\frac{I_1 - I_0}{I_0}}$ where T = tax liabilities and I = income. This measure would be best for estimating tax elasticity and comparing the progressivity of one tax system compared to another tax system. (Rosen, 2005:278)

The most attractive and famous of the existing approaches in the literature is the Tanzi's Method. Its simplicity in application and the consensus about the correctness of its elasticity estimates has made this model widely used in empirical studies.

Tanzi's method has the advantage of providing not only estimates or the elasticity and flexibility of the income tax but also estimates of the elasticity of the tax base and elasticity of the rate structure (Tanzi, 1969:206). Tanzi's method however, does not necessarily measure the elasticity with respect to equiproportionate growth. It measures the revenue responsiveness for aggregate if the national distribution of income evolves in a manner parallel with the interstate pattern of distributional differences (Fries, Hutton and Lambert, 1982:149).

There are two effects that have to be mentioned in terms of income tax elasticity; exemption effect and rate effect. According to the exemption effect, at low levels of income, small increases in personal income or adjusted gross income are accompanied by very large percentage increases in taxable income and very high tax elasticity. The exemption effect will decline in importance as more taxpayers' adjusted gross income exceeds the amount of their exemptions, but will vanish only when all taxpayers have positive taxable income. Taxable income per return however will continue to be accompanied by a high elasticity because of the rate effect. Under a progressive rate structure, increases in taxable income per return will cause effective average and marginal tax rates to rise and revenues will thus rise more rapidly than taxable income. The rate effect will persist as long as effective marginal tax rates rise with increasing income, that is, over the progressivity of the tax structure. Once all taxpayers have reached the maximum marginal tax rate the rate effect will vanish. Future values of the tax elasticity will depend on base effect, the extent to which the taxable income base increases at a rate different from adjusted gross income or personal income. On the basis of the slow growth rates of deductions and exclusions (such as transfer payments) the base effect seem likely to yield tax elasticity slightly greater than unity over wide ranges of tax revenue and personal income (Singer, 1970:427).

The estimation of the elasticity of taxable income and the responses to taxation begins with the work of Lawrence Lindsey (1987). According to Lindsey, the elasticity of taxable income for the highest-income taxpayers is greater than one. Feenberg and Poterba (1993) estimates that incomes raise substantially for the group that had the largest relative cut in their marginal tax rates. The research from 1980s indicates in general large income tax elasticities. However, in the 1990s the elasticity of income tax is found to be significantly lower than one (e.g. Slemrod 1998; Goolsbee, Hall and Katz, 1999). These findings are mostly based on the U. S. data. There is no study which estimates the income tax elasticity for Turkey as to the knowledge of the authors.

In this study, the tax elasticity of the Personal Income Tax in Turkey in the period 1975-2005 will be calculated by using Tanzi's Method. The elasticity estimates obtained from this study will show us the responsiveness of the

Turkish Income Tax System to national income. Also the elasticity figures will enable us to make policy implications about the government's fiscal policy actions and the tax system.

In the second section, first data and methodology are provided, and then empirical results are presented. The third and final section concludes the paper.

2. EMPIRICAL ANALYSIS

2.1. Methodology and data

Tanzi's method of income tax elasticity estimation is based on the following formula:

$$\varepsilon = \Delta T / \Delta Y = \Delta TI / \Delta Y \bullet \Delta T / \Delta TI \qquad (1)$$

where TI = taxable income, T = tax revenue, Y = adjustable gross income

Income tax elasticity, ε, can be calculated in two ways: either by estimating equations (2) and (3) below and multiplying the coefficients of the independent variables, or by estimating equation (4) where the coefficient of the independent variable on the right hand side. These two estimates from two different estimations should be approximately equal.

$$\ln T = \ln b_0 + b_1^1 \ln(TI) \qquad (2)$$

$$\ln TI = \ln b_0 + b_1^2 \ln(Y) \qquad (3)$$

$$\ln T = \ln b_0 + b_1^3 \ln(Y) \qquad (4)$$

where $\varepsilon = b_1^1 \cdot b_1^2$ or $b_1^1 \cdot b_1^2 \cong b_1^3 = \varepsilon$

Our data from 1975 to 2005 is annual. The data for Y (nominal GNP) is taken from the statistics releases of State Planning Organization of Turkey. Income tax revenue, represented by T is obtained from the Revenue Administration of Ministry of Finance. Taxable Income, TI, is thought to be similar to Personal Income according to national accounting concept because theoretically, direct taxes are levied upon Personal Income. Personal disposable income is obtained by subtracting direct taxes are from personal income. In this study, personal income is used as taxable income. The definition of Personal Income is the total income of the citizens of a country before the Income Taxes in a certain period of time. The taxable income series are calculated by the authors as follows:

GNP = GDP + Net Factor Income from Abroad

Net National Product = GNP - Depreciation

National Income (NI) = Net National Product - Indirect Taxes

Personal Income or Taxable Income = NI – (Social Security Payments + Corporate Taxes) + Domestic Interest Payments + Transfer Payments

The aggregate numbers of depreciation in the period 1975-2005 for Turkey cannot be obtained so the calculation is done without depreciation figures. Other series are taken from State Planning Organization of Turkey and from the

Electronic Data Delivery System of The Central Bank of the Republic of Turkey. In econometric applications below, we use the real variables which we obtain by deflating our variables by the GNP deflator. Our data is given in Table 1 below.

Table 1: Income Tax Revenue and Taxable Income: 1975-2005, in million YTL

years	Income Tax Revenue (T)	Nominal GNP (Y)	Taxable Income(TI)
1975	43.50	690.9008	647.3917
1976	59.30	868.0658	805.9202
1977	87.70	1108.2707	1031.7467
1978	139.40	1645.9685	1527.1844
1979	233.10	2876.5229	2690.0576
1980	463.80	5303.0102	4965.6312
1981	745.80	8022.7453	7442.9227
1982	804.90	10611.8592	9886.9590
1983	1109.87	13933.0081	12843.8519
1984	1341.00	22167.7399	20785.9830
1985	1771.76	35350.3184	32384.8482
1986	3052.87	51184.7593	46316.3705
1987	4424.40	75019.3880	67945.9444
1988	6918.50	129175.1037	118219.1656
1989	13468.50	230369.9371	211369.0890
1990	23245.90	397177.5474	365731.4159
1991	40419.50	634392.8411	583794.7753
1992	70133.70	1103604.9090	1009425.5400
1993	125793.00	1997322.5974	1848801.7668
1994	246578.60	3887902.9165	3633779.7261
1995	436000.00	7854887.1670	7337185.5632
1996	865909.00	14978067.2830	14090439.2427
1997	1897693.00	29393262.1470	26601657.9519
1998	4231794.70	53518331.5800	50873904.4317
1999	6537502.00	78282966.8090	73941964.6117
2000	10503414.60	125596128.7550	119662278.5856
2001	15647885.00	176483953.0210	176446798.1920
2002	19343401.00	275032365.9528	262196553.8044
2003	25716174.00	356680888.2222	324693990.8191
2004	29307924.00	428932343.0257	374787394.4870
2005	34219410.00	480922786.9	404019328.9

Source: SPO and CB of Turkey

A time series is said to be nonstationary if its mean and variance are not constant over time and the value of the covariance between two time periods depend on the actual time at which the covariance is computed. Regressions involving nonstationary time series data include the possibility of obtaining spurious regressions. The results of such regressions seem artificially good but they do not reflect the true relation. So the stationarity of a time series must be tested by a unit root test. In our study, we use Augmented Dickey Fuller Unit Root test (ADF) and KPSS unit root test (Kwiatkowski, Phillips, Schmidt, Shin, 1992), to test the time-series properties of our variables.

ADF unit root test sets the null hypothesis that the series has a unit root (not stationary). In other words, this test use unit autoregressive (AR) roots as null hypothesis. But KPSS unit root test sets stationarity as the null hypothesis. The asymptotic distributions of two tests are different. It is much more confident that if two tests' results support each other. After the integration level of time series is found, the cointegration analysis must be applied.

The basis of cointegration idea is that a linear combination of time series might be stationary even if the series themselves contain unit root. If the time series are cointegrated, that means there is a long run equilibrium relationship between series. The Johansen (1988) procedure is one of the most common tools in the estimation of cointegrated systems. Johansen procedure has some advantages over the single equation approaches. In the system estimation of Johansen method, the normalization problem does not appear and also the number of cointegrating vectors is not fixed a priori but is determined in the course of estimation.

Johansen procedure applies maximum likelihood to the VAR (Vector autoregressive) model, assuming the errors are Gaussian. The procedure leads to two test statistics for cointegration. The first is the Trace test, which tests the hypothesis that there are at most r cointegrating vectors. The second called the Maximum Eigenvalue Test, which tests the hypothesis that there are r+1 cointegrating vectors versus the hypothesis that there are r cointegrating vectors. The results of the ADF, KPSS and Johansen test are reported in the Results section.

2.2. Results

The results of ADF test on our variables real GNP, real income tax revenue and the real taxable income are reported in Table 2.

Table 2: Augmented Dickey Fuller Unit Root Test Results

Variables	Level / First Difference	Constant	Constant & Trend
Ln (realT)	Level	-1,01957 [0]	-2,1253[0]
	First Difference	-4,8978[0]*	-4,7957[0]*
ln(realTI)	Level	-0,5850[1]	-1,2540[1]
	First Difference	-8,1190[0]*	-8,0003[0]*
Ln(realY)	Level	-0,0177[1]	-2,8090[0]
	First Difference	-7,2666[0]*	-7,1447[0]*

Note: In the table, the test statistics are shown from the model including constant term and from the model including constant term and trend. * denotes the rejection of null hypothesis at %1 significance level. That means the null hypothesis about the series have a unit root is rejected. The numbers in parenthesis near estimated coefficients are the optimal lag numbers determined by the SIC (Schwarz Information Criteria). Test statistics are compared with the critical values of MacKinnon(1991)

Table 3: KPSS* Unit Root Test Results

Variables	Level / First Difference	Constant	Constant&Trend
Ln (realT)	Level	0,6679 [4]**	0,12055[4]**
	First Difference	0,0604[1]	-0,0632[1]
ln(realTI)	Level	0,7137[4]**	0,886164[1]*
	First Difference	0,1477[1]	-0,07742 [1]
Ln(realY)	Level	0,7242[4]**	0,2982 [0]*
	First Difference	0,04138[0]	0,041[0]

Note: In the table, the test statistics are shown from the model including constant term and from the model including constant term and trend. * denotes the rejection of null hypothesis at %1 significance level and ** denotes the rejection of null hypothesis at %5 significance level. That means the null hypothesis about the series are stationary (do not have unit root) is rejected. The numbers in parenthesis near estimated coefficients are the optimal lag numbers determined by the selection of Newey-West Bandwidth. Bartlett kernel spectral estimation method is used. Test statistics are compared with the critical values of Kwiatkowski, Phillips, Schmidt, Shin (1992, Table1)

According to ADF test, all of the three variables are not stationary at their level values. We cannot reject the null hypothesis of the series has a unit root. But when we take the first difference of these series they become stationary. In other words, real T (Income tax revenue), real TI (Taxable Income) and the real GNP (Y) are in the form of I(1) at the %1 level of statistical significance level.

Table 3 shows the results of the KPSS test. Here the null hypothesis says that the series is stationary. For real T and real TI and real GNP, the null hypothesis of stationarity is rejected at %5 level in the model with constant term. In the model with constant and trend, we can conclude that real T is not stationary at %5 level and real TI and real Y are not stationary at %1 level. That means they are not stationary at the level values. When we take the first differences we cannot reject the null hypothesis of stationarity at %1 level. So these three variables become stationary at their first differences. In short, these variables are I(1) at the %5 level.

So the results of the KPSS and ADF unit root tests confirm each other. To apply the Johansen Procedure all variables must be in the form of I(1). So this condition is satisfied.

There are three cointegration test specifications for the Johansen method. First model includes intercept but no trend in cointegration equation and no intercept in VAR. Second model includes intercept and no trend in cointegration equation and trend in VAR. Third model includes intercept and trend in cointegration equation and no trend in VAR. Model selection is done according to the suggestion of Johansen (1992). In the trace test, we start with model 1, go on with model 2 and finally model 3, where the trace test statistics is compared with critical values. According to this criterion, the first model is the most appropriate model for our equations.

Table 4 shows the result of cointegration analysis between the variables of real income tax revenue and the real taxable income [equation (2)]. Optimal lag selection is done by estimating the VAR system and choosing the lag number which yields the smallest value of Schwarz Information Criteria. The optimal lag number at this model is 2. After selecting the optimal lag number, we run the Johansen tests and both trace test and maximum eigenvalue test indicate that there is one cointegrating vector in the system.

Johansen test also allows finding the cointegrating coefficients. These coefficients can be interpreted as long run elasticity since the variables are in logharitmic form. Standard errors are in parenthesis and the coefficient of real taxable income is statistically significant at %5 level.

The normalized cointegrating vector for equation 2 is as follows:

LnRealT = -1,0996 + 0,959262 LnReal TI

(1,004) (0,08937)

Table 4: Johansen Trace Test and Maximum Eigenvalue Test Results (For Ln(realT) and Ln(realTI))

Trace test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r≥1	24,8171*	20,261
r≤1	r≥2	3,7392	9,1645
Maximum Eigenvalue Test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r=1	21,07785*	15,8921
r≤1	r=2	3,7392	9,1645

* Denotes the rejection of the null hypothesis at the 0, 05 level

To find the income tax elasticity, we need to estimate equation (3). Table 5 shows the results of the cointegration analysis of this equation, between the variables of real income taxable income and the real GNP (Y). The optimal lag number for this equation is found to be 1 and Johansen trace test and maximum eigenvalue tests indicate evidence of one cointegrating vector in the system.

The normalized cointegrating vector for equation 3 is:

Ln Real TI = 0,26339 + 0,980447 Ln Real Y

(0,6344) (0,05620)

The coefficient of real GNP is statistically significant at %5 level.

Table 5: Johansen Trace Trace and Maximum Eigenvalue Test Results (For Ln(realTI) and Ln(realY))

Trace test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r≥1	23,03424*	20,261
r≤1	r≥2	2,3599	9,1645
Maximum Eigenvalue Test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r=1	20,67433*	15,8921
r≤1	r=2	2,3599	9,1645

* Denotes the rejection of the null hypothesis at the 0, 05 level.

As we have estimated the coefficients from equation (2) and (3), we can calculate the long run income tax elasticity by multiplying these two coefficients.

Remembering that:

$$\ln T = \ln b_0 + b_1^1 \ln(TI) \qquad (2)$$

$$\ln TI = \ln b_0 + b_1^2 \ln(Y) \qquad (3)$$

$$\varepsilon = b_1^1 \cdot b_1^2 = 0{,}959262 * 0{,}980447 = 0{,}9405055$$

Our results show that the long run elasticity of income tax is 0. 94, which is slightly less than unity. Our next step is to estimate equation (4) and investigate whether there is a long run relationship for this equation in which income tax elasticity could be also obtained.

The results of the cointegration analysis for equation (4) are given in Table 6.

Table 6: Johansen Trace Test and Maximum Eigenvalue Test Results (For Ln(realT) and Ln(realY))

Trace test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r≥1	22,68904*	20,261
r≤1	r≥2	2,3484527	9,1645
Maximum Eigenvalue Test			
Null (H_0) Hypothesis	Alternative (H_1) Hypothesis	Test Statistics	%5 Critical Value
r=0	r=1	*19,2045**	*15,8921*
r≤1	r=2	2,3484527	9,1645

* Denotes the rejection of the null hypothesis at the 0,05 level

Johansen trace and maximum eigenvalue tests indicate that real income tax revenue and real income are cointegrated with one cointegrating vector. The optimal lag number is also one in this system.

The normalized cointegrating vector for equation (4) is found as :

Ln Real T = -1,8632 + 0,953928 Ln Real Y

(1,8333) (0,16254)

The coefficient of real GNP, which is the long run elasticity of income tax, is statistically significant at %5 level.

Comparing this elasticity to the one we have computed earlier, we see that:

$$\ln T = \ln b_0 + b_1^3 \ln(Y) \qquad (4)$$

$$\varepsilon = b_1^1 \cdot b_1^2 \text{ or } b_1^1 \cdot b_1^2 \cong b_1^3 = \varepsilon = 0,9405055 \approx 0,953928$$

there is a slight difference between the two elasticities; they are almost equal.

As a result, our analysis on income tax elasticity using Tanzi's method shows that long run income tax elasticity in Turkey for the period 1975-2005 is 0.95, which is slightly less than unity. This means that an increase in real income causes almost the same magnitude of increase in income tax revenue; in other words income tax revenue is almost unit elastic with respect to income.

3. CONCLUSION

This study aims to estimate the long run elasticity of the Personal Income Tax in Turkey in the period 1975-2005. This estimate is deemed to be important for formulating the government budgets and monitoring the progress of tax collections, for the specification of tax functions in terms of macroeconomic policymaking and for the automatic stabilizing properties of the tax system and for the public sector deficit during periods of growth in nominal income.

Tanzi's method, which is considered as the most attractive and famous of the existing approaches in the literature is used in this study. Our variables are income tax revenue, taxable income and total income. All of these variables are deflated by GNP deflator. We apply Augmented Dickey Fuller (ADF) and KPSS unit root tests to determine the time-series properties of our variables. These tests indicate that all our variables are integrated of order one and that Johansen cointegration tests can be applied.

Our results from Johansen trace and maximum eigenvalue tests for the period 1975 - 2005 show that personal income tax elasticity in Turkey is around 0.95, which is slightly lower than one. This can be interpreted as personal income tax revenue being unit elastic with respect to income. As real income increases, real personal income tax revenue increases almost by the same percentage.

This result also means that in the long run, specifically between the years 1975-2005, as real income in Turkey increased, real income tax revenue increased almost by the same amount. Increases in income did not led to *higher* increases in tax revenue. In this sense, increasing real income can be considered as insurance to maintain an equivalent increase in tax revenue to real income; however it does not seem to be the way to obtain tax revenues higher than increases in income. To be able to have "higher" tax revenue increases, government needs to pursue other policies in addition to promoting increases in income. This could be through changes in tax rates; such a policy change has been put into implementation in 2006.

This study provides an important step in analyzing the income tax system in Turkey. Further research on personal income tax should focus on personal income tax brackets and the income tax revenues corresponding to these brackets. Such an analysis would show how different tax rates and different income levels affect tax revenues. This actually is necessary to investigate the efficiency of the system and to be able to make sound policy recommendations for government fiscal policy.

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