WP/18/246

IMF Working Paper

Personal Income Tax Progressivity: Trends and Implications

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INTERNATIONAL MONETARY FUND

IMF Working Paper

Fiscal Affairs Department

Income Tax Progressivity: Trends and Implications[1]

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November 2018

Abstract

This paper discusses how the structure of the tax system affects its progressivity. It suggests a measure of progressive capacity of tax systems, based on the Kakwani index, but independent of pre-tax income distributions. Using this and other progressivity measures, the paper (i) documents a decline in progressivity over the last decades and (ii) examines the relationship between progressivity and economic growth. Regressions do not reveal a significant impact of progressivity on growth, suggesting that efficiency costs of progressivity may be small—at least for degrees of progressivity observed in the sample.

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[1] This paper extends preliminary results reported in the October Fiscal Monitor (IMF, 2017a). We are grateful for comments by Ruud de Mooij, Mercedes Garcia-Escribano, Victor Gaspar, Catherine Pattillo, Jiri Podpiera, and Abdel Senhadji, as well as FAD Seminar and Fiscal Monitor Workshop participants. Claudia Gerber, now with the Boston Consulting Group, worked on this paper while at the Fiscal Affairs Department.

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I. INTRODUCTION

Tax policy has an important role to play in addressing income inequality. At the lower end of the income distribution—where the focus is on poverty reduction—spending policies can also be used, and may be more important, in many countries. Even in this case, tax policy could: (i) be used to ensure that poor individuals pay little or no tax; (ii) mimic spending policies by offering refundable tax credits, such as tax credits related to minimum work/some other condition (e.g., the Earned Income Tax Credit - EITC in the United States), or through a general negative income tax (akin to a universal basic income); and/or (iii) help raise revenues required for inequality-reducing spending measures.

At the upper end of the income (and wealth) distribution, especially as far as the highest earners are concerned, there are few feasible alternatives to tax policy as a means of redistribution: Once an individual is above the highest qualification threshold for a free or subsidized good/service, there is no further way in which spending measures can be used to redistribute income.

The main way tax policy can reduce income inequality is through progressive income taxation, i.e. designing a tax system so that the average tax rate rises with income. There are two main aspects to this:

- First, the structure of the tax system determines by how much average tax rates rise. The simplest progressive tax system would be a flat tax rate combined with a personal allowance, but more complex systems with multiple rates can achieve greater progressivity.

- Second, the taxation of different sources of income plays an important role in determining the overall progressivity of the tax system. In many countries, capital income is taxed at lower rates than labor income. This affects the overall progressivity of the system, especially in the typical case in which capital is distributed even more unequally than wages.

One of the first obstacles to overcome in studying the progressivity of tax systems relates to its measurement. While many measures have been proposed, they each have their pros and cons. Notably, since the progressivity of most tax systems differs widely across incomes, many measures are very sensitive to the chosen income at which they are obtained. Hence, rankings of countries in terms of progressivity depend strongly on whether one looks at how progressive systems are for median wage earners or individuals with much lower or higher incomes. Other measures depend strongly on the pre-tax income distribution. Even very progressive tax systems will not redistribute much if the pre-tax distribution is already very even. Many measures are based on actual redistribution and would, therefore, identify such a system as lacking progressivity—even with average tax rates that rise very steeply. This paper suggests a different approach for the quantification of progressivity, which is independent of the pre-tax income distribution. Both this approach and other available measures confirm the suspicion that progressivity has declined over the last decades.

This decline in progressivity raises the questions of (i) why it occurred and (ii) whether it has benefited growth. Klemm, Liu, Mylonas, and Wingender (2018) examine potential explanations

within the framework of optimal tax theory, by exploring whether any of the standard components of optimal top tax rates may explain the decline in progressivity. They cannot find such evidence and conclude that other reasons, possibly related to political economy considerations, must lie behind the decline. The associated impact on growth is considered in this paper. A positive effect on growth would not in itself prove that a decline in progressivity is worthwhile or desirable, as it would have to be weighed against the greater inequality arising as a result. However, in the absence of such effect, the case for reducing progressivity is much weaker. This paper does not find evidence that reducing progressivity boosts growth, but given methodological difficulties in growth regressions, this should be interpreted carefully.

The rest of this paper is structured as follows. Section II covers the methodology of progressivity measurement, including a newly-proposed progressive capacity measure, and discusses data sources. Section III reports on the nature of trends in various progressivity measures for the tax and combined (central plus sub-central) tax plus social security systems. Section IV reports findings from an analysis of the impact of progressivity on growth, as well as the impact of the progressive capacity measure on market inequality. Section V discusses the role of capital income taxation in progressivity and concludes.

II. METHODOLOGY AND DATA

A. Methodology

A progressive tax system is defined as one with a rising average tax rate, but there is no consensus on how to measure the degree of progressivity. To make simple and yet robust cross-country comparisons of tax systems, an ideal measure would need to (i) summarize progressivity over the entire rate schedule in a single figure and (ii) focus on the redistributive power of the system without being affected by the pre-tax income distribution. As discussed below, no existing measure fully meets these requirements, but some come closer than others. Moreover, no existing measure takes the entire tax and benefit system, including public spending, into account, even though this ultimately determines overall outcomes. Finally, no single measure can fully capture what is ultimately the analysis of a distribution. Hence, when looking at only one country or a small number of countries, another option is to consider the average tax schedule directly rather than any summary measures.[2]

One issue that arises in all measures is the choice of what taxes to include. To allow a comprehensive analysis of the impact of the public sector on income inequality one would want to consider all its aspects, including all taxes and other levies, as well as spending, and all regulations. This would, however, run into major technical and data difficulties. Moreover, even for analytical purposes it can be interesting to focus on just one aspect, such as the tax system. Even then, there are important choices to be made. In this paper we focus on direct taxes on individuals, i.e. income taxes—including, where available, those charged at the regional/local

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[2] A single measure faces the difficulty of how to weigh changes that make part of a system more and another part less progressive. This is not a purely theoretical concern: Many tax reforms since the 1990s have involved an increase in the exemption threshold together with a lower top personal income tax rate, causing a shift in the tax burden from very low and very high incomes toward the middle (Keen, Kim, and Varsano, 2008).

government level—and social security contributions. Indirect taxes are disregarded, not because they do not have an impact but rather because they cannot be linked to incomes, as they are based on consumption choices that differ even among individuals or households with the same income. In some countries, it is moreover the case that the taxation of income differs by category, with pension or self-employed income for example tax favored. This creates difficulties for all measures of progressivity: those based on actual payments will represent the average of different schedules; those based on the system itself will have to choose the income category. In this case, employed labor—the most typical income source—is used.

An important consideration is the question of the inclusion of social security contributions. In many cases, the difference between a social contribution and a tax is often just labeling, in the sense that most social contributions are mandatory payments often determined by income, with only limited links to benefits. Some contributions, such as health insurance, may entitle payers to benefits, but the amount of payment is not linked to the quality or quantity of the benefit. The typical exception in many countries are pension contributions because those are sometimes closely linked to future pension rights, which implies that they exhibit some of the features of forced savings (as opposed to unrequited contributions). This means, in turn, that high payments do not necessarily imply progressivity, because they are not redistributed or used for general public consumption. Given these considerations, and a general absence of detailed data to distinguish between the part of social contributions that are available for general purposes and the part that is—notionally or actually—accounted for each individual, this paper calculates all progressivity measures including and excluding social security contributions, whenever data are available.

Measures of Progressivity

A simple measure, dating back to Pigou (1928), is the ratio of the change in the average tax rate to the change in income.[3] As shown in Figure 1, even for a very simple system with one flat rate (30 percent in this example) and a personal allowance (50 percent of the average wage in this example), progressivity changes substantially over the income distribution. This change creates a challenge for expressing overall progressivity in a single measure.

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[3] This measure equals the difference between the marginal and average tax rate divided by income (Musgrave and Thin, 1948).

Figure 1. Average Tax Rate across Incomes
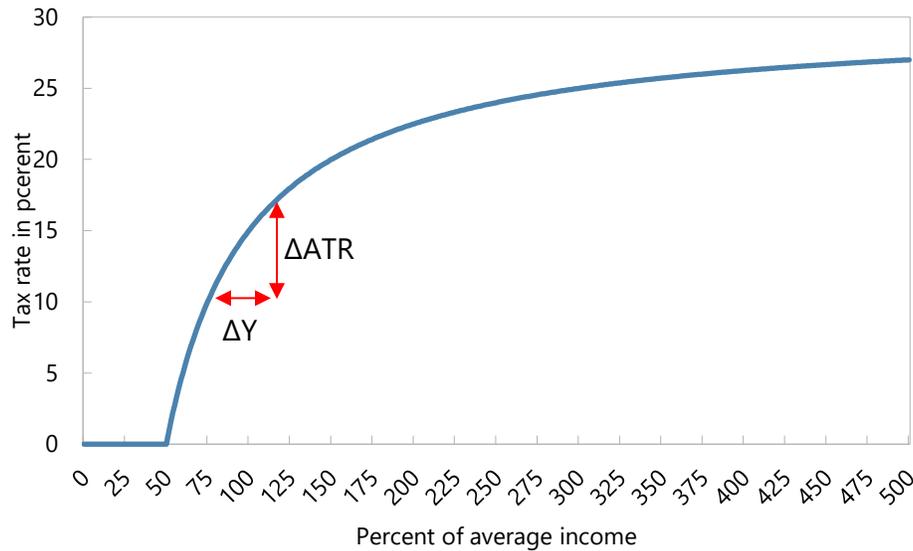
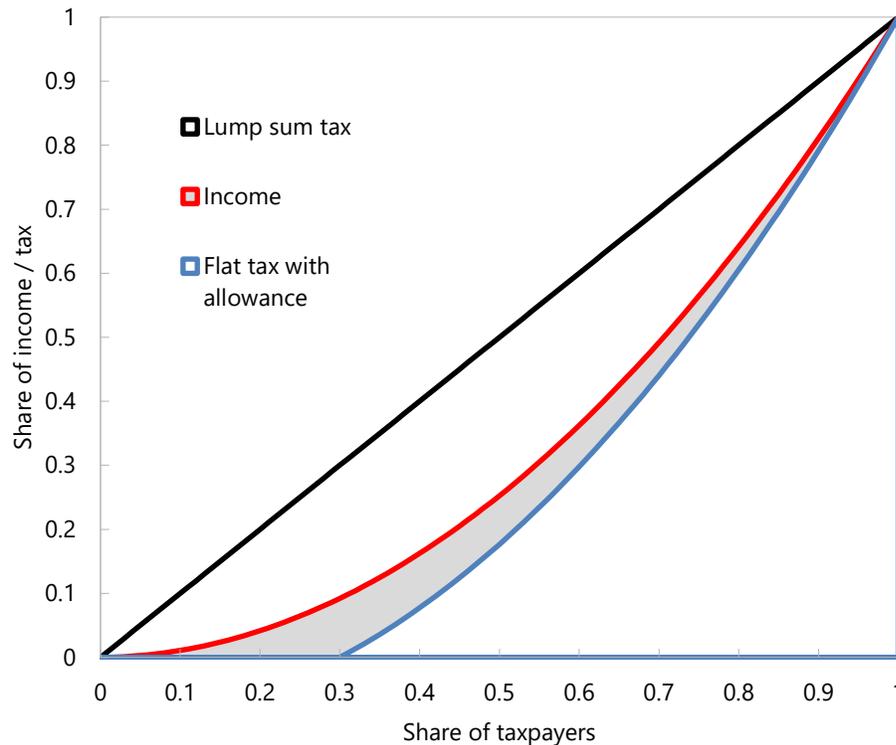Source: Authors' calculations.
Notes: The figure shows average tax rates under a flat tax of 30 percent with a personal allowance worth 50 percent of average income.

Sabirianova Peter, Buttrick, and Duncan (2010) address the challenge of capturing the overall progressivity in one estimate. They evaluate progressivity for a wide set of countries by calculating the average tax rate progression over 100 data points ranging from 4 to 400 (also 100 to 300) percent of per capita GDP (calculated as the slope of a regression of the average tax rate on income). Joumard, Pisu, and Bloch (2012) use a similar approach with a "synthetic indicator for net personal tax progressivity […]. It is calculated as the difference between the average net personal tax rate at two income levels based on the assumption of a similar income dispersion across OECD countries. This difference is then divided by the change in income level." They do not spell out the precise ranges used and how they are weighted.

Inspired by the Gini coefficient, a different approach is suggested by Kakwani (1977).[4] Specifically, progressivity is measured as twice the area between the income (red in Figure 2) and tax payment (blue) Lorenz curves (gray area). Compared to the previous two measures, the Kakwani index incorporates information from the entire rate schedule and does not vary by income level. A drawback of this measure is that it depends on the pre-tax income distribution. In this measure, a tax system will appear less progressive if the pre-tax distribution is relatively even, because for a given tax system, there will be less actual redistribution. Moreover, an increase in the top tax rate may show up as a reduction in the measure of progressivity if the higher tax rate discourages labor effort for very high incomes, resulting in a drop in pre-tax income inequality.

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[4] A similar measure is proposed by Suits (1977) who plots the share of taxes paid against the share of income (instead of taxpayers as in Figure 2) and defines the area between the resulting curve and the diagonal as a measure of progressivity. Both measures are compared in Formby and others (1981).

Figure 2. Lorenz Curves

Source: Authors' calculations.

A Measure of Progressive Capacity

To abstract from the underlying income distribution and focus on the redistributive potential of the tax system, this paper suggests calculating a measure of progressive capacity, which is unaffected by the pre-tax income distribution. The measure will be higher in countries, which have designed their tax system to redistribute more, even if there is little redistribution in practice, because incomes are very equal to begin with. Apart from the analytical advantage of focusing on tax laws alone, this measure also has the econometric advantage of being exogenous to changes in the income distribution that are caused by tax policy (there may still be policy endogeneity as discussed below).

The measure is defined as the Kakwani index, but calculated over a fixed range of incomes,[5] each of which is given equal weight (i.e., income is treated as if it were uniformly distributed). Under this assumption, the Lorenz curve for income simplifies to s^2, where s is the share of taxpayers

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[5] The choice of range is the only link between this measure and the actual income distribution in a country. To enable cross-country comparisons, we mostly use a range of 0–500 percent of per capita GDP. An even more exogenous (but less comparable) measure could be calculated by imposing the same income level range on all countries (e.g., US$0-US$100,000).

ranging from 0 to 1. The area below this curve is equal to 1/3.[6] To estimate the Lorenz curve for taxation, we use information on the tax system to calculate the tax payable for each of the 500 income points over the chosen range of incomes. We estimate the area below this by calculating 500 rectangles. For a country with a simple tax schedule it could also be done exactly by integrating the tax function.[7]

B. Data

The most important data in estimating progressivity are those related to tax systems. Ideally data on the whole tax system are needed (allowances, brackets, and rates), but ready-made estimates of average tax rates can also be used for simple Pigou-style measures.

Pigou-type measures of progressivity can be calculated using the OECD Taxing Wages data, which provide average tax rates for individuals earning 67, 100, and 167 percent of median income.[8] These data also provide average tax rates for families with two children, with one earner at 100 percent of average wages, and the second earner at 0, 33, and 67 percent of average incomes. These data, therefore, allow various possible Pigou-type measures of progressivity, as well as comparisons between the progressivity of the tax system with respect to individuals and families. Another advantage of these data is that they exist both for the personal tax rate and for a more comprehensive tax wedge including employer's social security contributions. A disadvantage, however, is that the range of incomes considered is not very high, and the data are silent about how progressivity evolves beyond incomes of 167 percent of the median.

Data on the average rate progression proposed by Sabirianova Peter and others (2010) have been made public by the authors.[9] These data have the advantage of covering a very large set of countries, including emerging and developing economies. A disadvantage is that they range only through 2005. Moreover, these data do not include social security contributions, thus not capturing the full progressive capacity of a tax system

To calculate our measure of progressive capacity, detailed tax system data are needed, including universally available allowances and tax credits, thresholds of tax brackets, tax rates and surtaxes. For the federal personal income tax, such data are available from the OECD starting from 1981, allowing us to calculate a long series. From 2000 onwards, data are also available on any

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[6] This is derived as follows: $L(s) = \int_0^{ms} \frac{1}{m} x dx / \int_0^m \frac{1}{m} x dx = \frac{(ms)^2}{2} / \frac{m^2}{2} = s^2$, $\int_0^1 s^2 ds = \frac{1}{3}$, where m is the chosen upper limit of incomes considered.

[7] The measure would be $\frac{2}{3} - 2 \int_0^1 \frac{\int_0^{ms} T(x)dx}{\int_0^m T(x)dx} ds = \frac{2}{3} - \frac{2}{\int_0^m T(x)dx} \int_0^1 \int_0^{ms} T(x) dx \, ds$.

[8] For the year 2017 only, the OECD also published data for each percentage point income ranging from 50-250 percent of average income. For selected other years, the OECD published changes in rate progression for various income ranges, with the highest covering incomes rising from 300 to 500 percent of the average (OECD, 2014).

[9] http://icepp.gsu.edu/world-tax-indicators

additional income taxes levied below the federal level (e.g., regional or municipal) and on social security contributions.[10] This allows a to calculate additionally a shorter, but more comprehensive, series. When calculating the measure with social security contributions, we include both employer and employee contributions, and define the labor cost as gross income plus employer-paid contributions. Moreover, for a subsample of countries, separate social security rates for self-employed individuals are also available.

III. PROGRESSIVITY TRENDS

Personal income tax progressivity declined steeply in the 1980s and 1990s and has remained broadly stable since then. Figure 3 shows our new progressive capacity measure, next to the average rate progression calculated by Sabirianova Peter and others (2010), which is shown both for the entire available sample and, for comparative purposes, OECD member countries. All measures clearly reveal a strong downward trend, especially in the 1980s, but the capacity measure, which is available for more recent years, reveals a stabilization over the 2000s.[11] Comparing the absolute value of average rate progression for the two samples also reveals that progressivity is much greater among OECD member countries. The downward trend in progressivity over the past three decades is consistent with the decline in top income tax rates across the world—although the most recent data suggest a slight reversal for advanced economies (Figure 4).[12]

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[10] These data are less complete than those on the federal income tax, hence we use additional information, such as IBFD, Ernst & Young, and national sources, to fill in missing data and correct apparent mistakes.

[11] The temporary trough in progressivity during the late 1980s and early 1990s is not driven by any particular country or temporary event, but by various reductions, followed by increases mostly in different countries.

[12] During the 1970s, many countries had even higher high top marginal personal income tax rates (Tanzi, 2011).

Figure 3. Tax Progressivity
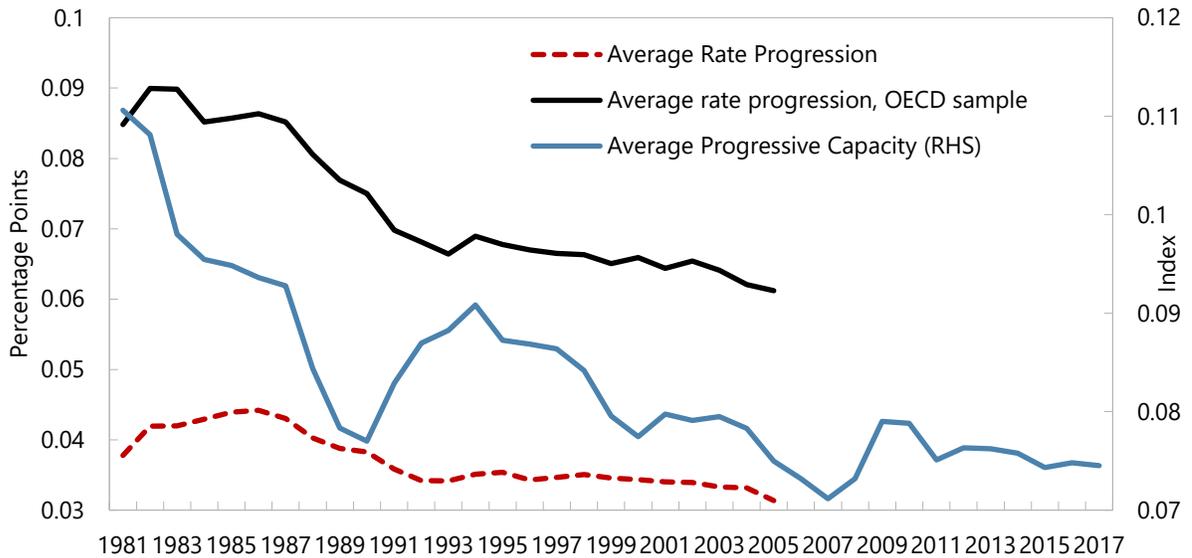
Source: Authors' estimates based on the Andrew Young School WTI and OECD Tax Databases.
Note: Average rate progression calculated and averaged over 161 countries. Progressive capacity covers 18-35 OECD members (if calculated on a balanced panel of 18 countries, the same pattern is observed).

Figure 4. Average Top (Combined) Personal Income Tax Rates

(in percent)
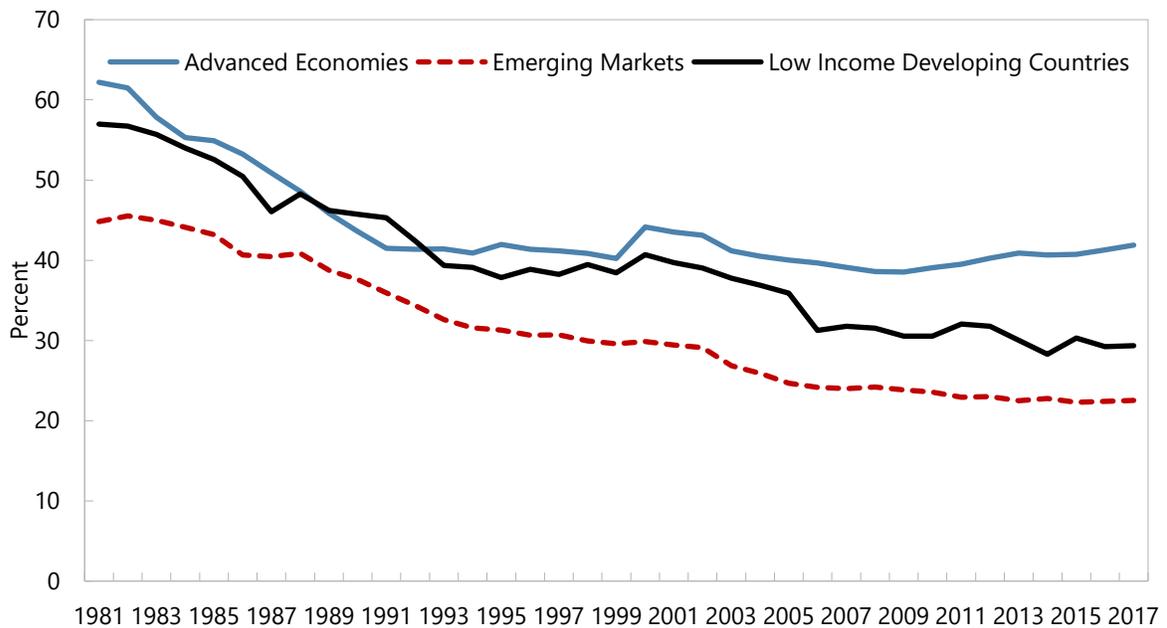
Source: FAD Tax Policy Rates Database.

For the subsample from 2000-2017, we have sufficient data to add social security contributions and any sub-central income taxes to central income taxes. As shown in Figure 5, the progressive

capacity measure calculated with social security contributions is flat over this shorter period, similar to the measure based on central income taxes only, which had declined more strongly in the 1980s and late 1990s. More noteworthy than the trend is the level: when social security contributions are included, the progressive capacity is much lower than when the focus is on taxes alone. This is not surprising: while tax systems are often characterized by progressive rate structures, social security contributions in many countries have a fairly flat structure, with no or a small personal allowance, and often an upper earnings limit, beyond which they do not apply (or a reduced rate applies).[13] The measure calculated for self-employed individuals equally shows no strong trend over this later period, but a slightly higher level of progressivity than the measure for employees. We have examined the raw data and did not find a systematic reason for this. In some countries, social security systems for the self-employed include a tax-free allowance, in some they are flat (while the standard system is regressive), and in others the self-employed system is more regressive. We have also confirmed that the difference in levels is not driven by the reduction in sample size associated with the lack of available data for the calculation of the average progressive capacity measure including social security contribution schedules faced by the self-employed.

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[13] Some social security payments may still have an ultimately positive impact on equality, for example because benefit payments are more generous for lower-income individuals. However, the focus of this analysis, just like in the case of tax is on the revenue side, not on the spending side.

Figure 5. Average Progressive Capacity, OECD countries
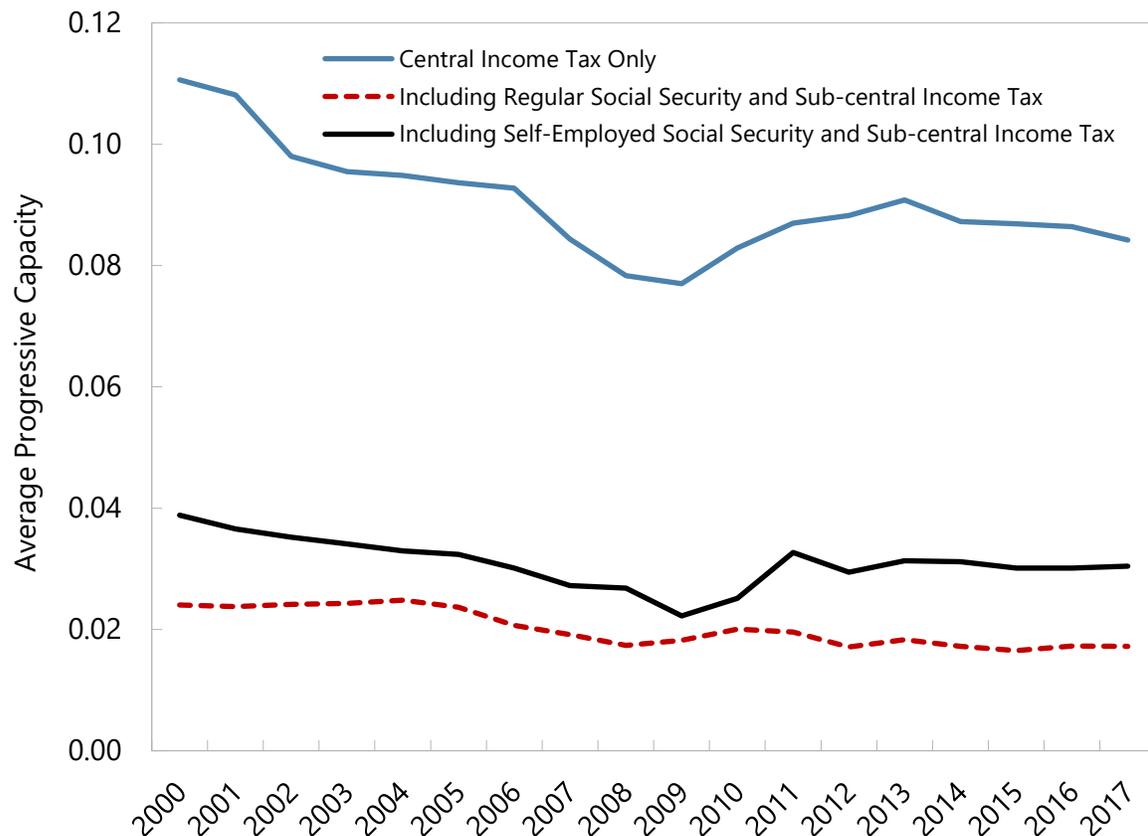
Note: The measure for self-employed excludes, for data availability reasons: Chile, France, Greece, Japan, Korea, Poland, and Turkey.
Source: Authors' estimates using OECD Tax Database data.

Using more readily-available Pigou-style measures reveals further details. OECD (2014), for example, uses such measures and finds that progressivity tends to be highest at lower income levels and presents country-by-country analysis of how progressivity differs by family type and income group. Using the annually available data reaching up to 167 percent of average earnings, Figure 6 compares a single individual to (ii) a family with two earners. In both cases the Pigou measure for increase in incomes from 100 to 167 percent of average earnings is shown. In the case of a two earner family this is the result of the second earner starting to work at 67 percent of the average wage (with the first earner at 100 percent before and after). The left panel focuses on taxes and the right panel also includes social insurance contributions.

Figure 6. Rate Progression, Increase from 100 to 167 Percent of Average Earnings
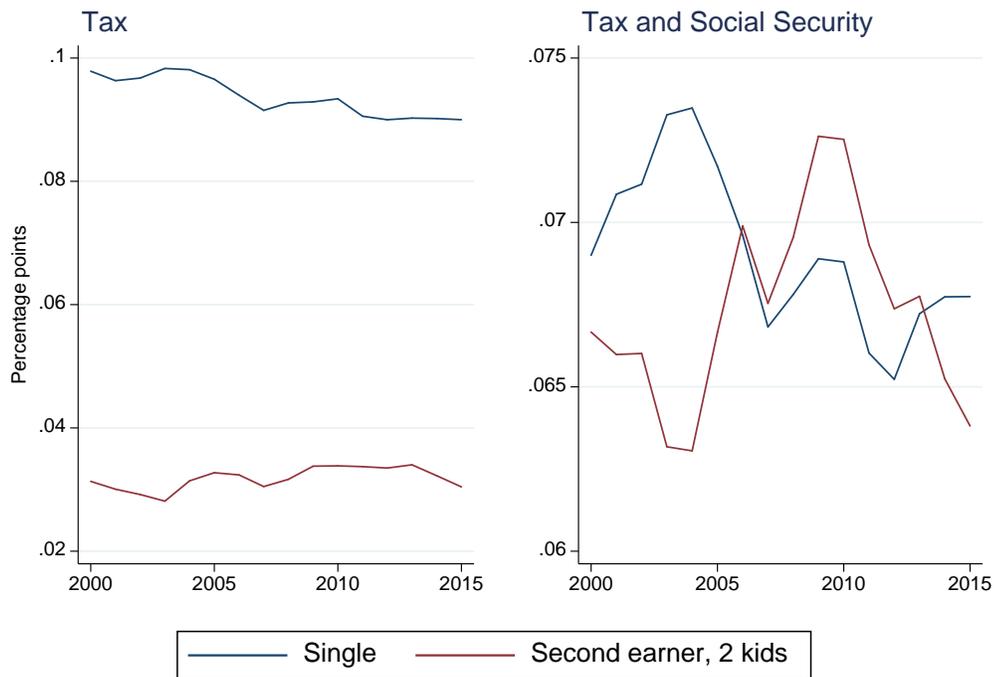
Source: OECD Taxing Wages and authors' calculations.

Focusing just on the levels of progressivity, Figure 6 shows that, on average across countries, the tax system will have a more rapidly rising tax rate for the single earner. This is due to two factors: First, the second earner benefits from new personal allowances and lower tax rates in most tax systems.[14] Second, most tax systems take children or possibly other dependents into account,[15] reflecting the idea that capacity to pay is reduced by the presence of dependents.[16] Turning to developments over time, the progressivity of the tax system as it applies to singles has fallen slightly since 2000, in line with the analysis above. For second earners entering the workforce, however, there has been no change in progressivity. The right panel of the figure repeats the same analysis for the tax wedge, including social security. Here, the difference in levels is much

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[14] Under perfectly separate taxation—either because of tax system design or because a couple chooses not to register a relationship—this effect would be even stronger and the rate progression would be negative, i.e., the second earner entering the labor force would reduce the unrecognized couple's average tax rate (though this is still likely to be higher than the average tax rate of recognized couples in most systems).

[15] Dependents typically reduce the tax base. In some systems, tax rates can also increase once the family position is considered, e.g., marriages among high earners can increase average tax rates in some countries ("marriage penalty").

[16] In this respect an interesting comparison for a family with two children would be between a second earner entering the workforce at 67 percent of average earnings (i.e., the situation in the chart) and a family with the first earner increasing the salary from 100 to 167 percent of earnings. The data for this case are, however, not available in the OECD database. It is, therefore, not possible to use these data to draw conclusions on how tax systems treat two-earner versus one-earner families for the same number of children.

smaller and no clear trend over time can be seen. This confirms again the importance of the social security system's impact on progressivity, and the likely negative impact of social security contributions on overall revenue progressivity.

In reality, tax systems may be even less progressive than suggested by these measures because wealthy individuals often have more access to tax relief and more opportunities to avoid taxes. For instance, since households with high incomes are more likely to be homeowners, they benefit more from deductions for mortgage interest, where applicable. Any allowable deduction is also worth more at higher marginal tax rates. In addition, the wealthier have more resources to dedicate to tax planning, as well as greater incentives to engage in such activities. Alstadsaeter, Johannesen, and Zucman (2017) provide empirical evidence suggesting that tax evasion is particularly high at the upper end of the income distribution.

IV. GROWTH REGRESSIONS

Growth regressions are notoriously difficult to estimate robustly, so this analysis is meant to provide indicative evidence rather than proof for or against a growth impact. As, despite the methodological difficulties, there is an existing literature on this topic, it is interesting to repeat the established findings with the new progressive capacity measure.

A. Previous studies

Previous studies show mixed results, but certainly no strong empirical evidence in favor of a pronounced negative relationship between progressivity and growth. Some empirical work has focused on the relationship between fiscal redistribution and growth and finds no or even positive effects for non-extreme levels of redistribution (e.g., Ostry, Berg, and Tsangarides, 2014). Rhee (2013) studies more directly the impact of progressivity (using the Suits (1977) index) on growth in U.S. states and finds a negative relationship. However, since there is more labor mobility between U.S. states than different countries, this result may not hold for national taxes. There are also some studies that do not employ direct measures of tax progressivity, but instead approximate this by using both a measure of the average and the marginal tax rates (e.g., Padovano and Galli (2005) who find a negative relationship between the marginal tax rate and growth). This is, however, a very crude way to measure progressivity, as a high economy-wide marginal tax rate could be the result of many different tax schedules with varying progressivity levels (tax allowances need not apply mostly to poor people, for example).

B. New results

In this paper, to assess the effect progressivity has on growth, the following regression is performed on a sample of annual data from OECD countries during the period 1981–2017:

$$\hat{y}_{it} = a + \beta_1 p_{i,t-5} + \beta_2 y_{i,t-5} + \gamma' \mathbf{X}_{i,t-5} + f_i + g_t + \varepsilon_{it} \tag{1}$$

in which $\hat{y}_{it}$ is growth over 5 years, $p_{i,t-5}$ is the initial level of progressivity, $y_{i,t-5}$ the initial level of real per capita GDP, $\mathbf{X}_{i,t-5}$ a vector of control variables, and f_i and g_t country and year fixed effects. This regression closely follows Ostry, Berg, and Tsangarides (2014), except that it uses tax progressivity measures rather than measures of overall distribution. The country fixed effects

capture any structural differences between countries, while the year dummies control for global economic shocks. The control variables used are population growth rate (to control for a nontax growth driver), per capita GDP (to control for convergence), the Gini coefficient (to control for inequality), and capital account openness.[17]

The results from these regressions generally do not reveal a significant impact of progressivity on growth for any of the measures (Table 1). The first regression presented is an exception, showing a positive impact of the average rate progression measure by Sabirianova Peter and others (2010) on growth. The other measures considered are all insignificant and include: the Pigou-style measures estimated using OECD Taxing Wages data for the tax rate and the tax wedge (regressions (2)-(3)); the top statutory tax rate and its square (regression (4)); and the proposed measure of progressive capacity calculated for the tax (regression (5)) and for the combined social security plus tax systems (regression (6)). Note that the same result is obtained both with measures that are available for many countries, and those that have more restricted availability.

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[17] This index was developed by Chinn and Ito (2006), updated measures are available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

Table 1. Regressions of 5-Year Growth on Progressivity Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Progressive capacity$_{t-5}$					17.52	
					(29.01)	
Progressive capacity including SSC$_{t-5}$						-50.46
						(38.80)
Avg. rate progression, 0-400% pc GDP$_{t-5}$	189.3*					
	(97.05)					
Δ Avg. tax rate / 100-167% avg. wage$_{t-5}$		182.6				
		(136.6)				
Δ Avg. tax rate / 67-100% avg. wage$_{t-5}$		-12.87				
		(29.48)				
Δ Avg. wedge / 100-167% avg. wage$_{t-5}$			77.77			
			(168.5)			
Δ Avg. wedge / 67-100% avg. wage$_{t-5}$			-17.12			
			(21.69)			
Top stat. rate$_{t-5}$				0.137		
				(0.469)		
Top rate$^2_{t-5}$				-0.00135		
				(0.00504)		
Pop. growth$_{t-5}$	-1.052	-1.455	-1.989	-1.823	-3.075	-2.074
	(1.393)	(2.069)	(1.995)	(1.132)	(2.370)	(2.005)
ln(GDP pc)$_{t-5}$	-7.965***	-113.0***	-111.3***	-8.550***	-59.33***	-114.8***
	(1.960)	(8.361)	(9.466)	(1.806)	(7.143)	(8.356)
Gini$_{t-5}$	-0.622	2.873***	2.752***	-0.478	0.840	2.471***
	(0.577)	(0.882)	(0.891)	(0.434)	(0.669)	(0.852)
Capital account openness$_{t-5}$	16.04**	30.49***	32.53***	11.75**	5.753	34.77**
	(6.225)	(10.77)	(10.75)	(4.961)	(7.639)	(15.67)
Observations	2,019	350	350	2,665	712	361
R-squared	0.528	0.899	0.894	0.515	0.803	0.896
Number of countries	135	33	33	148	34	34

Notes: All regressions include country and year effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' Estimates.

Certainly, the failure to find a significant negative result does not prove its absence. However, the one positive result gives some relief to doubts that the absence of significant results is simply due to large standard errors reducing the power of the regressions to reject the null hypothesis of no impact. To address as much as possible doubts about the finding, we implemented a range of robustness checks.

In line with Ostry, Berg, and Tsangarides (2014), we address possible endogeneity issues, by performing these regressions also using system generalized method of moments estimation due to Arrellano and Bover (1995) and Blundell and Bond (1998). The results on the progressivity measures are very similar (Table 2): the one previously significant result turns insignificant, but another (progressive capacity including social security contributions) turns positive and significant, with all other results remaining insignificant. Among the control variables one notable change is that the Gini co-efficient on net income now is consistently negative and significant, as reported also in Ostry, Berg, and Tsangarides (2014). The standard specification tests are all

passed: there is the expected first-order serial correlation, but the absence of second-order serial correlation cannot be rejected. One worry is the very large p-value for the Sargan/Hansen test. While this means that we cannot reject the validity of instruments, it may also indicate that too many instruments may have weakened the test. This does not mean that the results are biased, but that the test may be invalid. It is in any case reassuring that results for the relevant progressivity variables tell the same story as in the fixed effects regressions.

Table 2. Regressions of 5-Year Growth on Progressivity Measures, GMM results

	(1)	(2)	(3)	(4)	(5)	(6)
Progressive capacity$_{t-5}$					29.05	
					(33.87)	
Progressive capacity including SSC$_{t-5}$						89.25
						(73.58)
Avg. rate progression, 0-400% pc GDP$_{t-5}$	126.7					
	(85.13)					
Δ Avg. tax rate / 100-167% avg. wage$_{t-5}$		42.84				
		(74.41)				
Δ Avg. tax rate / 67-100% avg. wage$_{t-5}$		-92.57**				
		(45.20)				
Δ Avg. wedge / 100-167% avg. wage$_{t-5}$			46.21			
			(97.31)			
Δ Avg. wedge / 67-100% avg. wage$_{t-5}$			-71.75			
			(45.53)			
Top stat. rate$_{t-5}$				0.0808		
				(0.351)		
Top rate$^2_{t-5}$				-0.00199		
				(0.00436)		
Pop. growth$_{t-5}$	-4.109**	-2.667	-0.866	-3.475**	-5.120*	-3.957
	(1.715)	(4.701)	(5.165)	(1.430)	(3.093)	(4.433)
ln(GDP pc)$_{t-5}$	-6.537***	-20.64***	-20.76***	-7.573***	-20.91***	-24.98***
	(1.760)	(7.250)	(6.810)	(1.422)	(4.767)	(8.052)
Gini$_{t-5}$	-1.946***	-1.567***	-1.594**	-1.432***	-1.039**	-1.640**
	(0.355)	(0.606)	(0.637)	(0.244)	(0.431)	(0.706)
Capital account openness$_{t-5}$	32.71***	13.96	9.662	39.66***	32.87***	14.99
	(10.48)	(14.26)	(14.21)	(8.422)	(6.603)	(13.61)
Observations	2,019	350	350	2,665	712	361
Number of countries	135	33	33	148	34	34
AR1 p	9.42e-07	0.00166	0.00124	4.88e-09	0.00111	0.00170
AR2 p	0.334	0.985	0.886	0.830	0.311	0.761
Hansen p	1	1	1	1	1	1

Notes: All regressions include country and year effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' Estimates.

Further robustness tests include the following:

- To control for any bias from the particular choice of 5-year intervals, we also performed regressions of annual growth on one-year lagged variables. This yielded insignificant coefficients for all progressivity measures.

- We also repeated the annual regressions on samples restricted to 10-year periods to allow for a change in the relationship over decades, but this did not reveal any changes or significant results for sub-periods.[18]

- To address potential nonlinearities in the relationship between growth and progressivity, quantile regressions were run,[19] as well as regressions with a term for the interaction between the measure of progressive capacity and a dummy indicating high progressivity values (95th or higher percentile), but this still revealed no significant negative result.

- We repeated the analysis with the following additional controls: the top personal income rate, the personal income tax revenue to GDP ratio, and the government spending to GDP ratio. None of them changed the result. We also repeated the regressions using progressive capacity measures calculated for incomes ranging up to 1000 and 2000 percent of per capita GDP to allow for changes in progressivity at the very top of the income distribution, which also turns out insignificant.

- Given the very different coefficients on the Gini coefficient on net income when comparing fixed effect and GMM regressions, we repeated the fixed effect regressions excluding this variable. This yielded insignificant coefficients for all progressivity measures.

Even abstracting from any econometric concerns, the empirical finding of no significantly negative impact of progressivity on growth does not rule out the possibility of such a relationship for extremely progressive tax systems, like the tax rates of nearly 100 percent in Sweden or the United Kingdom in the 1970s. It does, however, suggest that there is no clear evidence that progressivity levels seen since 1981 in OECD countries have been demonstrably harmful for growth. Though this empirical finding may appear surprising, there are theoretical arguments as to why progressivity may lead to more efficient outcomes: Van Ewijk and others (2003) list a total of 10 arguments, including inefficient labor markets, in which higher taxes may discourage unions from negotiating excessively high wages. Piketty, Saez, and Stantcheva (2014) discuss rent seeking within firms, in which low taxes on high incomes may encourage managers to increase their share of rents at the expense of workers and owners, but without adding to output.

C. Progressivity and Pre-Tax Inequality

A benefit of the progressive capacity measure is that it is independent of the actual distribution of incomes in the economy. Hence, unlike measures of redistribution that are defined as differences between market and net Gini coefficients, this measure is exogenous to the behavior

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[18] This is done in two instances, by placing the following restrictions on the value of index t in equation (1): (i) $1981 \leq t \leq 1989$, $1990 \leq t \leq 1999$, $2000 \leq t \leq 2017$; and (ii) $1985 \leq t \leq 1994$, $1995 \leq t \leq 2004$, $2005 \leq t \leq 2017$. Because of data availability limitations, this exercise is carried out only for the following progressivity measures: (1) the top statutory rate and its square and (2) the proposed measure of progressive capacity.

[19] An analysis is conducted using both regular and bootstrapped standard error quantile regressions for quantiles 75, 80, and 90.

of private agents. Hence it can also be used to analyze the impact of progressive tax systems on market distributions of income. While redistribution (if successful) trivially reduced after-tax inequality, it may also reduce pre-tax inequality, for example if it reduces work effort or rent seeking at the upper end of the income distribution by more than at the lower end. A remaining possibility of endogeneity of this measure is political: it could be that governments in unequal societies implement progressive tax systems to address the issue. This would, however, go into the opposite direction and bias coefficients upwards.

To assess this empirically, we perform a few regressions of market (i.e., gross income) Gini coefficients (*G*) on tax progressivity.

$$G_{it} = a + \beta_1 p_{i,t-1} + \gamma' \mathbf{X}_{i,t-1} + f_i + g_t + \varepsilon_{it} \tag{2}$$

As shown in Table 3, we find quite strong evidence of such an effect, across various specifications, and with the progressive capacity calculated over different income ranges.[20]

Table 3. Progressive Capacity and Market Gini Coefficients

	(1)	(2)	(3)	(4)
Progressive capacity$_{t-1}$, 0-500% of income	-25.25***	-26.48***		
	(7.807)	(8.840)		
Progressive capacity$_{t-1}$, 0-1000% of income			-39.08**	
			(18.07)	
Progressive capacity$_{t-1}$, 0-2000% of income				-13.64*
				(7.477)
Pop. growth$_{t-1}$		-0.925	-0.964	-1.058
		(0.781)	(0.841)	(0.800)
ln(GDP pc)$_{t-1}$		1.754	1.768	1.804
		(1.508)	(1.461)	(1.574)
Capital account openness$_{t-1}$		-0.862	-0.921	-0.218
		(1.511)	(1.551)	(1.553)
Observations	707	678	678	678
Number of countries	35	34	34	34

Source: Authors' Estimates.

While the progressive capacity variable is exogenous in the sense that it is not affected by the actual distribution, it may still be politically endogenous, in the sense that policy makers could be more inclined to introduce progressive tax systems when inequality rises, so as to counteract this development. This possibility would, however, go in the opposite direction of the results presented here, and would bias the coefficient upwards.

This finding is particularly interesting when compared to the absence of an impact on economic growth. Provided both findings hold up to further research, this would suggest that making a tax

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[20] We also ran regressions on concurrent values of the progressive capacity measure and obtained the same results.

system more progressive does have a real impact on market economy outcomes by reducing inequality, but nevertheless no detrimental impact on growth.

V. DISCUSSION AND CONCLUSIONS

This paper has approached progressivity from different angles. Bringing together our findings, we can conclude strongly that progressivity has decreased over the last few decades, a finding that is robust to the choice of measure. We also conclude, but with less certainty, that the reduction in progressivity appears not to have given growth a boost.

While this paper focused on personal income taxes, developments in capital income taxation are also likely to have contributed to reducing overall progressivity: Capital income is distributed more unequally than labor income, has risen over the past few decades as a share of total income (IMF, 2017b), and is often taxed at a lower rate than labor income. The corporate income tax, in particular, plays an important role in determining progressivity. First, there can be a direct effect to the extent that it is partly borne by owners of corporations. Second, it indirectly supports the enforcement of the taxation of labor income: Corporate taxation mitigates arbitrage in response to taxation of entrepreneurial income, because distinguishing labor income from capital income can be difficult (or impossible) when individuals can freely choose the form through which they declare their income (IMF, 2014). When the personal income tax base can be shifted to some alternative tax base that is taxed at a lower rate (such as corporate income), optimal tax theory implies that the optimal tax rate on personal income rises with the tax rate on the alternative base.[21] In recent decades, international tax competition—resulting from capital mobility—has led to a steady downward trend in corporate income tax rates (Table 2). This trend reduces overall tax progressivity and may also put downward pressure on personal income tax rates—even though labor itself is less mobile and could be taxed more easily in a globalized world.

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[21] The optimal top income tax rate (t^*), allowing for income shifting, can be calculated based on the following formula: $t^* = (1 + s \cdot \tau \cdot ae)/(1 + ae)$, in which s is the share of marginal income shifted from the individual base, τ is the tax rate on the alternative tax base (for example, corporate income or capital income), and all other parameters are as previously defined, with the marginal welfare weight set to zero (Saez, Slemrod, and Giertz 2012).

Figure 7. Average (Combined) Corporate Income Tax Rates

(in percent)
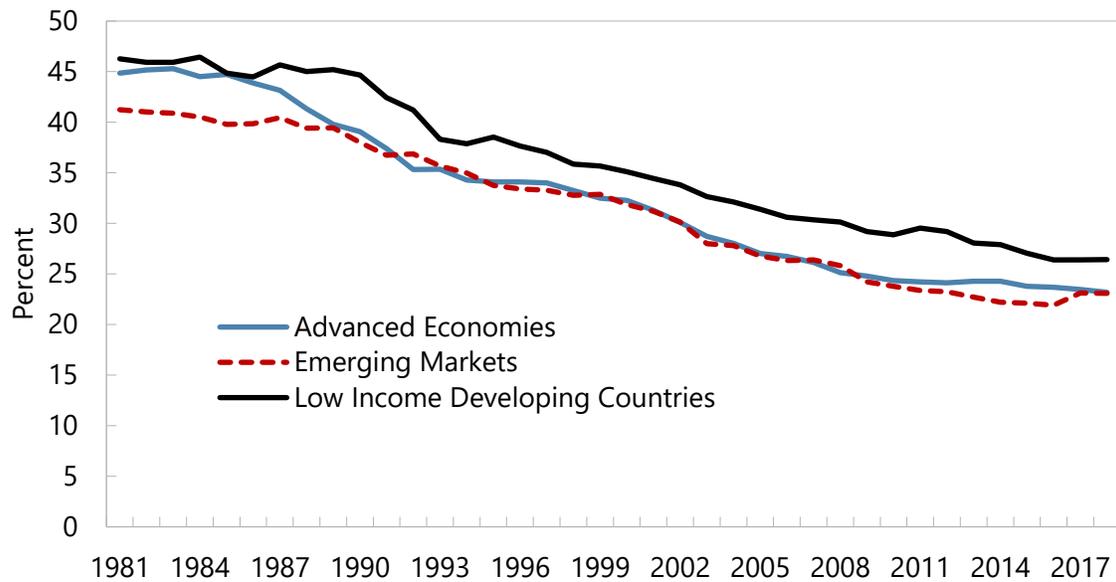
Source: FAD Tax Policy Rates Database.

There are many unresolved questions and areas for further research. For example, progressivity measures taking the entire tax and benefit system, and ideally even public spending, into account would enhance the understanding of overall progressivity tremendously. The challenges in finding such a measure, especially one that is still independent of pre-tax and spending distributions are enormous.

Despite the absence of a fully comprehensive measure of progressivity, and some reasonable doubts about the impact of progressivity on growth, it appears safe to say that progressivity-enhancing measures could be taken without major risks to growth. This would be especially relevant in countries that are marked by great inequality.

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