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ABSTRACT

Global Reform of Personal Income Taxation, 1981-2005: Evidence from 189 Countries

In this paper we use a panel of 189 countries to describe the salient trends that have emerged in national personal income tax systems spanning the twenty five year period from 1981 to 2005. Using complete national income tax schedules, we calculate actual average and marginal tax rates at different income levels as well as time-varying measures of structural progressivity and complexity of national tax systems. We show that frequent alterations of tax structures have reduced tax rates at higher levels of income and diminished the overall progressivity and complexity of national tax systems; however, the degree of this change varies considerably across countries. We also find that the relationship between the tax rates and revenue is positive for high income countries; however, the strength of the relationship declines with weaker institutions and lower levels of economic development.

JEL Classification: C8, E62, H2, H87, N10, O1

Keywords: personal income tax, marginal rate, average rate, tax complexity, progressivity, flat tax, revenue, global trends

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1. Introduction

About one hundred years ago, Seligman (1908) observed that "the tendency toward progressive taxation is almost everywhere on the increase". However, income tax progressivity at the beginning of the 20th century was rather moderate by contemporary standards. The top personal income tax (PIT) rate in 15 surveyed countries hardly exceeded 10%. "The highest point known to history as actually enforced is thirty-seven and a half percent", which lasted only a year in Holland in 1796. Referring to this case, Seligman remarks "the progression was so severe as to become a confiscation".

By 1981, the 37.5% top PIT rate was no longer the highest historical point – 4 of every 5 country had the top PIT rate exceeding 37.5%, with the maximum of 90% in Iran. The GDP-weighted average top statutory marginal PIT rate was 62% among 108 countries. National PIT systems were frequently plagued by multiple tax schedules, complicated tax formulas, surcharges, numerous exemptions, and escalating highly-partitioned tax scales.

However, many governments made significant changes to their national PIT systems, since 1981. The GDP-weighted average top statutory marginal PIT rate fell from 62% in 1981 to 42.9% in 1991 and by 2005 reached a twenty five year low of 36.4%. There was also a sizeable drop in marginal and average PIT rates at higher levels of individual income and an overall decline in structural progressivity of the PIT systems. We observe a growing trend toward the use of one-rate flat personal income taxation[1] and find some evidence of the increased simplicity of several characteristics of the PIT structure. It is apparent that the current tax rates are lower while tax structures are flatter and, to a certain degree, simpler than they were 25 years ago.

[1] Although this trend is more popular among transitional countries at the moment, there is ongoing debate in other parts of the world about the merits of making the switch (Paulus and Peichl 2008).

This study adds to the taxation literature by providing a careful methodological documentation of the changes that have taken place in personal income taxation over the last 25 years. The analysis we provide is important for a number of reasons. First, the coverage of the analysis is unprecedented as we describe the changes that have taken place in almost 190 countries worldwide. Relying on such a large panel of countries means that the trends we describe are not likely to suffer from a sample selection bias. More importantly, we are able to document the variation in the personal income tax (PIT) evolution across countries at different stages of economic development.

Second, we calculate and analyze the time varying marginal and average tax rates at different points of the income scale. These tax measures represent a significant improvement over the commonly used top statutory PIT rate. The existence of deductions, allowances, tax credits, surtaxes, and local taxes means that there is often a big difference between the effective and statutory tax rates. This, along with excessive income inequality, implies that the top rate does not apply to most individuals in many countries. We address this issue by using more common levels of earned income in calculating tax rates and by making adjustments for deductions, allowances, tax credits, and other legal rules. As such, our tax rate measures are much closer to the actual rates that individuals are supposed to pay.

Third, the unique information we collected allows us to identify the long-term trends in such important features of national PIT systems as progressivity and complexity. Our progressivity measure is the progression slope of either average or marginal rates along the income scale, which is calculated for each country and year using 100 data points that are formed around the country's GDP per capita. This measure has been trending downward in every country category, with the exception of low income countries. We also summarize the trends in

several observable dimensions of the PIT complexity, including the complexity of allowances and tax credits, the use of multiple tax schedules, non-standard tax formulas, local taxes, national surtaxes, and the number of PIT brackets.

Fourth, the existing measures of PIT rates are generally available for a cross section of countries at a point in time or very short panels with limited time variation. Furthermore, the existing data sources usually under represent developing countries. The coverage and comparability of our tax measures go a long way in filling this gap. Because we rely on data from several sources, we are able to provide a greater level of consistency, both across countries as well as within country over time, than data from any one source. Having a long panel is also useful in identifying within-country dynamics of tax measures while controlling for constant cross-country heterogeneity. We use a simple growth model to illustrate how having a large representative panel of countries with consistent time-series may have a significant impact on the inference and policy conclusions regarding the effect of tax rates on economic growth.

Finally, we examine the relationship between the tax rates and collected revenue for a large subset of countries. The question we are interested in is whether the reduced rates and progressivity had a considerable negative effect on PIT collection. We find that the relationship between the tax rates and revenue is positive for high income countries; however, the strength of the relationship declines with weaker institutions and lower levels of economic development. The PIT rates do not seem to matter for revenue collection in countries with high levels of government corruption.

Admittedly, we ignore other components of the tax system such as taxes on corporate income, domestic consumption, and international trade. Accounting for changes in these other taxes is important when looking at the impact of the global reform on economic outcomes.

However, collecting and analyzing information on these additional components, while useful, would prove too monumental a task for one paper. We leave the analysis of other components to future research.

We begin by providing a quick overview of the data followed by an analysis of major global trends in personal income taxation, in particular, the high frequency of PIT changes, a ubiquitous decline in top statutory PIT rates, a downward movement in actual marginal and average rates at higher levels of individual income, increasing simplicity of national tax systems, decreasing structural PIT progressivity, and the emergence of flat rate tax schedules. This is followed by an analysis of the effect these changes may have had on PIT collection. We then discuss the sensitivity of estimation results to the size and composition of the sample of countries.

2. Data Sources and Sample

The data analyzed in the paper covers personal income tax structures in 189 current and former countries worldwide for the period 1981 to 2005.[2] As far as we know, this is the first panel study of this size that analyzes the historical changes that have occurred in personal income tax structures over the last 25 years.

Our dataset is comprehensive and contains the complete national PIT schedules with statutory rates, tax brackets, country-specific tax formulas, basic allowances, standard deductions, tax credits, multiple tax scales, national surcharges, and local taxes. This information allows us to compute several important variables including country's statutory rates, number of tax brackets, actual average and marginal tax rates at different points of income distribution, frequency of tax changes, and various measures of PIT progressivity and

[2] The number of countries ranges from 108 in 1981 to 180 in 2004.

complexity. In the following sections we give a detailed description of each variable, including definitions, computation methodology, summary statistics, and trend analysis.

This consolidated PIT dataset was assembled from more than 100 distinct reference books and datasets. Of these, the most important sources are the tax anthologies published by international accounting firms (e.g., PricewaterhouseCoopers, Coopers and Lybrand, etc.) as well as publications and datasets of international organizations (e.g., International Bureau of Fiscal Documentation, OECD, World Bank, International Monetary Fund, etc.) and public policy centers (such as University of Michigan's World Tax Database (WTD), Economist Intelligence Unit, Heritage Foundation, and Fraser Institute). A wide variety of data sources allows for significant cross checking, thus minimizing the amount of errors that one will inevitably encounter in a study of this magnitude. We made every effort to reconcile contradictory reporting to produce a consistent series for each country across time (see Appendix 1 for the description of sources and data reconciliation efforts).[3] Through careful cleaning of the data, we have assembled a valuable consolidated personal income tax resource for scholars doing cross-country empirical research.[4]

One notable advantage of this consolidated dataset is that it provides a level of world representation that has not been attained in previous studies of tax structures.[5] Our full sample includes 3613 top statutory PIT rates for 189 current and former countries from 1981 to 2005.

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[3] The following examples can give a sense of inconsistencies we dealt with. The Russian top PIT rate is coded as 90% in the 1990 WTD while this rate was applied only to the inheritors of book writers for honorariums received. We had to change this rate to the second highest rate of 60% charged on incomes from individual economic activity that was often performed underground. The top marginal PIT rate for Denmark rises from 22% to 68% in the 1988 WTD while in fact it drops from 73% to 68%. The reason for such a discrepancy is omitted surcharges and regional taxes prior to 1988 in WTD. Significant inconsistencies may affect the overall trends as well as bias the estimates in the behavioral models based on these data.

[4] This dataset is planned to be publicly released as part of the World Tax Indicators v.1 in 2009.

[5] Some of the largest samples in earlier studies include 51 marginal PIT rates from developing countries in 1984-1985 (Sicat and Vermani 1988) and 66 top PIT rates in 1980-1989 (Lee and Gordon 2005).

This is an average of 145 countries per year. Even in the case of highly data-demanding variables such as tax progressivity measures which require the complete tax schedule, we have non-missing values for 175 countries, or an average of 123 countries per year (from 75 in 1981 to 157 in 2002). To further highlight the representativeness of our sample, we note that 31% of the countries included are classified as high income countries, 18% as upper middle income, 30% as lower middle income, and 22% as low income countries.[6] These countries are located in all populated geographic regions and continents,[7] and they represent approximately 94% of the world population and 98.5% of the world output (or more precisely, 86% of the world GDP in current U.S. dollars in 1981, 89% in 1982, 97% in 1983-1988, and 98-99% in all subsequent years).[8]

3. Continuous Tax Reform

An examination of the dataset reveals a number of remarkable changes in personal income taxation over the last twenty five years. The first important observation is that tax rates, income thresholds, and the overall tax structures are continuously changing. The last column of Panel A in Table 1 shows that, on average, 45% of the countries in our sample change at least one element of their national tax scale (statutory rates or tax brackets) every year. Of these countries, about half make full changes by altering both rates and bracket thresholds simultaneously. The share of countries with full changes in PIT was particularly high in the late 1980s relative to other periods. We find very few cases where countries modify their statutory

[6] Country categories are defined using the World Bank country classification based on historical (time-varying) income thresholds. For example, the income thresholds used for the 2005 classification are as follows: low income, $875 or less, upper middle income, $876-$3465, upper middle income, $3466-$10725, and high income, $10725 or more.

[7] The regional breakdown is as follows: Africa – 48 countries, Asia and Oceania – 31, Central and South America – 35, Eurasia – 16, Europe – 43, Middle East – 12, and North America – 4.

[8] The major economies with missing PIT rates in the early 1980s are former USSR in 1981-1982 and Italy in 1981.

rates while maintaining old thresholds (2.7% of the sample). However, the share of countries that adjust tax brackets but keep their statutory rates the same increased significantly in the early 1990s moving from 15% in the 1986-1990 period to 21% in the 1991-1995 period. Changes of this nature might be an indication that countries are increasingly adjusting their tax schedules for inflation.

An investigation of these changes by country type reveals that national PIT scales are changing more frequently in developed countries (62% of countries in the respective category per year) followed by upper middle income countries (44%), lower middle income countries (42%), and low income countries (29%). The significant number of developed countries that went through major tax reforms in the late 1980s explains the spike in the share of high income countries with full changes in their tax scales during the 1986-1990 period (42.7%).

The difference between high and low income countries is especially striking with respect to the share of countries that alter thresholds but not rates. From Table 1 it becomes apparent that most of the low income countries do not adjust their tax brackets for inflation over the whole considered period.[9] This is also true for the middle income countries in the 1980s. Without such inflationary adjustments, the tax structure may become less equitable if taxpayers are being pushed into higher tax brackets with no accompanying increase in real income. This is known as the "bracket creep" effect. Even if top statutory PIT rates are falling, the core taxpayers may actually experience an increase in marginal rates in an inflationary environment that is commonly present in less developed economies.

Apart from the inflationary adjustments, another explanation for continuous changes in tax rates and brackets could be that countries are simply attempting to identify the best tax

[9] The slow adjustment of tax brackets to inflation in low income countries is likely to be related to widespread evasion, weak enforcement, and little revenue collected from personal income tax.

structure. Identifying the best tax structure, however, is a normative matter, which can affect the changes in different ways. Countries that are concerned about equity, for example, may want to increase their tax rates while those more concerned about efficiency may reduce them. Whatever the motivation behind the high frequency changes, however, one might expect some negative feedback for efficiency. This follows from the fact that a constantly changing tax schedule adds uncertainty to the tax system which is likely to increase complexity and reduce efficiency.[10]

The important question for us is whether these changes are simply transitory in nature or is there some well defined direction of change. If changes are being made on the grounds of efficiency, then one may expect persistent trends to develop over time as countries try to improve the efficiency of their tax structures by reducing rates. The remainder of the paper will give a detailed analysis of the resulting trends that have developed over time.

4. Top Statutory PIT Rates

One of the frequently cited variables of any income tax system is the top statutory personal income tax (PIT) rate. This is a legally determined marginal tax rate applicable to the top bracket of the income tax schedule. This particular tax rate has occasionally been used in empirical cross-country research as a proxy variable for tax progressivity or as a way of assessing the overall excess tax burden (e.g., Johnson, Kaufmann, and Zoido-Lobaton 1998, Friedman *et al*. 2000, among others).

Figure 1 illustrates how the average top statutory tax rate has dropped considerably over the last twenty five years. This decline was especially pronounced for the GDP-weighted trend

[10] Constantly changing features of the tax schedule cause individuals to be uncertain about their tax liability and thus increase compliance and administrative costs (Slemrod 1992).

which is more representative of the world economy.[11] One interesting observation is that the most dramatic change occurred during the late eighties and early nineties. The weighted average top statutory PIT rate fell from a high of 62% in 1981 to 56% in 1986. During the ensuing eight year period (1986 - 1993), however, the PIT rate plunged by approximately 16 percentage points. The PIT rate then increased by a modest 2 percentage points before resuming its downward trend in 1996. Since then, the decline has continued, with average top statutory rates sliding a further 6.5 percentage points over the next 10 years. Together these changes represent a sizeable 41.2% decline in the weighted top PIT rate from a high of 62% in 1981 to a low of 36.4% in 2005.

Further evidence in support of the worldwide downward trend is reported in Table 2 where we observe that only 17% of unweighted top PIT rates were in excess of 40% in 2001-2005 compared to over 71% during the early 1980s. The share of countries with top PIT rates in excess of 60% plummeted from about a quarter in 1981 to less than 1% in 2005. The lower non-zero rates (1% to 40%), on the other hand, became more popular as the percentage of countries falling into these categories increased from approximately 15% to over 73% between 1981 and 2005.

The reader will notice that there are two changes in the weighted PIT trend that align perfectly with well known tax changes in the U.S. These are the 1986 and 1993 tax reforms which reduced and increased the top PIT rates respectively. The weighted top PIT rate fell by approximately 6 percentage points between 1986 and 1987. Similarly, the 2 percentage point increase in the top PIT rate between 1993 and 1994 coincides with the U.S. Budget Reconciliation Act enacted in August 1993. This casual observation would imply, incorrectly, that the larger countries, as measured by GDP, are driving these trends with little or no change

[11] The values are weighted by gross domestic product measured in 1990 U.S. dollars. Underlying numbers are reported in Appendix Table A1.

taking place elsewhere in the world. However, the summary statistics presented in Table 3 and Figure 2 show clearly that the changes are ubiquitous. From Table 3, for example, we are able to highlight that each country category experienced a significant decline in the GDP-weighted top PIT rate. The greatest decline was among the upper middle income countries, followed by low, lower middle and high income countries respectively. By 2005, upper middle income countries had the lowest top PIT rates on average. The downward trend remains statistically significant after controlling for country fixed effects and accounting for serial correlation.

While the evidence in Panel A proves that the downward movement in top PIT rates was universal, the trend coefficients in Panel B also suggest that the major changes appear to be sequential. What started as top tax rate cuts in high income countries during the early and mid 1980s was spread to middle income countries during the late 1980s and early 1990s before eventually reaching low income countries in the late 1990s.

5. Actual Marginal and Average PIT Rates

The top statutory PIT rate is generally quoted in impressionistic comparisons of national income tax schedules, and, in particular, as a proxy for the tax burden in some empirical research. In a sense, it is easy to see why this rate is so widely used, as it is potentially the maximum marginal tax rate facing the wealthiest taxpayers. However, the top statutory rate in less developed economies is often irrelevant to the majority of domestic high earners and entrepreneurs, with the exception of the small number of expatriates and wealthiest local elite. For example, in high income countries the top statutory PIT rate is applicable, on average, to the level of income equivalent to the triple of a country's GDP per capita. In contrast, the ratio of the top threshold to a country's GDP per capita is about 18 in upper middle income countries, 47 in lower middle income countries, and 83 in low income countries. Thus, it is important to

examine the trends in PIT rates at other points of the income distribution that are more relevant to the majority of population. The problem though, is that it is practically unfeasible to find the actual income distribution for the large number of countries over the 25-year period. As an alternative, we use a country's GDP per capita and its multiples as a comparable income base. For example, for each country in our sample, we can calculate the marginal rates for the level of individual income equivalent to 1, 2, 3, and 4 times GDP per capita by using the national PIT scale.[12]

In addition to having rates at different levels of individual earnings, our data also allow us to calculate the actual marginal tax rates that are generally more preferred to the statutory rates dictated by national tax schedules. It is not unusual for these two rates to differ significantly. A local tax, national surtax, or additional tax schedules can raise the actual marginal tax rate above the officially stated rate. Personal deductions and tax credits, on the other hand, can lower the actual marginal tax rate below the legal rate. To estimate actual marginal tax rates for each country in our sample, we first calculate taxable income for 100 different levels of pre-tax income that are evenly spread in the range from 4% to 400% of a country's GDP per capita. Taxable income excludes standard deductions, basic personal allowances, and employee/wage allowances, which are unconditionally applicable to all single, employed taxpayers.[13] Next, we apply the tax schedule and, whenever relevant, particular tax formulas to the taxable income in

[12] This approach was also used by Sicat and Vermani (1988) in comparing marginal rates across 51 developing countries.

[13] We use the rates for single taxpayers in calculating taxable income to preserve comparability across countries and because most of countries have individual-based tax systems. Some countries, like the U.S., Germany, Zimbabwe, have income tax systems based on the combined family income. However, because the number of countries with separate rates for married individuals is small in our data (8 to 12 in various years), it is unlikely that using rates for married taxpayers would alter the aggregate trends.

order to compute the tax liability for each income level.[14] The tax liability also includes local taxes and major national surtaxes if altogether they exceed 5% of the taxable income.[15] The final tax liability figure is adjusted by subtracting the tax credits that are universally applicable to single taxpayers. Finally, the actual marginal rates are calculated as Δ *tax liability* / Δ *income* for each of the 100 values of gross income.[16]

Using tax liability figures, we also compute the average tax rate as the ratio of total tax liability to gross income for each level of income. It is important to emphasize that the average rate is the tax rate that the individual taxpayers face or are supposed to pay under current tax laws, not the rate they choose to pay by means of underreporting their income. As such, the average tax rate gives an upper bound on the effective rate paid by individuals under the PIT.

Figure 3 shows that in any given year the marginal rates are higher than their respective average rates and that both average and marginal rates increase with the level of income. These are the two main indications that the personal income tax structure for most of the countries remains progressive. More important for the current discussion, however, are the observed trends for the various rates. Irrespective of the rate chosen, one observes a clear downward trend over the sample period. Furthermore, all of the variables show that the greatest downturn in the

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[14] In most cases, we apply the standard formula for calculating tax liability, $T=(Y-Y_r)*t_r+R$, where Y is taxable income, Y_r is the largest bracket less than Y, R is the tax liability if taxable income were equal to Y_r and t_r is the marginal tax rate for the r^{th} bracket. However, in 418 country-year cases we had to use non-standard country-specific procedures in computing tax liability. Countries may have local taxes and multiple surtaxes, an additional schedule for salaries (Egypt, Senegal, etc.), or non-standard tax formulas (e.g., Cote d'Ivoire, Denmark, and Germany). For example, federal tax liability in Denmark is calculated as $T= Y*t_0+(Y-Y_1)*t_1+(Y-Y_2)*t_2$, where t_0 is the bottom rate, t_1 is the middle rate, t_2 is the top rate, Y_i is the threshold for each rate and the combined top marginal rate is limited to 59% as of 2008.

[15] The methods used to incorporate local taxes vary from using simple average rates (e.g., Denmark, Finland, and Sweden) to applying separate local tax schedules such as in Canada (Ontario), Japan, and Switzerland (Zurich).

[16] For the level of gross income equivalent to a country's GDP per capita, actual and statutory marginal rates are approximately the same in 66% cases (within one percentage point deviation), the statutory rate is greater in 29% cases, and it is less in 5% cases. The similarities between actual and statutory rates tend to increase with the level of gross income.

tax rates took place during the mid to late eighties, with a consistent but moderate decline in the subsequent years.

Also important to note is that there is some amount of convergence between the actual rates for higher and lower income levels. That is, while both high-income rates and low-income rates trended downward throughout the sample period, the high-income rates (for the income corresponding to quadruple of a country's GDP per capita) fell at a much faster rate. For example, marginal tax rates (MTR) at y, where y denotes GDP per capita, fell by -0.49 percentage points per year whereas MTR at $4 \cdot y$ went down by -0.76 percentage points per year; the difference in the rates of decline is statistically significant at all conventional levels of significance. A similar convergence result is obtained with respect to the annual decline in average rates (-0.32 percentage point decline at y vs. -0.57 at $4 \cdot y$). This apparent convergence could be an indication that the tax reforms have reduced the progressivity of income tax structures that we examine further below.

Thus, if we take a worldwide weighted average, we observe a tendency of national tax systems toward lower actual marginal and average PIT rates at different points of the generated income distribution, and this tendency seems particularly strong at the higher levels of individual earnings. The unweighted trend is also negative and statistically significant even after controlling for country time-invariant heterogeneity and serial correlation (Table 4, Panel B). While it is true on average, this conclusion does not hold for the poorest countries. In Table 4 we report the estimated trend coefficients by country category at four income levels. High and upper middle income countries have declining actual PIT rates over the 25-year period. In concordance with an earlier observation, the decline in both marginal and average rates was stronger for higher levels of individual earnings. Perhaps the most interesting result in Table 4 is

that the least developed countries had either no change or an increase in rates throughout the sample period. These results are not that surprising in light of the evidence presented in the previous section on the frequency with which the PIT structure changes. Since the low income countries make very few changes to their bracket thresholds and experience much higher inflation than the other groups of countries, it is predictable that the actual rates are increasing over time, especially for the upper middle class.[17] Households with below median income are often not liable (and not able) to pay any taxes because their income is generally lower than the first tax threshold. Therefore, entrepreneurs and high skilled workers are most likely to be victims of the increase in average and marginal rates in the poor countries.[18]

Thus, the trends discussed so far make it clear that the observed downward movement in actual PIT rates is influenced significantly by more developed economies.

6. Trend Toward Simplicity

In this section, we show that in addition to the downward trend in statutory and actual PIT rates, there has also been a consistent drive toward PIT simplicity among the countries of the world. Having a complex tax structure is costly as it is likely to encourage tax evasion and unofficial economy transactions. There are also direct social costs imposed on the society by having a complex tax system, including the costs of filing the returns (both time and monetary), efforts to calculate deductions and allowances as well as other efforts to reduce taxable income. Slemrod and Sorum (1984) show that these direct costs were very high for the U.S. PIT system

[17] We found a positive correlation between the number of years since last change in brackets and the change in upper average and marginal tax rates (ATR and MTR at 3.*y* and 4.*y*), and that this correlation increases with the inflation rate. This finding supports the "bracket creep" explanation of increasing average and marginal rates in an inflationary environment.

[18] Higher rates on entrepreneurs could be detrimental to productivity growth and discourage saving and domestic investment. Instead, high earners find ways to avoid saving and domestic investment through immigration, money hoarding, spending money on luxury imported items, and investing abroad (Hall and Rabushka 1985).

in 1982 consuming approximately 5–7% of tax revenues generated in that year. There is also a tradeoff between simplicity and other characteristics of the tax structure. This is true especially where efforts to distinguish among taxpayers in achieving a more equitable distribution increases the complexity of the tax structure (Slemrod 1992). Therefore, the trend in complexity is important since it has implications for both equity and efficiency.

Measuring the extent of complexity in a tax system is extremely difficult, especially in the cross-country setting. We recognize that our cross-country analysis cannot account for many important dimensions of tax complexity such as clarity of tax laws and regulations, costs of tax planning and paperwork, time needed to submit declarations, number of exemptions and itemized deductions, and other analogous factors, which are hard to measure even for one country, much less for many countries. It is virtually impossible to collect time-varying data on these factors for our sample; 189 countries for 25 years. Despite these limitations, our discussion does provide useful and comparable cross-country information on several key dimensions of PIT complexity that we are able to quantify for a large number of countries.

Among those dimensions are the complexity of allowances and tax credits, multiple tax schedules, non-standard tax formulas, local taxes, national surtaxes, and the number of PIT brackets. Having no allowances, for example, is considered to be less complex than having allowances, while having allowances that depend on the spouse's employment participation is considered more complex than having a standard allowance.[19] Similarly, having a single PIT schedule is simpler than having multiple schedules since a single tax schedule eliminates any

[19] Personal allowances and tax credits are considered standard if they are applicable to the taxpayer, spouse, and/or children without any restricting conditions (such as age, children being at school, spouse not working, etc.).

confusion as to which schedule individuals should use when filing their tax returns.[20] Non-standard formulas for tax computations also add to the tax complexity as they often require extra rules, regulations and definitions to make these formulas work (footnote 16 gives an example of non-standard tax formulas). National surtaxes and separate local/provincial PIT rates are other obvious factors contributing to complexity. Finally, the excessive partitioning of personal income into multiple tax brackets is often associated with larger administrative and information costs and may create additional incentives for manipulating taxable income to move down the graduated scale.[21]

Table 5 provides summary statistics for the above indicators of PIT complexity. We see that 53% of countries had non-standard allowances or tax credits in the first five year period of the sample, but this number decreased to 40% in the last five year period. The largest changes took place in the first two periods where the share of non-standard allowances fell by 9% and 14% respectively. There is also a noticeable decline in the use of surtaxes and high local tax rates (defined as 5% of taxable income or greater) and a corresponding increase in the use of low local tax rates. Likewise, the percentage of countries using non-standard tax formulas fell by 10 percentage points or over 50% between 1981 and 2005. Unlike the other components, the use of multiple schedules increased slightly between the first and second period before also showing a steady decline from 22% in the second period to 17% in the last.

Results in Table 5 also indicate a significant cross-country variation in the characteristics of the PIT systems. From the probit estimates in Panel B, we see that high income countries are

[20] Multiple tax schedules include, but not limited to, alternative minimum tax as well as schedules that depend on occupation, industry, location, marital status, and other characteristics of a resident taxpayer.

[21] The large number of brackets makes it difficult for taxpayers to know their marginal tax rate and hence to make more informed decisions (Slemrod 1992). It also increases the incentives of taxpayers to play around the multiple thresholds in attempt to move down the graduated scale.

more likely to have non-standard allowances and tax credits, high local taxes, and non-standard tax formulas. Low income countries, on the other hand, have a higher likelihood of using multiple tax schedules, imposing low local taxes, and using standard allowances and tax credits. The downward trend depicted by the probit estimation is consistent with the above discussion of the mean values by period. Panel C of Table 5 reports the estimated trend coefficient from the linear probability model that controls for country fixed effects and accounts for arbitrary serial correlation. While the overall trend remains negative, it becomes statistically insignificant for three indicators (surtaxes, high local taxes, and multiple tax schedules) that could be due to limited within-country variation in these measures.

From Table 6, we find that approximately 50% of the sample had more than 10 tax brackets in the 1981–1985 period with approximately 9% having more than 20 brackets, up to 68 in Guatemala. This is in comparison to 5.5% and 0.4% in the 2001-2005 period, respectively. While the 6-9 range gained marginally, increasing by a total of 3 percentage points, the 1-3 and 4-5 ranges became the norm. As of 2005, approximately 55% (23% and 32% respectively) of countries fell into these ranges, while the zero range experienced a decline of approximately 5 percentage points. Both unweighted and GDP-weighted trends in Figure 4 indicate that the steep decline in the average number of tax brackets was worldwide. Although there was significant variation in the number of brackets at the beginning of the sample period, the average number of brackets since 1995 has remained around 4-6 for all country categories.

Thus, we find that the observed indicators of PIT complexity have exhibited downward trends over the last quarter century. The steep drop in the average number of tax brackets, the

gradual elimination of surtaxes, and the dwindling use of multiple tax schedules, non-standard allowances and tax formulas has moved countries toward simpler PIT structures.[22]

7. Structural Progressivity

The evidence so far shows that there has been a significant shift towards more simple income tax structures and lower tax burden, especially at the top of the income distribution. These changes can justifiably be assumed to have a negative effect on the structural progressivity of the income tax system. The term *structural progressivity* is introduced by Musgrave and Thin (1948) to denote changes in the calculated (nominal) tax burden along the income distribution, as opposed to the *effective progressivity* that depicts changes in actual income inequality.

In this study, we focus on the structural progressivity of personal income taxes. We believe that the measures of structural progressivity are particularly useful in determining the effect of legal changes in PIT schedules on growth, evasion, income inequality, and other important outcomes. Unlike structural progressivity, effective progressivity is directly derived from collected revenues and existing income distribution, which makes the identification of the causal effect of the effective progressivity on the outcomes from which it is derived highly problematic. Additionally, the data requirements of our approach are far less demanding than some of the existing approaches that calculate effective tax rates (Easterly and Rebelo 1993, Mendoza, Razin, and Tesar 1994).[23]

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[22] Transition to simpler income tax systems does not necessarily imply the drop in the cost of compliance and tax administration. The costs may increase even if there is a reduction in complexity (Blumenthal and Slemrod 1992, Tran-Nam, Evans, and Walpole 2000).

[23] Full implementation of Easterly and Rebelo's (1993) method requires data on income distribution, statutory tax rates, and actual tax revenues collected. Assumptions about the tax function, the income distribution, and the level at which taxes are paid are also required (e.g., taxes are assumed to be paid at the household level and that each household has 5 members). Only 32 countries were included in their analysis due to data requirements. Although Mendoza *et al*. (1994) rely on fewer parametric assumptions, their approach also requires data that are not readily available for many countries. Detailed data on national accounts (e.g., wages, consumption, operating surplus of the

To assess the structural PIT progressivity for each country in the sample, we calculate the marginal rate progression (MRP) and average rate progression (ARP). Unlike Musgrave and Thin (1948), whose progressivity measures vary over the income distribution, we develop a single, comprehensive measure for each country using the following procedure. First, we compute marginal and average rates for each country and each year at 100 different levels of pre-tax income that are evenly spread in the range from 4% to 400% of a country's GDP per capita (the calculation process is described earlier in the text). These variables are then used to construct marginal and average rate progression indices (MRP1 and ARP1, respectively) by regressing marginal (or average) rates on the log of gross income. For example, ARP1 for Canada in 2005 is the estimated slope coefficient from the regression of average tax rates in 2005 on the log of gross income using 100 data points that are formed around Canada's GDP per capita. The tax structure is interpreted as progressive, proportional or regressive if the slope is positive, zero, or negative, respectively. Thus, in order to get a single, comprehensive measure, we had to impose a linearity restriction on the relationship between rates and income levels. In an effort to capture some nonlinearity of these measures, we also calculate MRP2 and ARP2 for the middle portion of income distribution in the range from 100% to 300% of a country's GDP per capita.

Table 7, Panel A provides the GDP-weighted means of the progressivity measures over the sample period. We observe that both progressivity measures were positive for the full sample period indicating that the tax structures remain progressive despite many reforms. It is also shown that structural progressivity declined over the sample period. We note, for example,

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economy, etc.) and tax revenues (for different sources and at different levels of government) are needed to calculate their effective tax rates. Besides the fact that these data are not available for many countries and years, comparability across countries remains an issue where the data are available. In fact, the authors initially calculated their tax measure for G7 countries only and later included 11 additional OECD member countries.

that MRP1 fell from 9.98 in 1981-1985 to 6.96 in 2001-2005, while the ARP1 fell from 8.01 in 1981-1985 to 5.46 in 2001-2005. When examined on a period basis, in Table 7, we observe a noticeable decline in all progressivity measures throughout the late 1980s and early 1990s. This is consistent with our earlier discussion which highlighted these years as periods of significant tax reforms. Panel C shows that after accounting for country fixed effects and serial correlation, the average within-country trend for progressivity measures stays negative and for the most part statistically significant, with the exception of MRP2 that has large standard errors.

We also note that the structural progressivity of the income tax system is smaller in the middle of the income distribution (MRP2 and ARP2) than for the broader distribution (MRP1 and ARP1), thus confirming the non-linearity of the progressivity measures.

Along with the average worldwide trend toward lower structural progressivity, we also observe significant variation in the progressivity dynamics across country type. Panel B in Table 7 shows that countries that experienced the strongest decline in the progressivity measures belong to the high income and upper middle income categories. The downward trend slope is much smaller in lower middle income countries, and the trend is positive and statistically significant in the poorest developing economies. This result is not surprising given our earlier finding of an increase in actual tax rates at the top of the distribution in low income countries.

Thus, data analysis points to personal income tax schedules becoming increasingly flatter over time.[24] Whether these changes translated into lower or higher effective progressivity (and associated income inequality) remains an open question. The relationship between structural progressivity and effective progressivity is quite complex. In theory, it is possible for structural

[24] This trend is not limited to the personal income tax. In fact, evidence suggests that corporate income tax schedules are also flatter now than they were in the past. The share of countries with progressive corporate income tax schedule declined from 32% in 1981 to just 12% in 2005. Furthermore, despite some modest variation across countries, consumption taxes are generally administered at a single flat rate.

and effective progressivity to move in opposite directions following changes in tax rates. Musgrave and Thin (1948) showed that a shift to a higher revenue-yielding tax structure that maintains the same level of average rate progression at all points of the income distribution will cause effective progression to increase. Furthermore, if the tax reform increases productivity and reduces tax evasion, then a reduction in *structural* progressivity may actually result in higher *effective* progressivity, and hence greater equity, assuming that the redistribution of the increased tax revenues is progressive or pro-poor. But even when redistribution from rich to poor does not occur, lower taxes on the rich could in principle decrease true net income inequality if the share of hidden income among the rich is large while the elasticity of true income/productivity is small relative to the elasticity of hidden income with respect to tax changes (Duncan and Sabirianova Peter 2008).

While we focus on personal income taxes, it is also important to acknowledge the role of other taxes in determining the overall effective progressivity of the tax system. Changes in other aspects of the tax system can either reinforce or offset the equity implications of the fall in PIT progressivity that we document. For example, developing countries have increased their reliance on consumption taxes while reducing their dependence on tariffs over the period of our study (Bahl and Bird 2008). Because consumption taxes are known to be regressive, the net effect of these changes on effective progressivity is likely to be ambiguous for low income countries; recall that PIT progressivity increased for the poorest developing countries. The scientific assessment of how reduced PIT structural progressivity may have contributed to the overall effective progressivity requires detailed micro-level analysis, which is difficult to implement on a large cross-country basis due to significant data requirements.

8. Flat Tax Revolution

The outmost case of zero (or near to zero) structural progressivity deserves special consideration. It occurs when a country has either no tax[25] or a one-rate flat tax that is not dependent on where an individual falls in the income distribution. The case of the flat personal income tax rate is particularly interesting as the number of countries introducing the flat tax rate is rapidly growing in recent years.[26] The flat tax rate may or may not be accompanied by an allowance or an additional zero-rate threshold, which could make progressivity measures different from zero.

Only 1.6% of countries had flat rate income tax schedules during the 1981-1985 period. This number doubled to 3.67% over the next ten years and almost quadrupled to 6.23% by 2001-2005. By 2005, fourteen countries worldwide have adopted the one-rate personal income tax, eleven of which are middle income countries.

While still in its early stages, the trend toward flatter taxes continues to gather strength as the list of countries adopting the flat tax expands. Since 1994, for example, when Estonia adopted the first flat tax in Europe, Georgia, Latvia, Lithuania, Russia, Romania, Slovakia, Ukraine, and Serbia have all adopted flat tax rate schedules. This group has increased to 21 by 2008, as seven more countries (Albania, Kazakhstan, Kyrgyzstan, Mongolia, Montenegro, Poland, and Republic of Macedonia) introduced the flat PIT rate in 2007-2008.

Despite the increasing popularity of the flat rate, there continues to be significant debate among countries about the merits of making the switch to a flat tax. Gorodnichenko, Martinez-

[25] The number of countries with zero tax was relatively stable throughout the sample period, between 15 and 17 countries. These countries include some of the oil countries (e.g., Brunei Darussalam, Saudi Arabia, United Arab Emirates, etc.) and famous offshore islands and tax heavens (e.g., Bahamas, Bermuda, British Virgin Islands, Cayman Islands, etc.).

[26] It should be noted that the flat PIT rate is not a pure flat consumption tax as outlined in Hall and Rabushka (1985). Different rates may still apply to capital gains and business income. The presence of deductions in some countries means that the 'flat' PIT rate may not be proportional.

Vazquez, and Sabirianova Peter (2009), for example, show that the Russian flat tax reform led to a significant decline in tax evasion, but only to a small increase in productivity. This study concludes that such reforms could be useful in countries experiencing large tax evasion but the governments should not expect a large productivity response. It could explain why flat tax reforms are especially popular among former socialist countries that are plagued by large shadow economic activities. Although there is a need for more work on the equity and efficiency effects of the flat tax, it is reasonable to conclude that the long term trend towards lower tax rates and broader tax bases may be entering a new era of change where countries move away from their conventional stair stepped progressive income tax schedules to simpler, flatter tax structures.

9. PIT Rates and PIT Revenue

Having examined the major trends in personal income tax rate structure, the natural follow-up question is whether and how these changes influenced collected PIT revenue. Since tax revenue is the product of the tax rate and tax base, determining what happened to collected revenues implicitly tells us what happened to the tax base. Our objective in this section is 1) to establish the trend in PIT revenue over the sample period, and 2) to examine the relationship between PIT revenue and our tax measures.

Existing, but limited, data show almost no change in the share of PIT revenue in GDP over time. From Panel A of Figure 5, we observe that the total PIT revenue as a share of GDP for OECD countries has been trending slightly downward but stayed in the range of 9% to 11% throughout the 1981-2005 period. A similar pattern is observed in Panel B of Figure 5 where we report the trend in the PIT revenue of the central government as a share of GDP for both

developed and developing countries.[27] High income countries display a slight downward trend in the PIT/GDP ratio, which stays in the range of 6% to 8%. This is about two thirds of the PIT revenue share for the general government that includes both central and local/state/province governments. In developing countries, the central government PIT share in GDP does not have a visible trend and has an average range of approximately 1 percentage point for each of the upper middle, lower middle and low income country groups.[28] Similar to previous studies, we find that the PIT/GDP ratio is significantly higher in more developed countries.

A more rigorous analysis of these trends is provided in Table 8 where we report the trend coefficients for PIT and total income tax revenue to GDP ratios. While the pooled OLS results show a statistically significant decline over the sample period, we find no evidence of a trend in both ratios when we include country fixed effects. Given the overall decline in average PIT rates described above, one implication of these results is that the PIT tax base increased over time. However, there appears to be some differences across country groups for PIT revenue (but not for total income tax revenue). In particular, we find evidence of a statistically significant within-country decline in the PIT/GDP ratio for high income countries (the coefficient on *Trend* in column 3). Lower middle and low income countries, on the other hand, have a modest upward trend after controlling for country fixed effects. These results are very interesting in light of the changes in PIT rates described in sections 4 through 7. In fact, the trends seem to imply that the

[27] The data used in Panel A are from OECD.Stat for about 25-29 countries per year. Panel B uses data from the International Monetary Fund's Government Financial Statistics for non-OECD countries and OECD.Stat for OECD countries for 59-80 countries per year.

[28] The ranges are 2%-3%, 1.7%-2.8%, and 0.7%-2% for upper middle, lower middle and low income countries, respectively. These results are consistent with findings elsewhere in the literature. For example, Bird and Zolt (2005), looking at the period 1981 to 1992 for OECD, African, and Asian countries, find similar evidence; personal income tax as a share of GDP did not change much. Using IMF Government Finance Statistics for 28 developing countries, Alm and Wallace (2006) report a small increase in PIT collections from 1.9% of GDP in 1986-1988 to 2.5% of GDP in 1996-1998.

lower PIT rates are associated with lower PIT revenue in high income countries and with higher PIT revenue in low income countries.

We explore this finding further by regressing the PIT/GDP ratio on selected tax variables, including the top rate, average and marginal rates, and PIT progressivity measures. The results with country fixed effects are reported in Table 9. Since PIT collection may influence which tax rates countries choose, the endogeneity of tax rates does not allow us to make any causal interpretations. Still, the estimates of within-country correlation between tax variables and PIT collection are quite informative. Panel A shows that there is a positive and statistically significant relationship between all our tax variables and the PIT revenue share. More interesting are the results in Panel B where we interact the tax measures with country category to see how the relationship varies with the level of economic development. The estimates imply that the PIT revenue share and tax rates move in the same direction in developed countries. However, the interaction terms of tax variables with other country categories are all negative though not always statistically significant when standard errors are clustered by country. For poor countries, we find that the interaction effect cancels out the main effect of the top PIT rate, marginal tax rate at income equivalent to four times GDP per capita, and both progressivity measures (MRP1 and ARP1). That is, the PIT revenue share is not found to be positively associated with higher marginal rates and progressivity measures in low income countries.

These results do raise additional questions. The most obvious being why is there such difference in the relationship between PIT rates and PIT revenue across country types? The following decomposition may help to answer to this question. Suppose R/Y is the share of PIT revenue in GDP, where revenue, R, is the product of the PIT base, B, and the average PIT rate, τ. Then, the response of the PIT/GDP ratio to changes in the tax rate can be written as:

$$\frac{\partial(R/Y)}{\partial\tau}=\frac{\partial(B(\tau)\cdot\tau)/Y(\tau)}{\partial\tau}=\frac{1}{Y^2}\left(Y\left(B+\tau\frac{\partial B}{\partial\tau}\right)-B\tau\frac{\partial Y}{\partial\tau}\right)=\frac{B}{Y}\left(1+\overset{(-)}{\in}_{B\tau}-\overset{(-)}{\in}_{Y\tau}\right), \qquad (1)$$

where $\in_{B\tau}$ and $\in_{Y\tau}$ are the elasticities of the PIT base and GDP in response to the tax rate, respectively. Equation (1) implies that the larger is the PIT base relative to GDP, the stronger is the response of PIT revenue to tax changes. Therefore, one possible explanation for the observed weak relationship between the tax rate and PIT revenue in developing countries is that their PIT base is small relative to their GDP. This, in turn, could be due to legal rules restricting taxable income, but more likely due to significant informal sector activities. Given that the tax base, by definition, does not include unreported income while GDP often accounts imperfectly for some portions of the informal sector (especially since adopting the 1993 System of National Accounts), the ratio of the tax base to GDP is likely to be inversely related to the size of the shadow economy.

However, we should not discount the importance of the second term in equation (1), $\left(1+\in_{B\tau}-\in_{Y\tau}\right)$. The difference in the responsiveness of the tax base relative to the responsiveness of GDP is another possible reason for the cross-country differences observed in Tables 8 and 9. In other words, tax induced behavioral responses may vary across countries in systematic ways that then lead to the observed trends.

Conventional wisdom in the taxation literature is that timing and accounting-form responses of the tax base are generally larger than real responses (Slemrod 1990). This is supported by recent evidence that the productivity response to the Russian flat tax reform was small relative to the compliance response (Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter 2009). If the tax base contracts more sizably relative to GDP in reaction to higher tax rates due to a large evasion response, as is probably the case in countries with substantial informal

economies, then the absolute difference between the elasticities in equation (1) becomes positive, $\left|\in_{B\tau} - \in_{Y\tau}\right| > 0$, thus reducing the responsiveness of the PIT/GDP ratio to tax rates. Again, we see the link between the large size of the shadow economy and the weak response of the PIT revenue share to tax changes.

While we cannot perform the formal testing of this hypothesis, we can check if the responsiveness of the PIT revenue share to tax rates declines with weaker institutions and, in particular, with the level of corruption that is likely to be correlated with the size of the informal sector. The results, reported in Panel C of Table 9, show that the relationship between the tax rate and PIT/GDP ratio is positive and statistically significant for countries with very low corruption, but the relationship significantly weakens with higher levels of corruption. These results imply that the size of the informal sector may have contributed to the observed weak relationship between the PIT revenue and the tax rate in developing countries.

10. Importance of Large Representative Samples

We pointed out earlier that one of the contributions of our study is the extensive coverage we provide across time and countries. Most existing studies looking at the effect of taxes on economic outcomes tend to focus on a small group of countries (e.g., OECD countries) and thus may suffer from sample selection issues. Our study addresses these issues by providing a dataset that is both representative and highly comparable. In this section we provide a simple analysis that highlights the importance of having a large representative sample. We also show that the changing composition of our sample over time has no effect on the trends discussed so far.

Year to year changes in the number of countries are unavoidable in long panels like ours. These changes are mostly due to 1) the lack of data in early years for some countries, and 2) the formation of new countries and the dismantling of old ones. The former mainly affects

developing countries while the latter applies primarily to transitional countries that emerged following the breakup of communism in the early 1990's.[29] The number of countries per year in our sample starts at 108 in 1981 and steadily increases up to a max of 180 in 2004, with the total number of covered countries being 189. Even at 108 countries, our initial sample is highly representative and accounts for approximately 86% of world GDP. The 1981 sample also represents every geographical region of world, and all World Bank income groups.[30] Nonetheless, it remains informative to examine the impact, if any, of these changes on the trends over time. We test for any such effects by estimating the trend coefficient on tax variables using only the initial set of countries and comparing the results with those obtained using the full sample. Any compositional effect should show up as the difference between these two trend coefficients. The results in Table 10 show that there is no statistically significant difference at the 5% level in the estimated trend coefficients and hence no compositional effect.[31] These findings imply that we can be confident that the results we document in the previous sections are not influenced in any significant way by changes in the number of countries over time.

In addition to the compositional effect, we also emphasize the importance of having a large representative panel of countries. Sabirianova Peter (2008) demonstrates that using panel data methods on a sample of 170+ countries switches the sign of the effect of various tax variables on the size of the shadow economy from negative in OLS to positive and highly

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[29] We gathered tax information on countries before and after they breakup to form new countries. For example, our dataset includes information for the USSR from 1983 up to its breakup in 1991. Data is then collected for all 15 new countries formed after the breakup for the remainder of our sample. Other countries that went through breakups are treated similarly, e.g., Czechoslovakia, Yugoslavia, and Ethiopia (with Eritrea included).

[30] The 1981 sample includes 19 African, 22 Asian/Oceanic, 29 Central/South American and Caribbean, 20 European, 9 Mid East and 4 North American (includes Bermuda) countries. Additionally, we have 31, 18, 38 and 15 High, Upper Middle, Lower Middle and Low Income countries, respectively, in the 1981 sample.

[31] We find statistically significant differences between the trend coefficients at the 10% level only for MRP1 in OLS estimations. In all other cases (including all FE estimations), the trend slopes estimated on the 1981 sample (108 countries) are not statistically significant at the 10% level from the trend slopes estimated when all countries are included. The results for other tax variables are similar and not reported.

statistically significant in fixed effect models. In this paper, we illustrate the importance of large representative samples in the context of a simple GDP growth model.[32] We estimate the effect of the top PIT rate on the growth of GDP using several alternative data sources (University of Michigan WTD, Heritage Foundation, OECD, World Bank, and the Economist Intelligence Unit) and compare the estimates with the estimates from our data (World Tax Indicators). The results from this exercise are reported in Table 11. We first note that alternative data sources are smaller in size and typically under-represent low-income countries (see Panel A). Panel B reports the trend coefficient on the top PIT rate and shows the large variation in sign, size and significance by data source. For example, Heritage Foundation and Economist Intelligence Unit databases show no trend in the top PIT rate, OECD and World Bank data sources produce a large downward bias in the estimated trend while the WTD shows a relatively steep descending trend in top rates. From Panel C, we see that only our dataset shows a negative and statistically significant relationship between the top PIT rate and GDP growth rate. The estimates of the tax rate effect on growth from other data sources are all statistically insignificant.

These results make it clear that reliance on small unrepresentative samples may lead to incorrect inferences and thus affect policy prescriptions. In this respect, we believe that our dataset is superior to most of the existing data on PIT rates.

11. Conclusion

This paper introduces a panel dataset on the PIT structure that is highly comparable across countries and years, and unprecedented in its coverage. The dataset includes the measures

[32] The growth model includes the top PIT rate, annual change in the share of government consumption expenditures in GDP, annual change in the share of gross fixed capital formation in GDP, population growth rate, the share of industrial production in value added, year dummies, and country fixed effects to control for a country's endowment in human and physical capital and other time-invariant characteristics. We use the top PIT rate for comparability with other data sources.

of structural progressivity as well as average and marginal PIT rates at different points of the income scale. Also included is information on tax brackets, statutory rates, basic allowances, tax credits, etc. These features make our data the desirable source for studies of the relationship between tax policy and economic outcomes in a country level setting.

Using this dataset, we identify and determine the direction of a momentous change in the world's tax systems. We highlight a tax reform process in which governments have moved away from complex, progressive tax systems featuring multiple tax brackets and escalating stair step tax rates to simpler, flatter tax schedules distinguished by fewer tax brackets and lower tax rates. In fact, taxpayers on average face lower personal income tax rates and simpler rate structures than they did twenty five years ago. This transformation suggests an epic and ubiquitous change in fiscal policy.

As the trends continue to play out, we also see a nascent secondary trend emerging where the conventional stair-stepped tax schedule is being replaced by a flat tax rate. The recent acceleration in this trend began with Estonia's adoption of a flat tax in 1994 and has since spread to other post-communist countries. As noted earlier, the number of countries using flat tax rates has soared since 1981 but still remains relatively small at about 12% of the sample countries by 2007. However, at the writing of this paper, other countries such as Croatia, Czech Republic, Greece, and Mexico are giving a flat tax schedule serious consideration. It seems to us that the trend toward flat taxes is likely to continue for the next several years. Whether or not this second trend continues, exceptional long term changes have already transformed the tax systems of the world.

We also analyzed the relationship between PIT rates and PIT revenue collection and find that the relationship varies in important ways across countries. In particular, we find a

statistically significant positive association between tax rates and PIT collection in high income countries. Developing countries, on the other hand, show very weak relationship between tax rates and the PIT/GDP ratio. Our results imply that the size of the informal sector may have contributed to the observed weak relationship between the PIT revenue and the tax rate in developing countries.

The observed trends raise a number of questions that we briefly addressed in the current paper and hope to address more carefully in future work. For example, what are the implications for efficiency, equity, and growth? Conceivably, flatter tax structures could reduce the excess burden without necessarily sacrificing equity. Davies and Hoy (2002), for example, argue that moving from a graduated tax schedule to a flat tax may improve equity. Furthermore, flatter, simpler tax systems can possibly increase the efficiency of the tax system by broadening the tax base as well as improving tax compliance.[33] On the other hand, flatter tax systems can lead to less equity as more of the tax burden is redistributed from the wealthier taxpayers to the lower and middle income classes. The effect of these changes on growth is also of grave importance. To the extent that efficiency has increased, we might expect a positive effect on growth. If inequality also increased, however, then the effect on growth may be ambiguous. That is, increased inequality arising from the tax reform may or may not lead to increased growth (Milanovic 2000, Persson and Tabellini 1994, Perotti 1992, among others). As such, the net effect on equity, efficiency, and growth remains an empirical question.

[33] Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009). Feldstein (1995) demonstrated that the sensitivity of taxable income with respect to changes in the marginal tax rate is much larger than can be explained by estimated labor supply elasticities. The implication then is that there are other behavioral responses at work.

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Table 1: Frequency of Changes in PIT Schedule by Period and Country Category

Period	High Income	Upper Middle Income	Lower Middle Income	Low Income	Total
Panel A: Share of countries with no yearly changes in statutory rates and thresholds					
1981 – 1985	0.348	0.667	0.735	0.661	0.592
1986 – 1990	0.298	0.560	0.623	0.671	0.526
1991 – 1995	0.419	0.525	0.500	0.606	0.506
1996 – 2000	0.439	0.491	0.545	0.747	0.558
2001 – 2005	0.378	0.576	0.571	0.782	0.574
All years	0.383	0.552	0.583	0.711	0.550
Panel B: Share of countries with yearly changes in both statutory rates and thresholds					
1981 – 1985	0.359	0.117	0.173	0.220	0.227
1986 – 1990	0.427	0.307	0.239	0.224	0.303
1991 – 1995	0.199	0.273	0.259	0.257	0.245
1996 – 2000	0.269	0.202	0.175	0.139	0.198
2001 – 2005	0.311	0.196	0.186	0.129	0.210
All years	0.306	0.223	0.210	0.179	0.233
Panel C: Share of countries with yearly adjusted thresholds but unchanged statutory rates					
1981 – 1985	0.250	0.200	0.071	0.102	0.155
1986 – 1990	0.258	0.120	0.130	0.059	0.152
1991 – 1995	0.331	0.152	0.209	0.101	0.207
1996 – 2000	0.269	0.254	0.245	0.101	0.215
2001 – 2005	0.272	0.207	0.229	0.082	0.196
All years	0.277	0.191	0.185	0.090	0.190
N	703	440	677	581	2401

Notes: Frequencies are computed on the sample of countries with a complete national PIT schedule in both current and previous years.

Table 2: Distribution of Countries by Top PIT Rates

Period	0%	1-20%	21-30%	31-40%	41-60%	61-95%
1981 – 1985	13.11	5.42	2.80	6.99	46.33	25.35
1986 – 1990	12.87	8.47	5.70	14.66	47.07	11.24
1991 – 1995	11.55	10.05	14.13	32.20	29.62	2.45
1996 – 2000	10.32	11.53	19.78	34.47	22.94	0.97
2001 – 2005	9.69	15.80	23.30	34.03	16.26	0.92

Note: N=3613.

Table 3: Top Statutory PIT Rates by Period and Country Category

Period	High Income	Upper Middle Income	Lower Middle Income	Low Income	Total
Panel A: GDP-Weighted Top PIT Rates (Mean and Standard Deviation)					
1981 – 1985	58.012	61.111	54.188	52.138	57.936
	(13.588)	(11.506)	(10.833)	(9.961)	(13.205)
1986 – 1990	46.494	55.764	48.736	47.085	47.848
	(15.121)	(14.115)	(11.648)	(6.559)	(14.853)
1991 – 1995	42.663	37.546	42.242	43.312	42.179
	(11.347)	(15.018)	(14.118)	(6.737)	(11.823)
1996 – 2000	42.791	33.206	39.933	36.258	41.456
	(9.500)	(11.768)	(8.731)	(8.582)	(10.037)
2001 – 2005	38.908	29.546	35.818	31.823	37.739
	(8.327)	(11.549)	(10.647)	(7.001)	(9.149)
Panel B: GDP-Weighted Average Trend					
1981 – 1985	-1.481*	1.149	-0.367	-1.871*	-1.110**
	[189]	[99]	[197]	[87]	[572]
1986 – 1990	-3.744**	-3.445**	-1.340*	0.238	-3.408**
	[205]	[108]	[202]	[99]	[614]
1991 – 1995	0.760	-3.313**	-3.220**	-1.332**	0.099
	[209]	[139]	[242]	[146]	[736]
1996 – 2000	-0.870*	0.241	0.302	-2.528**	-0.814**
	[240]	[149]	[208]	[227]	[824]
2001 – 2005	-0.862*	-0.590	0.182	-0.467	-0.745**
	[261]	[142]	[219]	[245]	[867]
All years	-0.797**	-1.752**	-0.855**	-1.059**	-0.892**
Panel C: Within-Country Trend, FE					
All years	-0.551**	-0.869**	-1.079**	-1.294**	-0.876**
	(0.079)	(0.163)	(0.115)	(0.199)	(0.063)
	[1104]	[637]	[1068]	[804]	[3613]

Notes: Panel A reports means and standard deviations (in parentheses) of the top PIT rates weighted by GDP in constant 1990 U.S. dollars. Panels B and C report estimated slopes from regressing top PIT rates on the trend variable. In Panel B, the estimates are weighted by GDP in constant 1990 U.S. dollars. In Panel C, the estimates are obtained with country fixed effects and heteroskedasticity-and-autocorrelation-robust standard errors (reported in parentheses); ** significant at 1% level, * significant at 5% level. Number of observations is in square brackets, and it is the same in all three panels.

Table 4: Trend Coefficients for Actual PIT Rates by Country Category

Period	High Income	Upper Middle Income	Lower Middle Income	Low Income	Total
Panel A: GDP-Weighted Average Trend					
Marginal PIT rate					
$1 \cdot y$	-0.491**	-0.172	-0.347**	0.054	-0.491**
$2 \cdot y$	-0.623**	-0.309**	-0.291**	0.037	-0.622**
$3 \cdot y$	-0.731**	-0.413**	-0.378**	0.335**	-0.716**
$4 \cdot y$	-0.796**	-0.428**	-0.414**	0.716**	-0.756**
Average PIT rate					
$1 \cdot y$	-0.329**	-0.022	-0.255**	0.037	-0.323**
$2 \cdot y$	-0.431**	-0.128*	-0.280**	0.040	-0.431**
$3 \cdot y$	-0.523**	-0.218**	-0.296**	0.068	-0.520**
$4 \cdot y$	-0.584**	-0.274**	-0.317**	0.214**	-0.573**
Panel B: Unweighted Within-Country Trend, FE					
Marginal PIT rate					
$1 \cdot y$	-0.404**	-0.204**	-0.131	-0.063	-0.218**
$2 \cdot y$	-0.423**	-0.291**	-0.084	-0.198	-0.242**
$3 \cdot y$	-0.430**	-0.388**	-0.084	-0.158	-0.263**
$4 \cdot y$	-0.465**	-0.414**	-0.154	-0.147	-0.307**
Average PIT rate					
$1 \cdot y$	-0.272**	-0.137**	-0.067*	-0.038	-0.146**
$2 \cdot y$	-0.341**	-0.181**	-0.094*	-0.079	-0.183**
$3 \cdot y$	-0.372**	-0.244**	-0.085	-0.115	-0.207**
$4 \cdot y$	-0.390**	-0.282**	-0.095	-0.121	-0.226**
	[1035]	[571]	[827]	[649]	[3082]

Notes: Reported are the estimated slopes from regressing marginal and average PIT rates on the trend variable; y is a country's GDP per capita. In Panel A, the estimates are weighted by GDP in constant 1990 U.S. dollars. In Panel B, the estimates are obtained with country fixed effects and heteroskedasticity-and-autocorrelation-robust standard errors; ** significant at 1% level, * significant at 5% level. Number of observations is in square brackets, and it is the same in all panels.

Table 5: Complexity Components of PIT Systems by Period

	Allowances/credits		Surtax	Local Taxes		Multiple Schedules	Tax Formula
	Standard	Non - Standard		Low	High		
Panel A: Complexity Measures by Period (Mean and Standard Deviation)							
1981 – 1985	0.275	0.527	0.281	0.067	0.093	0.207	0.193
	(0.447)	(0.500)	(0.450)	(0.250)	(0.290)	(0.406)	(0.395)
1986 – 1990	0.289	0.482	0.297	0.081	0.092	0.228	0.182
	(0.453)	(0.500)	(0.457)	(0.272)	(0.290)	(0.420)	(0.387)
1991 – 1995	0.307	0.413	0.266	0.087	0.080	0.198	0.125
	(0.461)	(0.493)	(0.442)	(0.282)	(0.271)	(0.399)	(0.331)
1996 – 2000	0.315	0.404	0.230	0.108	0.067	0.192	0.107
	(0.465)	(0.491)	(0.421)	(0.311)	(0.250)	(0.394)	(0.309)
2001 – 2005	0.307	0.397	0.212	0.102	0.069	0.172	0.092
	(0.462)	(0.490)	(0.409)	(0.302)	(0.253)	(0.378)	(0.289)
Panel B: Probit Estimates							
Trend	0.001	-0.006**	-0.004**	0.001	-0.002*	-0.003**	-0.005**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Upper middle income	0.248**	-0.135**	0.049*	0.039**	-0.253**	0.027	-0.148**
	(0.025)	(0.025)	(0.022)	(0.013)	(0.019)	(0.020)	(0.017)
Lower middle income	0.387**	-0.330**	0.037	-0.057**	…	-0.040*	-0.146**
	(0.021)	(0.023)	(0.019)	(0.014)		(0.018)	(0.015)
Low income	0.417**	-0.446**	0.038	0.061**	…	0.058**	-0.091**
	(0.023)	(0.026)	(0.021)	(0.012)		(0.019)	(0.015)
Panel C: Within-Country Trend, FE							
Trend	-0.000	-0.006**	-0.002	0.002	-0.000	-0.002	-0.003**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
N (observations)	3388	3388	3395	3392	3392	3387	3143
N (countries)	182	182	182	182	182	182	177

Notes: Panel A reports unweighted, unconditional means with standard deviations in parentheses. Omitted categories are countries with no basic allowances or tax credits and no local taxes. Panel B reports the results of the probit regression of each complexity indicator on the trend variable and country categories, with heteroskedasticity-robust standard errors in parentheses; ** significant at 1% level, * significant at 5% level. The omitted category is high income countries. Panel C reports the fixed effect linear probability regression of each complexity indicator on the trend variable, with country-clustered robust standard errors in parentheses. Number of observations is the same in all panels.

Table 6: Distribution of Countries by the Number of Brackets, %

Period	0	1-3	4-5	6-9	10-19	20+
1981 – 1985	15.76	6.30	2.73	25.00	41.18	9.03
1986 – 1990	14.71	12.10	11.92	25.70	30.17	5.40
1991 – 1995	13.30	19.41	26.60	26.29	12.68	1.72
1996 – 2000	11.50	21.65	28.28	28.01	9.74	0.81
2001 – 2005	11.17	23.54	31.78	27.93	5.19	0.40

Note: N=3613. The zero bracket category applies to countries that do not have a PIT.

Table 7: Structural Progressivity Measures of PIT Systems by Period

Period	Marginal Rate Progression		Average Rate Progression		N
	MRP1	MRP2	ARP1	ARP2	
Panel A: GDP-Weighted Progressivity Measures					
1981 – 1985	9.982	8.912	8.011	7.012	459
	(3.563)	(4.090)	(2.877)	(2.519)	
1986 – 1990	8.331	7.177	6.906	6.090	517
	(3.324)	(4.129)	(2.514)	(2.288)	
1991 – 1995	7.521	7.056	5.909	5.215	624
	(3.140)	(4.129)	(2.381)	(2.181)	
1996 – 2000	7.220	5.986	5.788	5.141	734
	(2.603)	(2.958)	(2.376)	(2.074)	
2001 – 2005	6.963	5.901	5.461	5.006	748
	(2.506)	(3.222)	(2.293)	(2.100)	
Panel B: GDP-Weighted Average Trend					
All countries	-0.133**	-0.135**	-0.117**	-0.092**	3082
High income	-0.141**	-0.145**	-0.116**	-0.090**	1035
Upper middle income	-0.141**	-0.162**	-0.093**	-0.095**	571
Lower middle income	-0.040**	-0.017	-0.043**	-0.012	827
Low income	0.194**	0.090**	0.041**	0.007	649
Panel C: Unweighted Within-Country Trend, FE					
All countries	-0.045**	-0.031	-0.041**	-0.028*	3082
	(0.015)	(0.022)	(0.010)	(0.011)	

Notes: MRP1 and ARP1 are marginal and average tax rate progressions up to an income level equivalent to four times y, where y is a country's GDP per capita; MRP2 and ARP2 are marginal and average tax rate progressions for the levels of income between y and $3 \cdot y$. Means and standard deviations (in parentheses) of progressivity measures in Panel A are weighted by GDP in constant 1990 U.S. dollars. Panels B and C report estimated slopes from regressing progressivity measures on the trend variable. In Panel B, the estimates are weighted by GDP in constant 1990 U.S. dollars. In Panel C, the estimates are obtained with country fixed effects and heteroskedasticity-and-autocorrelation-robust standard errors (reported in parentheses); ** significant at 1% level, * significant at 5% level.

Table 8: Income Tax Revenue by Country Type

	PIT/GDP			All Income Taxes/GDP		
	OLS	**FE**	**FE**	**OLS**	**FE**	**FE**
Trend	-0.061***	-0.010	-0.052*	-0.088***	-0.026	-0.026
	(0.022)	(0.017)	(0.030)	(0.029)	(0.025)	(0.030)
Upper middle income	-3.692***	-0.583**	-1.111*	-2.682**	-1.329***	-0.721
	(0.850)	(0.283)	(0.578)	(1.057)	(0.444)	(0.958)
Lower middle income	-4.120***	-0.781*	-1.804**	-3.897***	-1.695***	-2.411**
	(0.799)	(0.417)	(0.696)	(0.980)	(0.593)	(1.006)
Low income	-4.985***	-1.402**	-2.608***	-5.050***	-1.750**	-2.569
	(0.799)	(0.616)	(0.891)	(1.063)	(0.773)	(1.596)
Upper middle income	…	…	0.034	…	…	-0.066
× Trend			(0.039)			(0.077)
Lower middle income	…	…	0.079**	…	…	0.027
× Trend			(0.036)			(0.044)
Low income	…	…	0.091**	…	…	0.032
× Trend			(0.037)			(0.059)
Cash vs. accrual	-1.031*	0.371	0.061	-1.828**	-0.610	-0.646*
	(0.610)	(0.274)	(0.291)	(0.773)	(0.419)	(0.383)
Intercept	8.105***	…	…	11.532***	…	…
	(0.927)			(1.134)		
N (observations)	1695	1695	1695	1956	1956	1956
N (countries)	118	118	118	126	126	126
R-squared	0.36	0.03	0.07	0.23	0.02	0.04

Notes: Country-clustered robust standard errors are in parentheses; *** significant at 1% level, ** significant at 5% level, * significant at 10% level. Table reports the results of unweighted regression of income tax revenue as percent of GDP on the time trend, country type, and their interaction, controlling for the reporting revenue base (cash or accrual). The omitted category is high income countries. FE = estimator with country fixed effects. PIT = personal income tax. All income taxes are taxes on income, profits, and capital gains payable by individuals and corporations.

Table 9: PIT Rates and PIT Revenue

	Top PIT rate	MTR at 4·*y*	MTR at 2·*y*	ATR at 4·*y*	ATR at 2·*y*	MRP1	ARP1
Panel A: FE Estimates							
Tax variable	0.018**	0.043***	0.042***	0.057***	0.055***	3.432*	12.897***
	(0.009)	(0.010)	(0.010)	(0.011)	(0.013)	(1.782)	(4.483)
R-squared	0.04	0.11	0.09	0.10	0.08	0.04	0.06
Panel B: FE Estimates with Country Type Interactions							
Tax variable	0.047**	0.061***	0.052***	0.068***	0.061***	6.767*	19.537***
	(0.019)	(0.012)	(0.011)	(0.012)	(0.014)	(3.484)	(5.884)
Upper middle income	-0.033*	-0.024**	-0.024	-0.025	-0.033	-4.597	-6.514
× Tax variable	(0.018)	(0.012)	(0.016)	(0.017)	(0.023)	(3.752)	(5.785)
Lower middle income	-0.040*	-0.032*	-0.028	-0.033	-0.033	-4.884	-12.043*
× Tax variable	(0.021)	(0.017)	(0.018)	(0.020)	(0.027)	(4.337)	(6.854)
Low income	-0.042*	-0.052***	-0.037	-0.038	0.003	-11.265**	-21.388**
× Tax variable	(0.021)	(0.018)	(0.023)	(0.036)	(0.043)	(4.431)	(9.275)
R-squared	0.07	0.12	0.10	0.11	0.09	0.05	0.07
N (observations)	1500	1379	1379	1379	1379	1379	1379
N (countries)	103	97	97	97	97	97	97
Panel C: FE Estimates with Corruption Interactions							
Tax variable	0.051***	0.061***	0.057***	0.072***	0.069***	4.356	20.909***
	(0.019)	(0.015)	(0.015)	(0.017)	(0.018)	(4.357)	(6.012)
Corruption index	0.297	0.146	0.048	0.050	-0.032	-0.206	-0.000
	(0.256)	(0.169)	(0.158)	(0.162)	(0.146)	(0.127)	(0.152)
Corruption index	-0.014**	-0.013**	-0.013**	-0.015**	-0.016*	-0.705	-5.550**
× Tax variable	(0.006)	(0.005)	(0.006)	(0.007)	(0.009)	(1.584)	(2.587)
R-squared	0.09	0.13	0.11	0.12	0.11	0.05	0.07
N (observations)	1244	1165	1165	1165	1165	1165	1165
N (countries)	92	87	87	87	87	87	87

Notes: Country-clustered robust standard errors are in parentheses; *** significant at 1% level, ** significant at 5% level, significant at 10% level. Table reports the results of unweighted regression of PIT revenue as percent of GDP on the time trend, country type, and variables shown in the table, controlling for the reporting revenue base (cash or accrual). The omitted category is high income countries. All estimates include country fixed effects. MTR = marginal PIT rate; ATR = average PIT rate; MRP1 and ARP1 are marginal and average tax rate progressions up to an income level equivalent to four times *y*, where *y* is a country's GDP per capita. The number of observations is the same in Panels A and B. Corruption index is taken from the International Country Risk Guide (ICRG) but it is rescaled from 1 to 6, where 6 indicates worse corruption.

Table 10: Sensitivity of Trend Estimates to Changing Composition of Countries

	OLS		FE	
	All Countries	**1981 Sample**	**All Countries**	**1981 Sample**
Top PIT rate	-0.796**	-0.867**	-0.876**	-0.849**
	(0.080)	(0.067)	(0.063)	(0.068)
	[189/3613]	[108/2612]	[189/3613]	[108/2612]
Chi^2 test for difference between coefficients	*p*-value=0.128		*p*-value=0.322	
Marginal PIT rate at $4 \cdot y$	-0.308**	-0.289**	-0.307**	-0.299**
	(0.087)	(0.074)	(0.060)	(0.066)
	[175/3082]	[105/2353]	[175/3082]	[105/2353]
Chi^2 test for difference between coefficients	*p*-value=0.667		*p*-value=0.621	
MRP1 × 100	-0.055**	-0.037**	-0.045**	-0.042**
	(0.020)	(0.019)	(0.015)	(0.016)
	[175/3082]	[105/2353]	[175/3082]	[105/2353]
Chi^2 test for difference between coefficients	*p*-value=0.088		*p*-value=0.540	

Notes: Country-clustered robust standard errors are in parentheses; ** significant at 1% level, * significant at 5% level. Number of countries/observations is reported in brackets. Table reports the unweighted estimates of the slope coefficient from regressing selected tax variables on the trend variable using the sample indicated at the top of each column. The 1981 sample includes countries with available data in 1981.

Table 11: Sensitivity of Estimates to Different Data Sources

	World Tax Indicators	Univ. Michigan WTD	Heritage Foundation	OECD	World Bank WDI	Economist Intelligence Unit
Panel A: Composition of Countries, %						
Low income	15.31	12.26	13.78	0.00	8.41	1.53
Lower middle	25.05	25.11	20.51	0.00	17.29	14.80
Upper middle	24.63	25.58	27.88	6.78	28.04	23.47
High income	35.01	37.05	37.82	93.22	46.26	60.20
N (observations)	3613	1892	312	177	647	196
Panel B: Trend Coefficient for Top PIT Rate						
Trend	-0.876**	-1.220**	-0.528	-0.658**	-0.520**	0.159
	(0.063)	(0.099)	(0.496)	(0.134)	(0.114)	(0.495)
N (observations)	3613	1892	312	177	647	196
N (countries)	189	134	158	30	127	58
N (years)	25	23	2	6	6	4
Panel C: Effect of Top PIT Rate on GDP Growth						
Top PIT rate	-0.076**	-0.016	-0.016	0.076	-0.060	0.016
	(0.025)	(0.021)	(0.067)	(0.064)	(0.052)	(0.048)
N (observations)	3018	1619	297	177	588	196
N (countries)	168	119	152	30	114	58
N (years)	24	22	2	6	6	4

Note: Country-clustered robust standard errors in parentheses; ** significant at 1% level, * significant at 5% level. Panel B reports the unweighted estimates of the slope coefficient from regressing top PIT rates on the trend variable using the data sources indicated at the top of each column. Estimation is done by OLS with country fixed effects. Panel C presents the estimates of the relationship between the top PIT rate and real GDP growth rate using data from different sources. The growth model controls for the annual change in the share of government consumption expenditures in GDP, the annual change in the share of gross fixed capital formation in GDP, the population growth rate, the share of industrial production in value added, and year dummies.

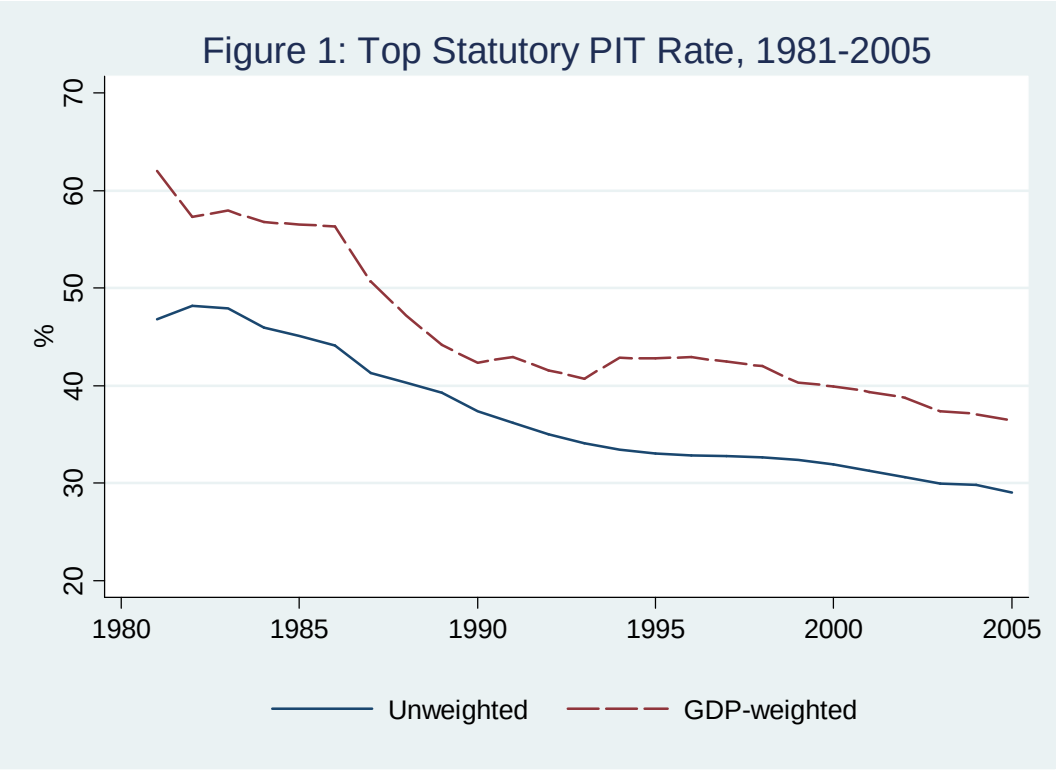
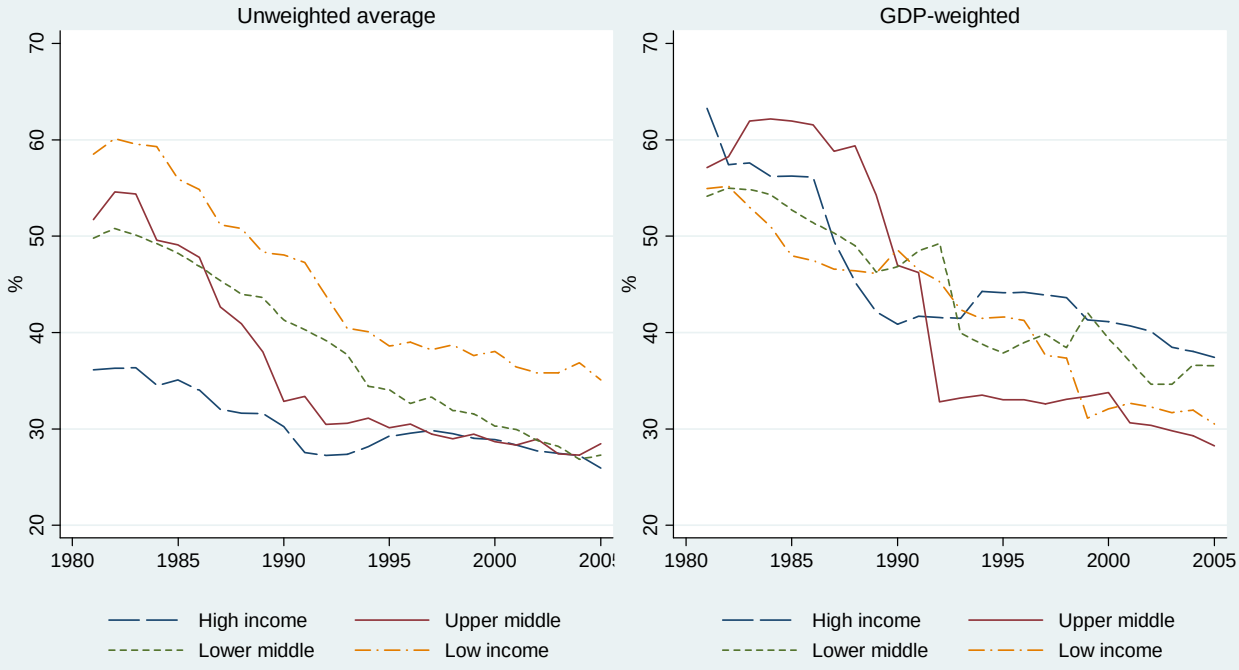
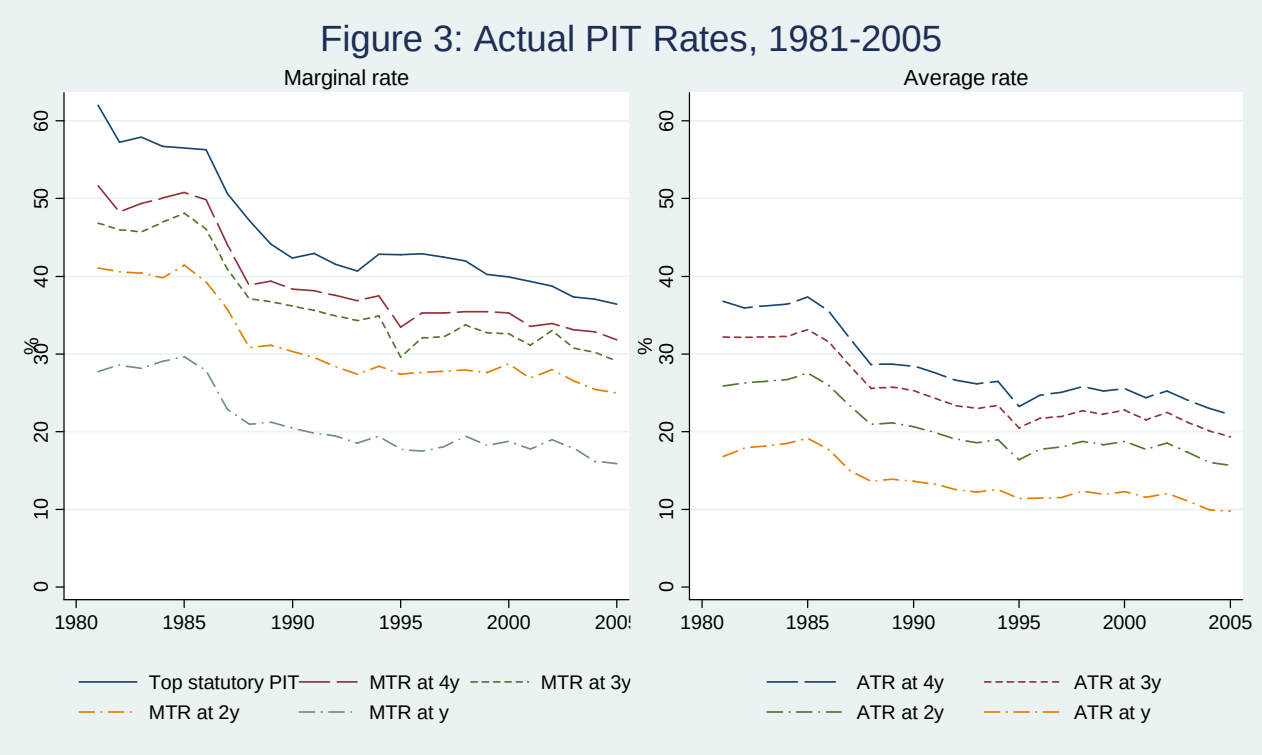


Figure 1: Top Statutory PIT Rate, 1981-2005
%
70
60
50
40
30
20
1980
1985
1990
1995
2000
2005
Unweighted
GDP-weighted

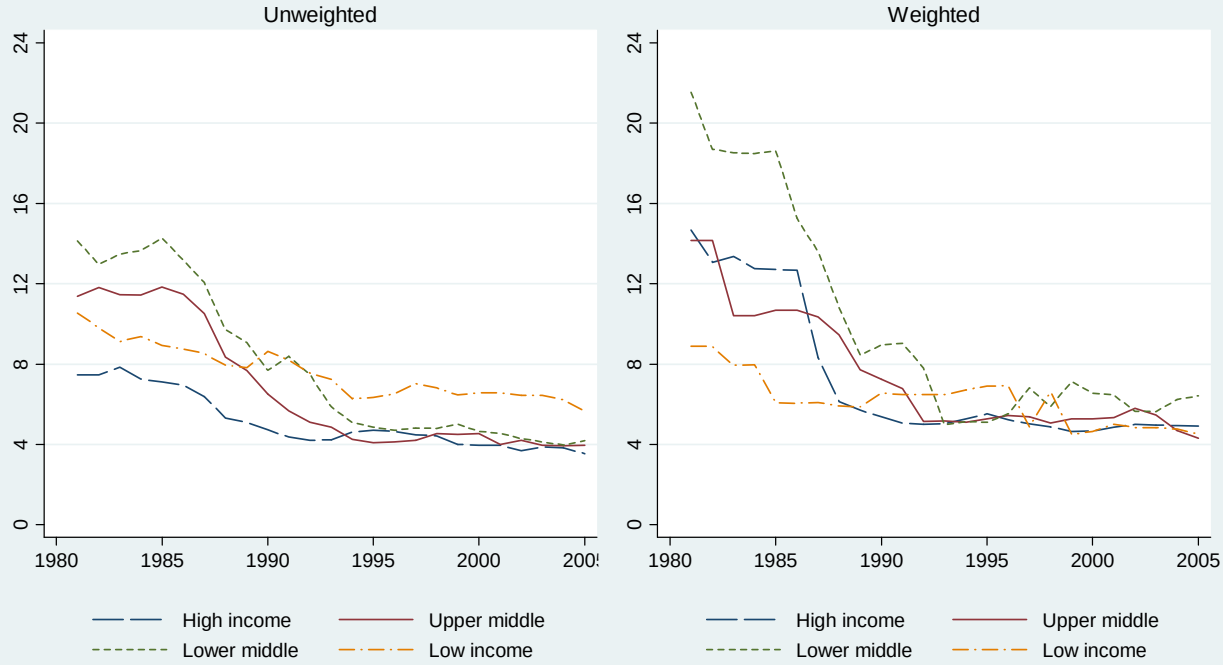
Figure 2: Top Statutory PIT Rate by Income Group, 1981-2005

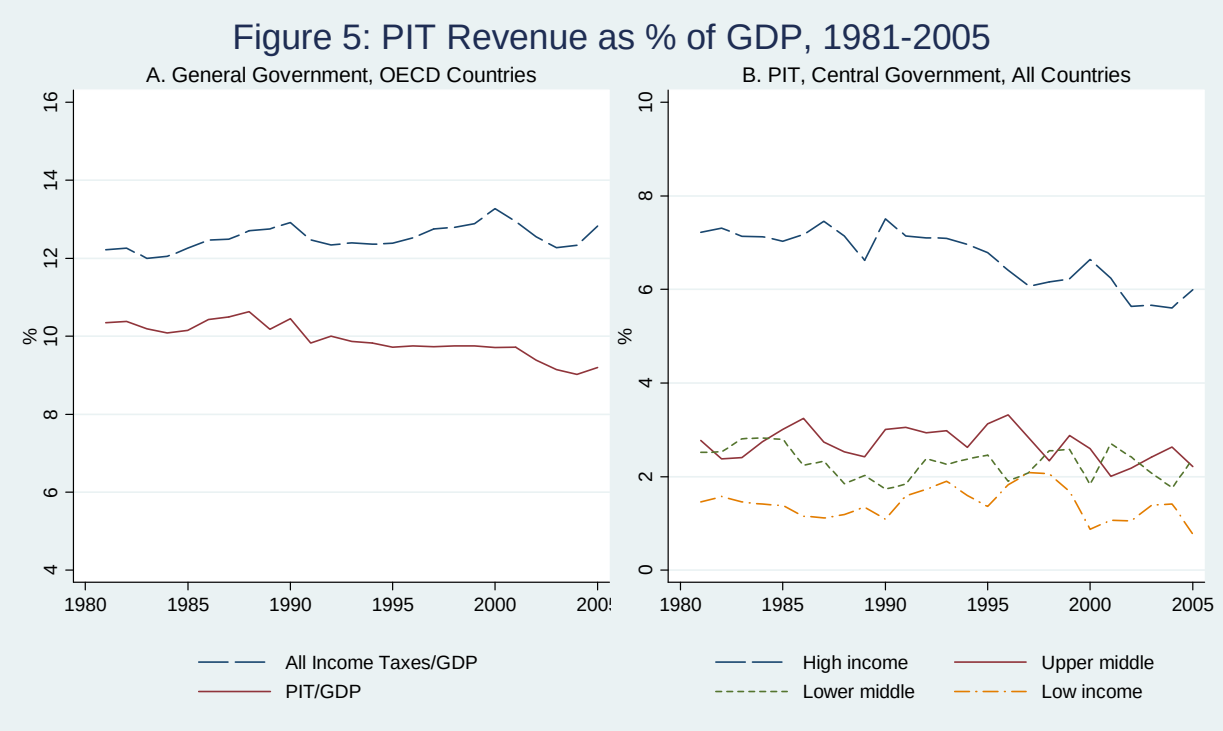




Notes: Both marginal and average rates are weighted by GDP in constant 1990 U.S. dollars; *y* denotes the level of gross income equivalent to a country's GDP per capita.

Figure 4: Number of Brackets by Income Group, 1981-2005





Notes: Both panels report unweighted means by year. Panel A is based on the OECD Data Source for the general government that includes central as well as local and state governments. All income taxes are taxes on income, profits, and capital gains. The number of OECD countries ranges from 24 in 1981 to 29 in 2005 for all income taxes and 25 in 1981 to 29 in 2005 for PIT. Panel B is based on the OECD Data Source and IMF Government Finance Statistics for the consolidated central government only. The number of countries in Panel B ranges from 59 to 80 per year.

Appendix

Table A1: Summary Statistics of Main PIT Variables by Year

	Unweighted	Weighted			
	Top PIT Rate	Top PIT Rate	Number of Brackets	MRP1	ARP1
1981	46.775	62.009	14.674	0.110	0.084
	(23.775)	(14.006)	(6.570)	(0.042)	(0.032)
1982	48.192	57.265	13.245	0.096	0.080
	(23.364)	(13.796)	(6.340)	(0.034)	(0.029)
1983	47.913	57.918	12.984	0.098	0.079
	(23.219)	(13.440)	(6.477)	(0.034)	(0.028)
1984	45.930	56.736	12.503	0.098	0.078
	(23.469)	(12.289)	(6.256)	(0.034)	(0.027)
1985	45.102	56.503	12.413	0.099	0.080
	(22.959)	(12.234)	(6.199)	(0.035)	(0.027)
1986	44.083	56.280	12.246	0.097	0.078
	(22.511)	(12.183)	(5.994)	(0.033)	(0.027)
1987	41.307	50.635	8.732	0.088	0.073
	(21.851)	(13.054)	(5.631)	(0.031)	(0.026)
1988	40.323	47.153	6.760	0.079	0.066
	(21.135)	(15.881)	(3.806)	(0.031)	(0.024)
1989	39.238	44.139	6.104	0.077	0.065
	(20.771)	(15.195)	(3.740)	(0.033)	(0.024)
1990	37.372	42.345	5.818	0.078	0.065
	(19.527)	(13.471)	(3.646)	(0.034)	(0.023)
1991	36.139	42.937	5.534	0.078	0.062
	(19.105)	(12.807)	(3.712)	(0.035)	(0.022)
1992	34.977	41.566	5.260	0.078	0.061
	(18.234)	(12.714)	(3.747)	(0.033)	(0.024)
1993	34.047	40.689	5.108	0.076	0.060
	(17.306)	(12.223)	(3.528)	(0.034)	(0.025)

Table A1 Cont'd: Summary Statistics of Main PIT Variables by Year

	Unweighted	Weighted			
	Top PIT Rate	Top PIT Rate	Number of Brackets	MRP1	ARP1
1994	33.401	42.830	5.333	0.076	0.060
	(16.709)	(10.800)	(2.758)	(0.030)	(0.024)
1995	33.024	42.786	5.554	0.067	0.052
	(16.198)	(10.478)	(2.765)	(0.024)	(0.023)
1996	32.813	42.894	5.362	0.072	0.058
	(16.257)	(10.331)	(2.715)	(0.026)	(0.023)
1997	32.785	42.463	5.195	0.074	0.058
	(15.954)	(10.370)	(2.091)	(0.027)	(0.024)
1998	32.657	41.972	5.052	0.073	0.058
	(15.875)	(10.367)	(1.910)	(0.028)	(0.024)
1999	32.335	40.271	4.907	0.072	0.057
	(15.627)	(9.589)	(1.876)	(0.027)	(0.024)
2000	31.910	39.936	4.851	0.070	0.058
	(15.463)	(9.331)	(1.855)	(0.023)	(0.024)
2001	31.224	39.346	5.049	0.069	0.055
	(15.159)	(9.328)	(1.883)	(0.023)	(0.022)
2002	30.593	38.727	5.103	0.070	0.058
	(14.772)	(9.225)	(1.864)	(0.024)	(0.024)
2003	29.914	37.353	5.073	0.070	0.055
	(14.720)	(9.106)	(1.853)	(0.025)	(0.023)
2004	29.825	37.062	5.050	0.072	0.054
	(14.611)	(9.085)	(1.862)	(0.028)	(0.024)
2005	29.011	36.434	5.031	0.068	0.052
	(14.492)	(8.815)	(1.869)	(0.024)	(0.022)
N	3613	3613	3143	3082	3082

Notes: Standard deviations are in parentheses. Weight is GDP in constant 1990 U.S. dollars. MRP1 and ARP1 are marginal and average tax rate progressions up to an income level equivalent to four times GDP per capita. All variables are described in the text.