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Competition in Corporate and Personal Income Tax: Evidence from 67 Developed and Developing Countries*

Young Lee**

This paper empirically investigates tax competition in corporate income taxes (CIT) and personal income taxes (PIT) in 67 countries between 1981 and 2015. We find that tax competition in PIT is weaker than that in CIT, and various domestic considerations appear to act strongly in determining PIT. We also find that tax competition is a key determinant in setting CIT in developing countries as well as in developed countries. In addition to estimating the response function, we explore the possibility of adjustment cost and rigidity by estimating the error correction model type (ECM-type) and pooled mean group estimation (PMG). ECM-type and PMG estimations provide evidence of a partial adjustment instead of an instant full adjustment of tax rates. Furthermore, we find evidence that countries tend to adjust more strongly when lowering than raising rates, in agreement with the kinked demand curve model, which has not been explored in tax competition studies.

JEL Classification: H24, H25, D43
Keywords: Tax Competition, Corporate Income Taxes, Personal Income Taxes, System Generalized Method of Moments, Pooled Mean Group, Kinked Demand Curve

I. Introduction

This paper empirically investigates tax competition in corporate income taxes (CIT) and personal income taxes (PIT) in 67 countries from 1981 to 2015. A remarkable drop in CIT and PIT during the last three decades provides an intriguing opportunity to investigate the determinants and consequences of tax rate

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** Professor, Department of Economics and Finance, Hanyang University, 222 Wangsimni-ro, Seongdong-gu, Seoul 04763, Korea, Email: younglee@hanyang.ac.kr

changes. A large body of literature on the determinants of CIT has found evidence of tax competition using the data from Organization for Economic Co-operation and Development (OECD) and European countries. What distinguishes the current research from previous studies is that its sample covers 32 developing countries and 35 developed countries. In addition, the current study has a sample period longer than that of any existing study. This large sample with ample variation allows us to identify tax competition in CIT even after controlling for country and year dummies and country-specific trends.

We contribute to the related literature in four ways. First, we examine the determinants of PIT and CIT together in a comparable setting. Only Egger, Pfaffermayr, and Winner (2007) have previously analyzed PIT as a dependent variable. Conceptually, tax competition in PIT can be significantly different from that in CIT. Hence, an empirical investigation of the determinants of PIT is needed. We find that tax competition in PIT is weaker than that in CIT. Moreover, various domestic considerations appear to act more strongly in determining PIT. A policy implication of these findings is that adjusting the CIT rate is often limited by international competition. Hence, fulfilling domestic consideration, such as a large welfare expenditure, often requires adjusting PIT.

Second, we investigate developing and developed countries. In the empirical analysis of previous studies about tax competition, the data of developing countries are seldom used.[1] We find that tax competition in CIT has been present in developing countries as strongly as in developed countries.

Third, most recent studies estimate the response function. However, we explore the possibility of adjustment cost and rigidity by estimating the error correction model type (ECM-type) and pooled mean group estimation (PMG). Conceptually, tax competition fits well with the ECM because only partial adjustments of tax rates are feasible due to the presence of keen interest groups and high adjustment costs. Our ECM-type and PMG estimation results provide evidence of a partial adjustment instead of an instant full adjustment of tax rates. Furthermore, we can add a new interpretation to the estimated response function by conducting an ECM-type analysis.

Last, we find that countries adjust asymmetrically depending on the direction of changes in tax rates. Countries respond more strongly when lowering than raising CIT rates, in agreement with the kinked demand curve model. This finding is not surprising because raising tax rates faces strong opposition by specific interest groups, whereas lowering rates is welcome from those who benefit (Devereux et al., 2002). Moreover, the resulting deterioration of government finance is an issue general enough not to rouse organized opposition (Olson, 1965). This kind of

[1] Exceptions are Keen and Simone (2004), Klemm and Parys (2012), and Abbas and Klemm (2013). See Section 2 for details.

asymmetric response is common. Other firms respond more strongly when one firm lowers the price than when it raises the price. Hence, firms' strategic behaviors in oligopoly markets are conjectured to have an asymmetric response function. Most existing studies on tax competition borrow an analytical framework from firms' strategic behaviors in various market conditions, such as the Cournot-Nash equilibrium, Stackelberg model, and monopolistic competition. However, this kinked demand curve model has not been explored in tax competition studies.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 explains specifications, data, and samples. Section 4 reports the summary statistics and simple correlation results. Section 5 reports regression results. Section 6 concludes with a summary and discussion.

II. Literature Review

Many studies on the determinants of tax rates exist. Leibrecht and Hochgatterer (2012) and Devereux and Loretz (2013) provide an excellent review of the issue. Devereux and Loretz (2013) nicely summarize the various forms of tax competition and empirical strategy taken by previous studies. Forms of tax competition used in the literature include Bertrand competition with *N* players, monopolistic competition, asymmetric Bertrand competition, and Stackelberg competition (Table 1 in Devereux and Loretz, 2013). However, the kinked demand model has not been investigated as a form of tax competition. Our findings on asymmetric response by countries depending on the direction of changes in tax rates show the importance of the asymmetric expectation in the kinked demand model. To the best of our knowledge, no previous studies have investigated tax competition in PIT. The reason may be that domestic consideration is a more important factor affecting PIT than international tax competition. Theoretical investigation for tax competition in PIT can be similar to that in CIT. Thus, our empirical investigation on tax competition in PIT can fill the gap.

The literature has attempted to explain CIT rates by global tax competition, domestic economic/social need, and the economic/social/political environment. Global tax competition induces governments to lower CIT rates, forcing them to "race to the bottom." Corporate tax harmonization among countries has been suggested to avoid harmful tax competition (OECD, 1998; Weiner and Ault, 1998; Sørensen, 2004). "Racing to the bottom" implies convergence toward zero tax rates and no significant tax revenue from CIT. However, corporate tax revenues have been rather stable despite tax competition (Devereux *et al.*, 2002). Huizinga and Nicodème (2006) suggest foreign ownership of firms as one reason for the absence of a "race to the bottom" in corporate tax levels. They find that countries with high foreign ownership are expected to impose relatively high corporate taxes in Europe.

The weighted average of CIT in other countries and CIT in the Stackelberg leader country are used in the literature as a variable to capture tax competition. Most recent studies investigating tax competition use the weighted averages of CIT in other countries as the main determinants. Moreover, various weights are used and interpreted accordingly (Redoano, 2007). Devereux *et al.* (2008) are early pioneers in using response function estimation. They find a positively sloped reaction function for the statutory rate and additional mixed evidence concerning the effective tax rate. Davies and Voget (2008), Dreher (2006), Overesch and Rincke (2011), Redoano (2007), and Osterloh and Debus (2012) find evidence of Nash-type tax competition by using the weighted averages of CIT of other countries. Stackelberg competition in CIT is suggested by Gordon (1992). Altshuler and Goodspeed (2015) find supportive evidence of the United States' playing the role of Stackelberg leader after the 1986 U.S. tax reform. A spatial approach using the weighted averages of a policy variable in neighboring countries is used to investigate international competition in other policies. Examples are labor standards (Davies and Vadlamannati, 2013) and environmental policy (Davies and Naughton, 2014).

Previous studies have examined the role of CIT working as a backstop for PIT, satisfying government revenue need and lowering the efficiency cost of taxation as a domestic economic/social need. A corporate tax can serve as a backstop to the reclassification of labor income as business income. Hence, the statutory CIT can be high in countries in which PIT is high (Slemrod, 2004). In a country with a population structure of few workers and many dependents, CIT rates tend to be high to finance social and welfare expenditures (Devereux *et al.*, 2008; Overesch and Rincke, 2011). One needs a CIT with low rates and a broad base to lower the efficiency cost of CIT.[2]

Previous studies have investigated an economy's size, openness, and political environment, as economic/social/political environment affects CIT. Large countries with few open economies can have high CIT tax rates. Empirical evidence of the effects of openness is quite mixed. Overesch and Rincke (2011) find no evidence that countries that have become open have greatly reduced their tax rates. By contrast, the negative effect of openness on tax rates is reported in Slemrod (2004) and Winner (2005). Right-wing parties emphasizing business-friendly environments can contribute to lowering CIT rates, whereas left-wing parties focusing on distributive justice may raise CIT rates (Leibrecht and Hochgatterer, 2012).

Few studies investigating tax competition in developing countries exist. Keen and Simone (2004) find that developing economies have cut rates, introduced special

[2] Downward pressure on CIT rates is offset by broadening the tax base, which enables countries to maintain their effective marginal tax rates on capital (Devereux, Griffith, and Klemm, 2002; Swank and Steinmo, 2002; Loretz, 2008).

regimes, and lost revenues using the sample of 40 economies over 1990–2002. Klemm and Parys (2012) assemble a new dataset of tax incentives in over 40 developing countries. They find evidence of tax competition over the CIT rate and strategic interaction in tax holidays. They use the system generalized method of moments (GMM) estimation to circumvent endogeneity problems associated with using fixed country effects and the lagged weighted average of tax rates in other countries. Our most preferred specifications also use the system GMM as in Klemm and Parys (2012). Abbas and Klemm (2013) use the dataset on CIT regimes in 50 emerging and developing economies over 1996–2007. They find that the effective tax rate reductions have not been larger than those witnessed in advanced economies. In addition, revenues have held up well over the sample period except in Africa.

The focus of the empirical investigation of tax rate determination has been on CIT. An exception is Egger, Pfaffermayr, and Winner (2007), who investigate the determinants of PIT together with CIT. They find that OECD countries increased their PIT rate in response to a foreign increase of PIT rate and a foreign cut of CIT rate using 30 OECD countries from 1985 to 2005.

III. Specification, Data, and Sample

We start with the specifications most widely used in previous studies. Our independent variables are the four categories of determinants of a country's tax rates: tax competition, economic environment, domestic need, and political environment. We elaborate on independent variables for CIT because independent variables for the regressions of PIT rates are symmetric to those of CIT rates. Tax competition is represented by a weighted average of lagged CIT rates in other countries, weighting by the reciprocal of the distance between the two countries ($\overline{CIT}_{-i,t}$).[3]

Variables representing domestic need economic environment are the log of GDP ($GDP_{i,t}$), the log of GDP per capita ($GDPPC_{i,t}$), and the ratio of import and export to GDP ($OPN_{i,t}$). The log of GDP is included because large countries face less severe international competition and often manage to have CIT and PIT rates customized to their own needs instead of the international norm. The log of GDP

[3] We use the reciprocal of distance as weights (as in Lee and Gordon, 2005), We investigate the reciprocal of the square of the distance (as in Overesch and Rincke, 2011) and the GDP of the other country divided by the square of the distance. See Devereux and Loretz (2013) for the discussion about the meaning of various weights used in previous studies. In ordinary least square (OLS) and three-stage least square (3SLS) estimations with the alternative weights, the estimated coefficient of $\overline{CIT}_{-i,t-1}$ becomes small but is still statistically significant. In the system GMM estimations with the alternative weights, the estimated coefficient of $\overline{CIT}_{-i,t-1}$ becomes insignificant though generally taking the expected sign.

per capita is included because many developed countries tend to rely on PIT. In the literature, various measures of openness are used, including financial market openness, trade, and foreign direct investment. Openness variables are often found to be insignificant in previous studies.

Variables representing domestic need are personal income rate ($PIT_{i,t}$) because of its functioning as a backstop to CIT (Slemrod, 2004), urbanization rate ($URB_{i,t}$), proportion of the population aged 0–14 as a percentage of the total population ($POP_{i,t}^{0-14}$), and proportion of population aged 65 and above of the total population ($POP_{i,t}^{65}$). Similar to PIT's functioning as a backstop to CIT, CIT also functions as a backstop to PIT. We use the term "the systemic complementarity between PIT and CIT" to capture these two-way impacts.

Last, the political environment is represented by the political orientation of the government party from the Database of Political Institutions 2015 (DPI) (Cruz *et al.*, 2016). The political orientation variable in the study is constructed slightly differently from that in Devereux *et al*. (2008) and Exbrayat (2017). We follow Devereux *et al*. (2008) and Exbrayat (2017), except that we use the original category of DPI (i.e., right, center, and left). Moreover, we require the executive party as one of the government parties. Changing tax law requires overcoming the interest groups and persuading the public. Hence, whether the party of government or its coalition has a majority in the parliament is important.

The above specification assumes an instant adjustment of tax rates. The lagged dependent variable is included as an independent variable to allow for the rigidity of tax rates and sluggish adjustment by Swank and Steinmo (2002), Winner (2005), Cassette and Paty (2008), Overesch and Rincke (2011), Klemm and Parys (2012), and Exbrayat (2017). The specification with the lagged dependent variable is

$$CIT_{i,t} = \beta_0 + \beta_1 \overline{CIT}_{-i,t-1} + \beta_2 CIT_{i,t-1} + \beta_3 PIT_{i,t} + \gamma X + \varepsilon_{i,t}, \tag{1}$$

where X is a vector of other control variables.

Our specification and data fit well with the system GMM estimation designed by Arellano–Bond (Arellano and Bond, 1991) in the following aspects (Roodman, 2009): (1) our data are "small *T*, large *N*"; (2) left-hand-side variables depend on their own past realizations; (3) the weighted average of tax rates in other countries is not strictly exogenous; (4) fixed country effects are included; and (5) heteroskedasticity and autocorrelation within countries but not across them may exist. The system GMM allows the use to distinguish causality and correlation, which is extremely important from a policy perspective. In the system GMM estimations, we treat two regressors as potentially endogenous variables: the weighted average of tax rates in other countries and the tax variable for the systemic complementarity between PIT and CIT. We use the lagged dependent variable and all its available lags as a GMM type variable. We use the weighted average of the control variables in other countries as instruments, weighting by the reciprocal of the distance, as is common in the literature (e.g., Devereux *et al.*, 2008; Davies and Voget, 2008). In the system GMM estimations, we use the level of instruments.[4]

In addition to the system GMM, we conduct ordinary least square and three-stage least square (3SLS) estimation to discuss bias from endogeneity.

Equation (1) resembles the ECM. Equation (2) is a typical specification used in ECM, except that we use $\overline{CIT}_{-i,t-1}$ instead of $\overline{CIT}_{-i,t}$. This event is because of the assumption that the CITs of other countries are observable only with a time lag.

$$\Delta CIT_{i,t} = \alpha_1 \Delta \overline{CIT}_{-i,t-1} + \alpha_2 (CIT_{i,t-1} - \alpha_3 \overline{CIT}_{-i,t-1}), \tag{2}$$

where α_1 and α_3 are positive, and α_2 is negative, representing error correction.

Rearranging Eq. (2) gives us

$$CIT_{i,t} = CIT_{i,t-1} + \alpha_2 (CIT_{i,t-1} - \alpha_3 \overline{CIT}_{-i,t-1}) + \alpha_1 \Delta \overline{CIT}_{-i,t-1}, \tag{3}$$

$$= (1+\alpha_2) CIT_{i,t-1} + (\alpha_1 - \alpha_2 \alpha_3) \overline{CIT}_{-i,t-1} - \alpha_1 \overline{CIT}_{-i,t-2}. \tag{4}$$

Comparing Eqs. (1) and (4) allows us to interpret the coefficient of Eq. (1) using the meaning of the corresponding ECM. Eq. (1) is equivalent to Eq. (4) with the assumption of $\alpha_1 = 0$. In this case, $\beta_1 = -\alpha_2 \alpha_3 > 0$, and $\beta_2 = 1 + \alpha_2 < 1$. If estimation results imply $\hat{\beta}_1 + \hat{\beta}_2 \approx 1$, then $\hat{\alpha}_3 \approx 1$, and $\hat{\beta}_1 \approx 1 - \hat{\beta}_2 \approx \hat{\alpha}_2$ (i.e., $\hat{\beta}_1$ can be treated as the estimated coefficient of the error correction term).

Another way to compare Eqs. (1) and (4) is to add $\overline{CIT}_{-i,t-2}$ to Eq. (1). In this case, $\beta_1 = \alpha_1 - \alpha_2 \alpha_3 > -\alpha_2 \alpha_3$, $\beta_2 = 1 + \alpha_2 < 1$, and the coefficient of $\overline{CIT}_{-i,t-2}$ is equal to $-\alpha_1$. We expect the coefficient of $\overline{CIT}_{-i,t-1}$ to increase. Moreover, the coefficient of $\overline{CIT}_{-i,t-2}$ is negative when $\overline{CIT}_{-i,t-2}$ is added, which is confirmed in our regression results (see Column (3) of Table 3).

Our tax variables come from various sources: the OECD Statistics Tax Database (OECD Table II.1 for CIT, OECD Tables I.1 and I.7 for PIT), the *World Tax*

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[4] The STATA command we use for GMM estimations is

xtabond2 $CIT_{i,t}$ $CIT_{i,t-1}$ $\overline{CIT}_{-i,t-1}$ $PIT_{i,t}$ *"ControlVar" YD* CodeD* TrendCodeD*, gmmstyle(* $CIT_{i,t-1}$ *, laglimits(1 .)) ivstyle("ControlVarIV" "ControlVar" YD* CodeD* TrendCodeD*, equation(level)),*

where "*ControlVar*" are control variables, that is, X in equation (1), "*ControlVarIV*" are the weighted average of the control variables in other countries, *YD** are year dummies, *CodeD** are country dummies, and *TrednCodeD** are country-specific trends. This *STATA* command implies that we have a lagged dependent variable and all its available lags as GMM-type instruments for first differences equation. Moreover, we have "*ControlVarIV*," "*ControlVar*," *YD**, *CodeD**, and *TrendCodeD** as standard instruments and difference in lagged dependent variables for level equation.

Database from the Office of Tax Policy Research (OTPR) at the University of Michigan, the World Bank's *World Development Indicator* (WDI), Price Waterhouse Cooper (PwC) annual publications on *Corporate Taxes: Worldwide Summaries and Individual Income Taxes: Worldwide Summaries*, Ernst & Young's annual publications on *Global Executive: Individual tax, Social Security, and Immigration, KPMG's Corporate Tax Rate Survey around the World*, and Deloitte's *Corporate Tax Rate Research*. OTPR and WDI stopped compiling the data around 2003. Hence, the data after 2003 are compiled using OECD statistics, using the annual publications of PwC, Ernst & Young, KPMG, and Deloitte. We compare the data from various sources and assess data consistency over time. CIT rates are statutory tax rates compiled for the general government, and PIT rates are top statutory rates compiled for the central government because of data availability.[5] The same CIT and PIT data are used in Park and Lee (2019). The data of tax rates are available upon request from the author.

Our tax variables are statutory rates, not effective rates. Effective tax rates are relevant when investigating firm decisions. However, statutory tax rates can be relevant in our analysis because we investigate government decisions. Furthermore, a debate about ways to measure effective rates exists, and many previous studies use statutory tax rates (e.g., Overesch and Rincke, 2011; Devereux *et al*., 2008). Devereux and Loretz (2013) discuss strengths and weaknesses of using different tax rates. Moreover, Table 2 in Devereux and Loretz (2013) classifies the tax rates used in previous studies.

Our main sample consists of 67 countries, with 35 OECD and 32 non-OECD countries.[6] After constructing a sample with non-missing observations, we eliminate six additional countries: China, Kuwait, Saudi Arabia, and Tunisia because of no variation in PIT, and Bolivia and Romania because of no variation in CIT.[7]

[5] We correct certain tax rates from OECD statistics. CIT rates are corrected or compiled for France (36.09% in 2012 and 2013; 37.99% in 2014–2016, reflecting CIT surcharge for large firms), Korea (32.25% in 1995), Estonia (26% between 1994 and 1999), and Slovenia (25% between 1995 and 1999). PIT rates are corrected or compiled for Denmark (70% between 1981 and 1986; 68% in 1987), Greece (60% in 1983; 45% in 2000; 42.5% in 2001), Luxembourg (57% in 1983 and 1984; 50% in 1997; 42% in 2001), Malaysia (29% in 2001), Slovak Republic (42% in 2001), Slovenia (50% in 2000 and 2001), Spain (56% in 1997 and 1998; 48% in 1999), and Switzerland (compiled using the original tables of OECD for tax rates before 1999).

[6] The 67 countries are as follows: Argentina, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Czech Republic, Denmark, Ecuador, Egypt, Arab Rep., Estonia, Finland, France, Germany, Greece, Guatemala, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Korea, Rep., Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Paraguay, Peru, Philippines, Poland, Portugal, Russian Federation, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela, RB, and Vietnam.

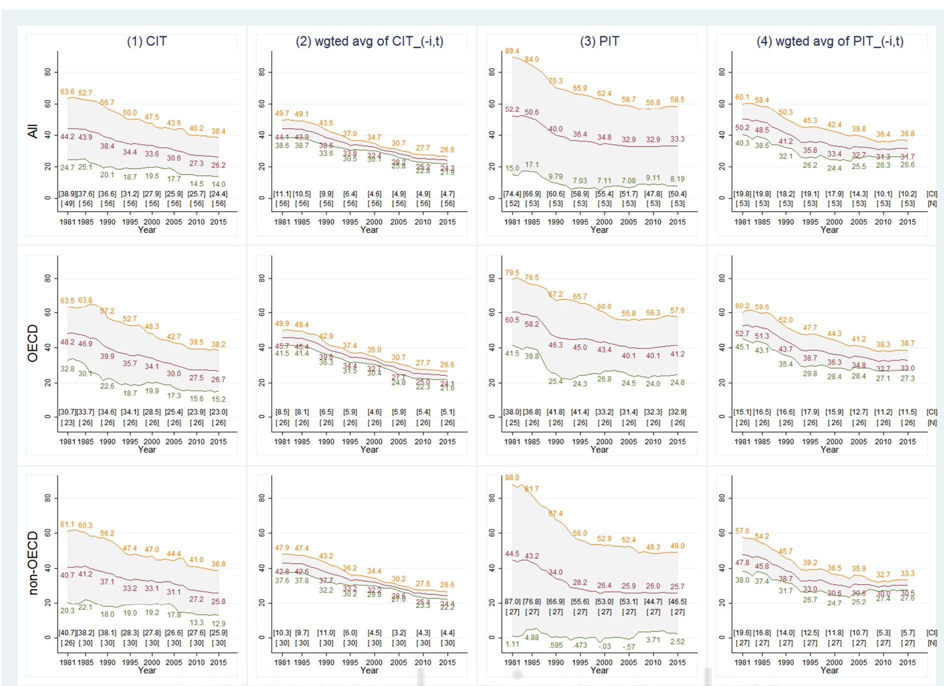
[7] Columns (4) and (8) in Table 2 report GMM estimation results when we add these six countries to the sample.

Variations in dependent variables are necessary to conduct PMG estimations. Our main dataset is an unbalanced data set of 1993 observation from 67 countries and a maximum of 35 years from 1981 to 2015. ECM-type regressions and PMG estimations for CIT have few observations because these regressions need a two-year lagged value of CIT rates, and their 1980s values are missing.

IV. Simple Analysis

Figure 1 shows that averages and standard errors of CIT and PIT have considerably decreased during the past 35 years. Average CIT decreased from 44.2% in 1981 to 26.2% in 2015, and the 95% confidence interval (CI) of CIT decreased from 38.9% to 24.4%. Average and 95% CI of PIT also decreased from 52.2% to 33.3% and from 74.4% to 50.4%, respectively. Variations in PIT across countries are larger than those in CIT. Interestingly, drops in CIT occur in two waves, one between 1985 and 1995 and the other between 2000 and 2010. The first wave was initiated by the U.S. Tax Reform Act of 1986. The second wave was most likely caused by the commencement of World Trade Organization (WTO) in 1995. Since 2010, the competition in lowering CIT appears to have calmed. The drop in PIT occurs in

[Figure 1] Trends and the 95% CI of $CIT_{i,t}$, $\overline{CIT}_{-i,t}$, $PIT_{i,t}$, and $\overline{PIT}_{-i,t}$ in 1981–2015



Notes: Numbers in brackets are the size of 95% CI and the number of countries.

one strong wave from 1985 to 1995. Averages PIT of the entire sample have remained stable since the early 2000s, and the average PIT in OECD slightly increased in the 2010s.

OECD and non-OECD countries appear to become alike over time. In the early 1980s, the averages of OECD were larger than those of non-OECD, and the standard errors of OECD were smaller than those of non-OECD. During the last 35 years, the average of OECD countries decreased more rapidly than that of non-OECD countries, and the standard error of non-OECD countries decreased more rapidly than that of OECD countries. The average $\overline{CIT}_{-i,t}$ values are similar to the average of CIT by construction. The standard error and 95% CI of the weighted average of CIT are approximately 1/3 to 1/4 of those of CIT.

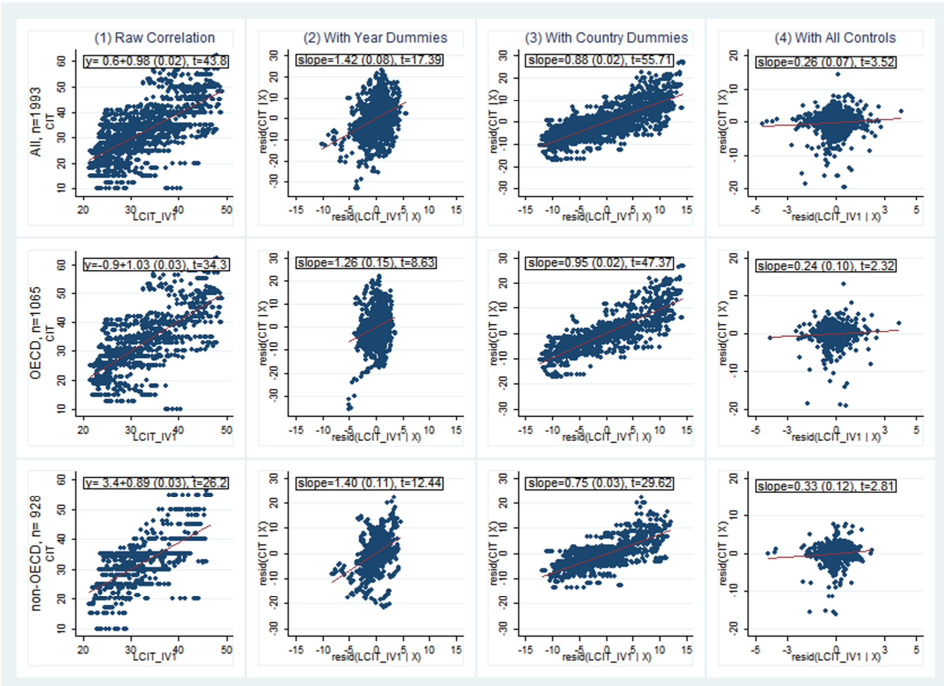
Figure 2A illustrates raw correlation and partial plots between CIT and $\overline{CIT}_{-i,t-1}$. The top result in the last column corresponds to Column (2) of Table 3. Several interesting patterns of tax competition in CIT emerge. First, tax competition in CIT is estimated to present strongly in developing and developed countries. In all four correlations, we find that using the sub-sample of non-OECD countries, CIT is estimated to be strongly correlated with $\overline{CIT}_{-i,t-1}$. Second, controlling for country fixed effects is crucial to identify tax competition. However, controlling for yearly effects appears to reduce identifying variations. The significance of correlation significantly drops to less than half, with the t-value decreasing from 44 to 17. This finding indicates that identifying variations from international tax competition has concurrently occurred in most countries since the mid-1980s. In this context, many studies controlling for a year effect exist.[8] Third, even after controlling for country and year dummies, country-specific trends, and other controls, tax competition is estimated to be statistically and economically significant.

Figure 2B shows tax competition in PIT using the same format of Figure 2A for CIT. The top result in the last column corresponds to Column (4) of Table 3. We find that tax competition in PIT is less salient than that in CIT. The correlation between PIT and $\overline{PIT}_{-i,t-1}$ remains significant after controlling for year dummies or country dummies. When other control variables are added, the estimated coefficient of tax competition is no longer significant. Domestic factors appear to be important in setting PIT.

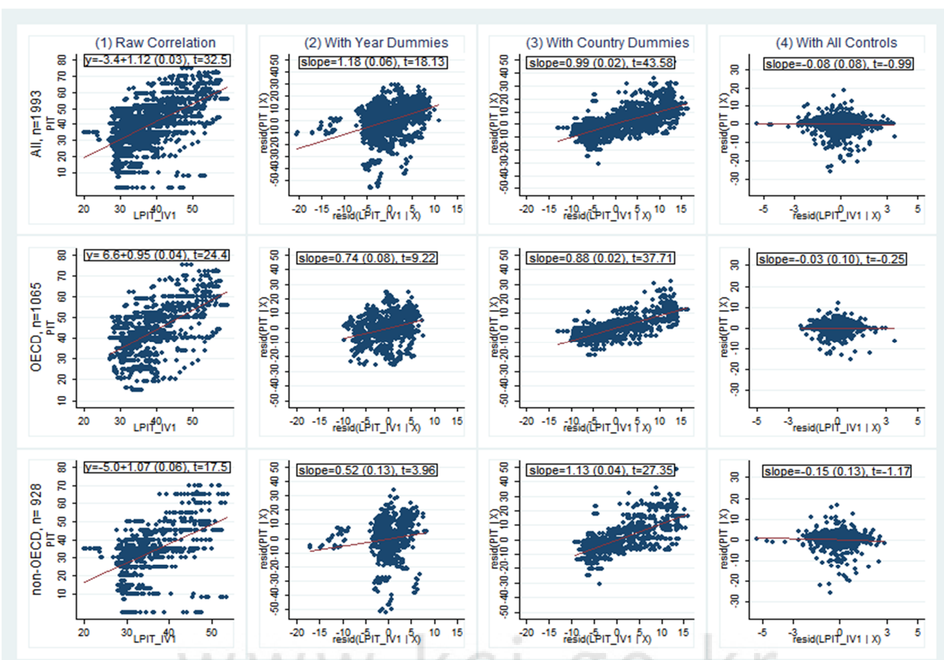
Geographical distance is more important for labor movement than for capital movement. The cost of moving capital may increase with the distance because capital movement involves the setup of a branch office and the movement of equipment and employees. We find that the correlation between $CIT_{i,t}$ and $\overline{CIT}_{-i,t-1}$ is 0.70 with a p-value of 0.00, whereas that between $PIT_{i,t}$ and

[8] The way we construct $\overline{CIT}_{-i,t-1}$ is also related to the feasibility of controlling for a year effect. If a uniform weight instead of the reciprocal of the distance is used, then controlling for year dummies is not possible because $\overline{CIT}_{-i,t-1}$ depends on the average of all statutory rates (Devereux *et al*., 2008).

[Figure 2A] Raw Correlation and Partial Plot between $CIT_{i,t}$ and $\overline{CIT}_{-i,t-1}$



[Figure 2B] Raw Correlation and Partial Plot between $PIT_{i,t}$ and $\overline{PIT}_{-i,t-1}$



$\overline{PIT}_{-i,t-1}$ is 0.59 with a p-value of 0.00. The large correlation between $CIT_{i,t}$ and $\overline{CIT}_{-i,t-1}$ can be caused by the proper working of geographical distance as weights, or by elastic response in CIT, or by both.

Table 1 reports the summary statistics for OECD, non-OECD, and all countries. The averages of CIT in the two sub-samples have a similar value, but the average PIT is larger in the OECD sub-sample than in the non-OECD sub-sample. In OECD countries, the average PIT is approximately 10%p larger than the average CIT.[9] As mentioned earlier when discussing Figure 2, $\overline{CIT}_{-i,t}$ has similar averages to those of $CIT_{i,t}$ but with small standard errors. The difference between $CIT_{i,t}$ and $\overline{CIT}_{-i,t}$ is quite close to zero for all countries and for the OECD and non-OECD sub-samples. However, the average of $PIT_{i,t} - \overline{PIT}_{-i,t}$ in the OECD sub-sample is significantly larger than zero, 5.0%p, and that of the non-OECD sub-sample is significantly negative, −2.1%p. This finding is further evidence that tax competition is not strong for PIT, and that domestic considerations other than tax competition are important. The summary statistics of controls show that developed countries tend to have a high income, are urbanized, and are aged. Another interesting difference involves the political system. The OECD and non-OECD sub-samples exhibit similar compositions of right, center, and left. However, OECD countries tend to form a government with a majority almost twice as frequently as non-OECD countries do.

[Table 1] Summary statistics

Sample (Number of observations)	All (N = 1993)				OECD (N = 1065)		Non-OECD (N = 928)	
	Mean	Standard Deviation (SD)	Min	Max	Mean	SD	Mean	SD
$CIT_{i,t}$	32.89	9.81	10.00	62.20	33.57	10.81	32.10	8.45
$PIT_{i,t}$	38.54	14.27	0	78.00	43.71	12.10	32.60	14.27
$CIT_{i,t-1}$	33.41	9.91	10.00	62.20	34.15	10.92	32.56	8.52
$PIT_{i,t-1}$	39.21	14.53	0	78.00	44.29	12.28	33.38	14.72
$\overline{CIT}_{-i,t-1}$	32.86	7.00	21.22	49.10	33.34	7.59	32.30	6.21
$\overline{PIT}_{-i,t-1}$	37.33	7.48	20.15	59.40	39.23	7.65	35.15	6.64
$CIT_{i,t-1} - \overline{CIT}_{-i,t-1}$	0.60	6.97	−29.64	22.03	0.85	7.40	0.32	6.44
$\max\{0, CIT_{i,t-1} - \overline{CIT}_{-i,t-1}\}$	2.96	4.16	0	22.03	3.23	4.54	2.64	3.65
$\min\{0, CIT_{i,t-1} - \overline{CIT}_{-i,t-1}\}$	−2.36	4.17	−29.64	0	−2.38	4.33	−2.33	3.97

[9] Figure C in the Appendix shows that most OECD countries have a larger PIT than CIT, and the gap becomes wider in the later period except in the Czech Republic, Hungary, Mexico, Norway, Slovak Republic, Sweden, and the United States.

$PIT_{i,t-1} - \overline{PIT}_{-i,t-1}$	1.70	11.52	−47.51	30.90	5.02	9.62	−2.10	12.32
$\max\{0, PIT_{i,t-1} - \overline{PIT}_{-i,t-1}\}$	5.32	6.29	0	30.90	7.02	6.61	3.37	5.26
$\min\{0, PIT_{i,t-1} - \overline{PIT}_{-i,t-1}\}$	−3.62	7.39	−47.51	0	−2.00	4.55	−5.47	9.34
$GDP_{i,t}$	26.07	1.57	21.84	30.44	26.72	1.47	25.32	1.33
$GDPPC_{i,t}$	9.31	1.27	6.01	11.62	10.22	0.67	8.27	0.96
$OPN_{i,t}$	79.78	60.32	12.35	441.6	78.92	48.82	80.78	71.28
$URB_{i,t}$	67.23	19.24	15.68	100	75.21	10.70	58.06	22.51
$POP^{0-14}_{i,t}$	25.14	9.38	12.86	50.10	19.59	5.06	31.51	9.14
$POP^{65}_{i,t}$	10.51	5.32	2.55	26.34	13.82	3.76	6.71	4.19
$MAJ^{R}_{i,t}$	0.23	0.42	0	1	0.28	0.45	0.17	0.38
$MAJ^{C}_{i,t}$	0.08	0.26	0	1	0.10	0.30	0.05	0.22
$MAJ^{L}_{i,t}$	0.18	0.38	0	1	0.22	0.41	0.13	0.34

V. Regression Results

We conduct a series of regression analysis for CIT and PIT. We started with the baseline regression results of the system GMM estimator in Table 2. Table 3 reports the regression results of OLS and 3SLS estimators. We investigate whether systematic differences exist between the OECD and non-OECD sub-samples in Table 4. We finally conduct ECM-type regressions, as presented in Tables 5A and 5B, and PMG regressions, as presented in Tables 6A and 6B.

Table 2 reports the baseline regression results of GMM estimators for CIT and PIT when different sets of dummies and trend variables are controlled for and when different samples, 67 or 73 countries, are used. As explained in Section 3, the difference between the main sample of 67 countries and the sample of 73 countries is whether we include six countries with no changes in PIT or CIT. Among the six added countries, four countries have no within-country variations in PIT and two countries have no within-country variations in CIT. The first four columns show the regression results for CIT, and the last four columns present those for PIT. In the regressions for CIT, the estimated coefficient of the tax competition variable ($\overline{CIT}_{-i,t-1}$) increases as we add controls. Moreover, such a coefficient remains significant even when the country and year dummies and country-specific trends are controlled. Column (4) uses the sample of 73 countries instead of the main sample of 67 countries. This column shows that the estimated coefficients of the tax competition variable decreases. The rigidity of CIT ($CIT_{i,t-1}$) is estimated to decrease as we add controls, and the estimated coefficient of $CIT_{i,t-1}$ is 0.759 when all controls are included. The systemic complementarity between PIT and CIT, that is, $PIT_{i,t}$, is estimated to be insignificant and very close to zero in estimations using the main sample of 67 countries. By contrast, the result is significantly positive in estimations when using the sample of 73 countries.

Regression results for PIT are meaningfully different from those for CIT. The tax competition variable becomes less significant as controls are added and becomes insignificant when country dummies and country-specific trends are added. In Column (8) where the sample of 73 countries is used instead of the main sample of 67 countries, the tax competition variable is significantly positive.[10] Notably, the tax competition variable in CIT regressions remains significant in all estimations. The estimated coefficients of the tax competition variable in PIT regressions are smaller and less significant than those in CIT. Hence, tax competition in PIT is not as strong as that in CIT. Moreover, the characteristics of an economy, observed or unobserved, affect PIT more strongly than CIT. The rigidity of PIT is estimated as significant as that of CIT. The systemic complementarity in PIT regressions is estimated to be more significant and larger than that in CIT regressions. Our interpretation is that international competition strongly affects CIT whose tax base is mobile internationally and that the systemic complementarity between PIT and CIT influences the PIT rate.

When we test autocorrelation in the first difference equations, we cannot reject the null hypothesis that no autocorrelation is observed in all estimations in Table 2. All the autocorrelation tests in Tables 4, 5A, and 5B indicate that we cannot reject the null hypothesis at the significance level of 5%. We also conduct the tests of overidentification restrictions, which produce different results depending on specifications. The results in Columns (1), (2), (4), and (5) indicate that the instruments are uncorrelated with the error term at the significance level of 5%. By contrast, the test results in Columns (3) and (6) indicate that the instruments are correlated with the error term or that the equation is misspecified in the sense that one or more of the excluded exogenous variables should be included in the structural equation. Tests of overidentifying restrictions in Tables 4, 5A, and 5B also produce mixed results. However, those of overidentifying restrictions are known to provide limited information on the ability of the instruments to identify the parameter of interest (Parente and Silva, 2012).

A large economy ($GDP_{i,t}$) is estimated to have high CIT rates. Moreover, a developed economy ($GDPPC_{i,t}$) is estimated to have high PIT rates and low CIT rates. This finding is consistent with the notion that an economy relies on CIT in an early stage of development and becomes dependent on PIT as the economy develops and tax administration of PIT becomes advanced. Urbanization can

[10] The two effects from adding six countries with no changes in CIT or PIT are large in cross-country variations but small in within-country variations. A possible explanation about seemingly contradictory results in Columns (4) and (8) is that small within-country variations outdo large cross-country variations for Column (4), and vice versa in Column (8).

represent economic development and the need for a large government role. Hence, a positive relationship with PIT may be observed. Youth population is estimated to be positively associated with CIT, perhaps because youth population represents low economic development. A right majority government party is estimated to have a high CIT, which is difficult to interpret. Exbrayat (2017) and Devereux et al. (2008) find similar results for their samples of OECD countries. Exbrayat (2017) suggests an explanation that right-wing parties may be willing to raise corporate taxes if fiscal revenues are used to finance public inputs that are attractive to firms.

Table 3 reports OLS and 3SLS estimation results to discuss bias from the endogeneity of the first three variables included as regressors. The first four columns show OLS results and the last four columns present 3SLS results. In OLS estimations, we treat all three potentially endogenous variables as exogenous. In 3SLS estimations, we estimate a system of simultaneous equation of PIT and CIT, treating the tax variable for the systemic complementarity as an endogenous variable and accounting for the correlation structure in the disturbances across the equations. We keep treating the lagged dependent variable and the weighted average of tax rates in other countries as exogenous in 3SLS estimations. Comparing OLS, 3SLS, and GMM, estimation results show that the significance of the three potentially endogenous variables is over-estimated when they are treated as exogenous. The tax competition variable in CIT regressions remains statistically and economically significant, whereas that in PIT regressions with country-specific trends is insignificant. The estimated coefficient of the tax variable for the systemic complementarity in PIT regressions, that is, $CIT_{i,t}$, remains significant in GMM. As mentioned earlier, our interpretation is that PIT is affected by CIT, which is strongly influenced by international competition.

Table 4A reports regression results when dividing the sample into the OECD and non-OECD sub-samples. The first four columns report the regression results of CIT and the last four columns report those of PIT. The tax competition variable becomes insignificant when country-specific trends are added in the OECD sub-sample. However, tax competition in CIT is generally observed in the OECD and non-OECD sub-samples. Tax competition in PIT is estimated to be insignificant in the OECD and non-OECD sub-samples.

The rigidity of CIT is observed to be present strongly in all regressions. The systemic complementarity of PIT and CIT is estimated to be present weakly in CIT regressions and strongly in PIT regressions. The size of an economy or the level of income is not estimated to be significantly associated with CIT rates. Therefore, the finding of their significant effect for the entire sample is driven by the between-group difference of the OECD and non-OECD sub-samples. The positive association between urbanization and PIT is present in the OECD sub-sample. The tendency of right-wing parties to have a high CIT and of left-wing parties to have a high PIT is observed only in the non-OECD sub-sample. Thus, the impact of the political system on taxation is strong in less developed economies.

[Table 2] Baseline regression results, GMM, 67 or 73 countries, 1981–2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	CIT	CIT	CIT	CIT	PIT	PIT	PIT	PIT
Dummy	{Y}	{C Y}	{C Y T}	{C Y T}	{Y}	{C Y}	{C Y T}	{C Y T}
$\overline{CIT}_{-i,t-1}$	0.156***	0.184***	0.317***	0.150**				
	(0.045)	(0.062)	(0.115)	(0.068)				
$CIT_{i,t-1}$	0.889***	0.860***	0.759***	0.762***				
	(0.015)	(0.015)	(0.015)	(0.015)				
$PIT_{i,t}$	0.002	−0.001	0.023	0.048***				
	(0.009)	(0.015)	(0.017)	(0.016)				
$\overline{PIT}_{-i,t-1}$					0.091***	0.114*	−0.067	0.125***
					(0.032)	(0.060)	(0.084)	(0.035)
$PIT_{i,t-1}$					0.921***	0.826***	0.703***	0.740***
					(0.010)	(0.013)	(0.015)	(0.015)
$CIT_{i,t}$					0.031**	0.043**	0.071***	0.065***
					(0.016)	(0.018)	(0.021)	(0.020)
$GDP_{i,t}$	0.207***	1.128	8.682**	10.39***	0.036	−4.45***	−5.873	−4.129
	(0.056)	(1.038)	(4.108)	(3.754)	(0.074)	(1.350)	(5.681)	(4.813)
$GDPPC_{i,t}$	−0.057	−0.746	−7.572*	−9.92***	0.455***	2.451*	5.387	3.128
	(0.105)	(1.007)	(4.013)	(3.626)	(0.148)	(1.296)	(5.541)	(4.638)
$OPN_{i,t}$	−0.000	0.003	−0.006	−0.007	−0.003	−0.006	−0.001	0.000
	(0.001)	(0.003)	(0.005)	(0.005)	(0.002)	(0.005)	(0.007)	(0.006)
$URB_{i,t}$	0.005	0.009	0.030	0.010	−0.004	0.050*	0.230***	0.189***
	(0.005)	(0.021)	(0.055)	(0.055)	(0.007)	(0.029)	(0.075)	(0.068)
$POP^{0-14}_{i,t}$	0.038**	0.076*	0.142*	0.169**	0.010	0.027	0.176	0.198**
	(0.016)	(0.043)	(0.081)	(0.076)	(0.023)	(0.056)	(0.109)	(0.096)
$POP^{65}_{i,t}$	0.026	−0.008	−0.098	0.007	−0.044	−0.145	−0.225	−0.161
	(0.027)	(0.068)	(0.156)	(0.155)	(0.039)	(0.092)	(0.214)	(0.191)
$MAJ^{R}_{i,t}$	0.408***	0.511***	0.500***	0.419**	0.017	−0.084	−0.173	−0.241
	(0.138)	(0.163)	(0.171)	(0.177)	(0.196)	(0.224)	(0.234)	(0.225)
$MAJ^{C}_{i,t}$	0.343	0.254	0.495	0.340	−0.008	0.038	−0.445	−0.425
	(0.210)	(0.273)	(0.315)	(0.319)	(0.296)	(0.376)	(0.430)	(0.400)
$MAJ^{L}_{i,t}$	0.107	0.153	0.271	0.261	0.249	0.316	0.339	0.250
	(0.150)	(0.182)	(0.194)	(0.199)	(0.213)	(0.248)	(0.264)	(0.253)
Observation	1993	1993	1993	2152	1993	1993	1993	2164
Country	67	67	67	73	67	67	67	73
AR(2) test†	0.299	0.309	0.368	0.523	0.589	0.613	0.665	0.669
OID test‡	0.263	0.086	0.000	0.000	0.983	0.750	0.011	0.029

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$; Dummy variables and constants are included but not reported. Set of dummies include: C = country dummies; Y = year dummies; T = country-specific trends.

†p-value of z in Arellano-Bond test for AR(2) in first differences. H0, no autocorrelation.

‡p-value of Sargan χ^2 in overidentifying restriction test. H0, instrumental variables are uncorrelated with the error term.

[Table 3] Regression results, OLS and 3SLS, 67 countries, 1981–2015, $n = 1993$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	CIT		PIT		CIT	PIT	CIT	PIT
Estimation method	OLS	OLS	OLS	OLS	3SLS		3SLS	
Dummy	$\{C\ Y\}$	$\{C\ Y\ T\}$	$\{C\ Y\}$	$\{C\ Y\ T\}$	$\{C\ Y\}$	$\{C\ Y\}$	$\{C\ Y\ T\}$	$\{C\ Y\ T\}$
$\overline{CIT}_{-i,t-1}$	0.219***	0.262***			0.236***		0.267***	
	(0.045)	(0.078)			(0.044)		(0.074)	
$CIT_{i,t-1}$	0.819***	0.727***			0.827***		0.733***	
	(0.012)	(0.015)			(0.012)		(0.014)	
$PIT_{i,t}$	0.036***	0.062***			0.009		0.017	
	(0.010)	(0.012)			(0.011)		(0.016)	
$\overline{PIT}_{-i,t-1}$			0.077	−0.076		0.107**		−0.050
			(0.055)	(0.080)		(0.054)		(0.077)
$PIT_{i,t-1}$			0.809***	0.697***		0.816***		0.705***
			(0.012)	(0.016)		(0.012)		(0.015)
$CIT_{i,t}$			0.080***	0.096***		0.043**		0.021
			(0.016)	(0.020)		(0.019)		(0.026)
$GDP_{i,t}$	1.843*	9.656**	−4.872***	−6.292	1.293	−4.517***	8.842**	−4.896
	(1.036)	(4.427)	(1.375)	(5.990)	(1.018)	(1.340)	(4.244)	(5.743)
$GDPPC_{i,t}$	−1.301	−8.707**	2.918**	5.818	−0.917	2.461*	−7.748*	4.465
	(1.012)	(4.313)	(1.324)	(5.842)	(0.991)	(1.293)	(4.137)	(5.601)
$OPN_{i,t}$	0.005	−0.006	−0.007	−0.001	0.004	−0.006	−0.006	−0.001
	(0.003)	(0.005)	(0.005)	(0.007)	(0.003)	(0.005)	(0.005)	(0.007)
$URB_{i,t}$	0.005	0.018	0.050	0.227***	0.008	0.051*	0.033	0.236***
	(0.022)	(0.059)	(0.030)	(0.080)	(0.022)	(0.029)	(0.057)	(0.076)
$POP_{i,t}^{0-14}$	0.065	0.107	0.036	0.181	0.077*	0.029	0.134	0.169
	(0.044)	(0.087)	(0.058)	(0.116)	(0.043)	(0.056)	(0.083)	(0.111)
$POP_{i,t}^{65}$	0.017	−0.064	−0.162*	−0.229	−0.002	−0.148	−0.095	−0.222
	(0.071)	(0.169)	(0.095)	(0.226)	(0.069)	(0.092)	(0.162)	(0.217)
$MAJ_{i,t}^{R}$	0.586***	0.522***	−0.163	−0.194	0.557***	−0.092	0.509***	−0.135
	(0.170)	(0.185)	(0.231)	(0.248)	(0.166)	(0.225)	(0.177)	(0.238)
$MAJ_{i,t}^{C}$	0.186	0.438	0.077	−0.430	0.218	0.035	0.454	−0.465
	(0.287)	(0.341)	(0.386)	(0.456)	(0.279)	(0.376)	(0.327)	(0.437)
$MAJ_{i,t}^{L}$	0.130	0.249	0.288	0.331	0.159	0.335	0.297	0.367
	(0.190)	(0.209)	(0.256)	(0.279)	(0.185)	(0.249)	(0.201)	(0.268)
R-squared	0.944	0.949	0.952	0.957	0.944	0.952	0.949	0.957

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$; Dummy variables and constants are included but not reported. Set of dummies include: C = country dummies; Y = year dummies; T = country-specific trends.

[Table 4] Regression results for OECD and non-OECD countries, GMM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	CIT				PIT			
Sample	OECD		Non-OECD		OECD		Non-OECD	
Dummy	{C Y}	{C Y T}	{C Y}	{C Y T}	{C Y}	{C Y T}	{C Y}	{C Y T}
$\overline{CIT}_{-i,t-1}$	0.287***	0.128	0.232***	0.432***				
	(0.077)	(0.106)	(0.073)	(0.127)				
$CIT_{i,t-1}$	0.851***	0.746***	0.813***	0.733***				
	(0.016)	(0.018)	(0.018)	(0.022)				
$PIT_{i,t}$	0.023	0.060***	0.024*	0.037**				
	(0.018)	(0.021)	(0.014)	(0.018)				
$\overline{PIT}_{-i,t-1}$					0.052	−0.026	0.082	−0.160
					(0.071)	(0.099)	(0.089)	(0.128)
$PIT_{i,t-1}$					0.806***	0.724***	0.799***	0.665***
					(0.016)	(0.019)	(0.018)	(0.023)
$CIT_{i,t}$					0.049***	0.090***	0.088***	0.094***
					(0.016)	(0.020)	(0.032)	(0.036)
$GDP_{i,t}$	0.569	6.503	1.084	8.006	−1.197	−1.007	−5.543**	18.393
	(2.165)	(5.847)	(1.403)	(7.982)	(2.338)	(6.436)	(2.264)	(13.576)
$GDPPC_{i,t}$	0.432	−2.257	−0.830	−6.393	0.562	−0.025	3.149	−19.238
	(2.058)	(5.900)	(1.428)	(8.046)	(2.259)	(6.468)	(2.326)	(13.677)
$OPN_{i,t}$	−0.001	0.001	0.005	−0.009	−0.013**	0.016	−0.005	−0.002
	(0.005)	(0.010)	(0.005)	(0.006)	(0.006)	(0.011)	(0.008)	(0.010)
$URB_{i,t}$	0.024	−0.019	−0.009	0.065	0.076**	0.180**	0.025	0.243
	(0.033)	(0.069)	(0.029)	(0.091)	(0.035)	(0.074)	(0.047)	(0.150)
$POP^{0-14}_{i,t}$	0.127**	0.166	−0.012	0.058	0.117*	0.145	0.048	0.459**
	(0.064)	(0.106)	(0.066)	(0.141)	(0.069)	(0.115)	(0.107)	(0.226)
$POP^{65}_{i,t}$	−0.064	−0.193	0.109	0.032	−0.151	−0.240	−0.028	0.048
	(0.095)	(0.187)	(0.148)	(0.316)	(0.096)	(0.203)	(0.245)	(0.507)
$MAJ^{R}_{i,t}$	0.287	0.251	1.225***	1.113***	0.016	−0.107	−0.370	−0.147
	(0.193)	(0.206)	(0.292)	(0.307)	(0.208)	(0.224)	(0.488)	(0.499)
$MAJ^{C}_{i,t}$	0.238	0.402	0.283	0.733	−0.110	−0.306	−0.002	−0.662
	(0.350)	(0.375)	(0.454)	(0.580)	(0.374)	(0.406)	(0.741)	(0.932)
$MAJ^{L}_{i,t}$	0.294	0.422*	−0.134	−0.028	−0.013	−0.105	1.088**	1.348**
	(0.219)	(0.230)	(0.331)	(0.381)	(0.233)	(0.247)	(0.539)	(0.608)
Observation	1,065	1,065	928	928	1,065	1,065	928	928
AR(2) test†	0.603	0.586	0.433	0.433	0.076	0.129	0.781	0.870
OID test‡	0.357	0.000	0.001	0.000	0.532	0.088	0.131	0.000

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$; Dummy variables and constants are included but not reported. Set of dummies include C = country dummies; Y = year dummies; T = country-specific trends.

†p-value of z in Arellano-Bond test for AR(2) in first differences. H0, no autocorrelation.

‡p-value of Sargan χ^2 in overidentifying restriction test. H0, instrumental variables are uncorrelated with the error term.

[Table 4B] OLS results of country-specific coefficients for 3 independent variables

	(1)			(2)		
Dependent variable		$CIT_{i,t}$			$PIT_{i,t}$	
Independent variable	$\overline{CIT}_{-i,t-1}$	$CIT_{i,t-1}$	$PIT_{i,t}$	$\overline{PIT}_{-i,t-1}$	$PIT_{i,t-1}$	$CIT_{i,t}$
Austria	0.326*	0.184**	1.486***	−0.191	0.271	0.284**
Costa Rica	1.371**	0.233**	0.592***	−0.794***	0.081	1.133***
Czech Republic	1.106**	0.248	0.102	1.397	0.362**	0.232
Denmark	1.126***	0.579***	−0.057	−0.369	0.729***	0.161
Egypt	0.863*	0.762***	−0.013	0.485	0.784***	0.228**
Greece	0.647*	0.687***	0.232***	0.374	0.367**	0.021
India	1.034**	0.223	0.321***	−0.179	0.440**	0.541**
Lithuania	1.742**	0.126	−0.403***	−0.516	0.865***	−0.332
Malaysia	1.166*	0.568*	0.034	0.181	0.557***	−0.221
Norway	2.266***	0.237***	0.223***	0.244	0.558***	−0.108
New Zealand	1.248**	0.403***	0.141***	−0.566*	1.073***	−0.499*
Pakistan	1.591***	0.463***	−0.065	−0.000	0.576***	−0.022
Paraguay	4.298***	0.364***	−0.236***	2.819***	0.239**	−0.399***
Singapore	1.130**	0.300	0.382**	−0.223	0.308	0.574
Sweden	0.825***	0.303***	0.563***	−0.796*	0.538***	0.548***
Turkey	1.670***	0.564***	−0.420***	−0.871***	0.791***	0.132
Vietnam	2.584*	0.782**	−0.152	0.742	0.820***	−0.057
South Africa	1.695***	0.675***	−0.026	−0.255	0.504	0.040
Argentina	0.320	0.420***	0.440***	0.079	0.324	0.530***
Australia	0.351	0.538***	0.272**	−0.194	0.550**	0.111
Belgium	0.571	0.495*	0.059	0.232	0.179	0.385
Bulgaria	−0.103	0.846***	0.097	0.333	0.247	0.274
Belarus	0.365	0.070	−0.062	12.186***	−0.534*	−1.546**
Brazil	0.032	0.485***	0.051	0.874***	0.700***	−1.595***
Canada	−0.296	0.811***	0.398	−0.043	0.013	0.114
Switzerland	0.596	0.302	0.051	−0.341	0.195	0.166
Chile	−0.299	0.116	0.236	0.090	0.241	0.301
Cote d'Ivoire	0.793	0.578**	0.011	−0.472	0.904***	−0.033
Colombia	−0.486	0.792***	0.057	−0.054	0.511***	0.534**
Germany	0.344	0.527***	0.373	−0.365	0.612*	0.184
Ecuador	−0.138	0.428	−0.073	0.643**	0.240***	−0.989***
Spain	0.223	1.170***	−0.040	−0.290	0.596***	0.360
Estonia	0.476	0.368	0.474	−0.777	1.367	0.252
Finland	−0.252	0.863***	0.625***	0.071	0.888***	−0.132
France	0.847	0.829***	−0.025	−0.763**	0.756***	0.146
United Kingdom	−0.229	0.892***	−0.066	0.334	0.571***	0.231
Guatemala	0.389	0.703***	0.199***	−0.852***	0.577***	0.574***
Croatia	1.241	−0.010	−0.637**	−0.075	0.701***	−0.487***
Hungary	−0.986**	0.732***	−0.241**	−0.639	0.628***	−0.286***

	(1)			(2)		
Dependent variable	$CIT_{i,t}$			$PIT_{i,t}$		
Independent variable	$\overline{CIT}_{-i,t-1}$	$CIT_{i,t-1}$	$PIT_{i,t}$	$\overline{PIT}_{-i,t-1}$	$PIT_{i,t-1}$	$CIT_{i,t}$
Indonesia	0.345	0.351	0.353**	−0.511**	0.175	1.098**
Ireland	−0.265	0.905***	0.264	0.334	0.228	−0.016
Iceland	−1.539	0.748	−0.334	1.496	0.374	−1.267*
Israel	0.887	0.381	0.307	0.192	0.312	0.386
Italy	0.163	0.775***	0.018	−0.128	0.553***	0.073
Japan	−0.712	0.538***	0.152**	0.246	0.522***	0.531**
Kenya	0.374	0.662***	0.156**	0.416	0.584***	−0.067
Korea, Rep.	−0.186	0.516***	0.140	0.154	0.600***	−0.041
Sri Lanka	0.433	0.156	0.468***	1.086	0.191	1.474***
Luxembourg	0.365	0.468*	0.207	0.088	0.616**	0.376
Latvia	2.176	0.201	0.094	−0.620	0.218	−0.560*
Morocco	0.542	0.644***	0.049	−0.064	0.467*	0.154
Mexico	−0.082	0.569	0.195	−0.159	0.340*	1.551***
Malta	0.022	−0.512	−0.048	−0.427	0.016	−11.839***
Nigeria	0.389	−0.048	0.313***	0.326	0.250**	1.664***
Netherlands	0.629	0.823***	−0.109	0.256	0.483**	−0.206
Peru	−0.155	0.630***	0.328***	0.451	0.410	0.241
Philippines	0.468	0.581*	−0.041	−0.467**	0.449***	0.045
Poland	0.816	0.729***	0.010	0.947	0.250	−0.560***
Portugal	0.239	0.633***	0.125**	−0.629*	0.807***	0.172
Russian Fed.	−0.199	0.470***	0.114	0.003	0.484***	0.490***
Slovak Republic	−1.233*	0.682***	0.316***	−0.634	0.546***	0.573***
Slovenia	0.216	1.241***	0.122	−0.475	0.745***	0.009
Thailand	−0.388	0.696***	0.120	0.588	0.275*	0.685***
Ukraine	−1.704*	0.154	0.213*	3.454***	0.810***	2.997***
Uruguay	0.252	0.605***	−0.084	0.134	0.531***	−0.507
United States	0.485	0.628***	0.149*	−1.235***	0.397***	1.444***
Venezuela	0.292	0.076	1.279***	−0.352	−0.011	0.782***

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Column (1) are results of the regression of *CIT* on country-specific $\overline{CIT}_{-i,t-1}$, country-specific $CIT_{i,t-1}$, country-specific $PIT_{i,t}$, other control variables, year dummy variables, trend, and constants as in Column (2) of Table 3. Estimated coefficients of the variables other than country-specific coefficients are not reported.

Column (2) are results of the regression of *PIT* on country-specific $\overline{PIT}_{-i,t-1}$, country-specific $PIT_{i,t-1}$, country-specific $CIT_{i,t}$, other control variables, year dummy variables, trend, and constants as in Column (4) of Table 3. Estimated coefficients of the variables other than country-specific coefficients are not reported.

Table 4B reports the regression results when we allow country-specific coefficients of tax competition, tax rigidity, and complementarity between CIT and PIT. We use OLS estimation technique because the number of instruments necessary is extremely large when the country-specific coefficients are allowed. Country-specific coefficients bestow benefit of allowing differential effects by country. However, such coefficients impose the cost of disallowing cross-country variations in the process of identification. The cost can be high if cross-country variations are larger than within-country variations. In CIT regressions, the estimated coefficients of tax competition for 18 countries are significant and positive as expected. These 18 countries are small countries which face strong international competition. In PIT regressions, those for only five countries are significant and positive, indicating again that tax competition in CIT is stronger than that in PIT. Results in Table 4B indicate the importance of utilizing cross-country variations in addition to within-country variations to identify the effect of tax competition on tax rates.

Table 5A reports ECM-type regression results for CIT. The estimated coefficient of $CIT_{i,t-1} - \overline{CIT}_{-i,t-1}$ is from −0.107 to −0.147 and highly significant, indicating the importance of tax competition. The coefficient of the lagged dependent variable is estimated to be very close to 1, ranging from 0.958 to 0.979, as indicated in Eq. (3). The systemic complementarity of PIT and CIT is estimated to be significant and 0.035–0.062. Moreover, the coefficient of $\Delta\overline{CIT}_{-i,t-1}$ is estimated to be significantly positive except for that in the non-OECD sub-sample. We test whether a country responds asymmetrically depending on the direction of the tax rate adjustment. This asymmetric response is tested by separating $CIT_{i,t-1} - \overline{CIT}_{-i,t-1}$ into two variables. One takes the original value when positive and 0 otherwise. The other takes the original value when negative and 0 otherwise. The test results provide evidence of asymmetric responses. The differences in responsiveness range from −0.092 to −0.159, and they are statistically significant. This result indicates that international tax competition may have a bias toward lowering rates. This asymmetric response is estimated to be stronger in the non-OECD sub-sample than in the OECD sub-sample.

Table 5B reports the ECM-type regression results for PIT. GMM and 3SLS estimation results of Tables 2 and 3 show that the tax competition variable is estimated to be significant or insignificant depending on the extent to which controls are included. The coefficient of $\Delta\overline{PIT}_{-i,t-1}$ is estimated to be significantly positive, implying tax competition. Comparing Tables 5A and 5B shows that the estimated coefficients of the tax competition variables in PIT regressions are smaller in the absolute value and less significant than those in CIT regressions. Hence, tax competition in PIT is weaker than that in CIT. Tax competition in PIT is estimated to be weaker than that in CIT. Thus, evidence of asymmetric responses can be difficult to find. Nonetheless, Columns (5) through (8), show that the difference in response in setting PIT depending on the direction of tax rate adjustment is significant at the 20% level when the OECD or the non-OECD sub-sample is used.

[Table 5A] Error correction-type regression results, CIT, GMM, 1982–2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	All				OECD		Non-OECD	
$CIT_{i,t-1}-\overline{CIT}_{-i,t-1}$	-0.15^{***}	-0.11^{***}						
	(0.023)	(0.026)						
$\max\{0, CIT_{i,t-1}-\overline{CIT}_{-i,t-1}\}$			-0.19^{***}	-0.20^{***}	-0.177^{***}	-0.172^{***}	-0.24^{***}	-0.26^{***}
			(0.041)	(0.041)	(0.039)	(0.039)	(0.059)	(0.061)
$\min\{0, CIT_{i,t-1}-\overline{CIT}_{-i,t-1}\}$			-0.065^{**}	-0.054^{*}	-0.084^{**}	-0.067^{*}	-0.090	-0.101^{*}
			(0.031)	(0.032)	(0.036)	(0.036)	(0.057)	(0.059)
$\overline{CIT}_{-i,t-1}-\overline{CIT}_{-i,t-2}$		0.232^{**}		0.228^{**}		0.379^{***}		0.111
		(0.098)		(0.097)		(0.118)		(0.143)
$CIT_{i,t-1}$	0.968^{***}	0.958^{***}	0.972^{***}	0.970^{***}	0.979^{***}	0.976^{***}	0.968^{***}	0.979^{***}
	(0.021)	(0.022)	(0.022)	(0.022)	(0.025)	(0.026)	(0.052)	(0.053)
$PIT_{i,t}$	0.048^{***}	0.035^{***}	0.052^{***}	0.041^{***}	0.062^{***}	0.039^{**}	0.040^{***}	0.036^{***}
	(0.012)	(0.012)	(0.012)	(0.013)	(0.015)	(0.016)	(0.013)	(0.013)
$GDP_{i,t}$	2.218^{***}	1.622^{*}	2.340^{***}	2.155^{**}	4.330^{***}	3.636^{**}	1.027	1.429
	(0.807)	(0.842)	(0.843)	(0.854)	(1.610)	(1.635)	(1.163)	(1.202)
$GDPPC_{i,t}$	-1.741^{**}	-0.978	-1.667^{**}	-1.271	-3.570^{**}	-2.374	-0.650	-1.055
	(0.826)	(0.869)	(0.848)	(0.867)	(1.701)	(1.722)	(1.176)	(1.228)
$OPN_{i,t}$	0.006^{*}	0.002	0.006^{*}	0.003	0.005	-0.002	0.005	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
$URB_{i,t}$	0.007	0.013	-0.002	0.002	0.002	0.016	-0.014	-0.015
	(0.021)	(0.022)	(0.021)	(0.022)	(0.033)	(0.033)	(0.029)	(0.030)
$POP_{i,t}^{0-14}$	0.057	0.068^{*}	0.059	0.070^{*}	0.143^{**}	0.150^{**}	-0.027	-0.020
	(0.040)	(0.041)	(0.040)	(0.041)	(0.063)	(0.064)	(0.062)	(0.063)
$POP_{i,t}^{65}$	0.040	-0.004	0.029	0.004	0.095	0.020	0.122	0.151
	(0.059)	(0.061)	(0.060)	(0.060)	(0.069)	(0.071)	(0.137)	(0.139)
$MAJ_{i,t}^{R}$	0.509^{***}	0.455^{***}	0.503^{***}	0.485^{***}	0.283	0.272	1.079^{***}	1.108^{***}
	(0.160)	(0.164)	(0.162)	(0.162)	(0.193)	(0.194)	(0.293)	(0.294)
$MAJ_{i,t}^{C}$	0.006	0.044	-0.003	-0.016	0.041	0.083	0.151	0.126
	(0.267)	(0.273)	(0.270)	(0.271)	(0.341)	(0.342)	(0.457)	(0.464)
$MAJ_{i,t}^{L}$	0.114	0.019	0.146	0.090	0.342	0.233	-0.090	-0.067
	(0.177)	(0.180)	(0.180)	(0.180)	(0.216)	(0.216)	(0.330)	(0.332)
Observation	1,993	1,965	1,993	1,965	1,065	1,051	928	914
Test of max{} − min{} = 0			-0.13^{**}	-0.15^{***}	-0.09^{**}	-0.11^{**}	-0.15^{***}	-0.16^{***}
	(p-value)		(0.011)	(0.003)	(0.048)	(0.023)	(0.003)	(0.001)
AR(2) test†	0.399	0.456	0.415	0.477	0.397	0.287	0.091	0.092
OID test‡	0.010	0.075	0.053	0.059	0.646	0.804	0.912	0.923

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$; Country dummy variables and constants are included but not reported.

†p-value of z in Arellano-Bond test for AR(2) in first differences. H0, no autocorrelation.

‡p-value of Sargan χ^2 in overidentifying restriction test. H0, Instrumental variables are uncorrelated with the error term.

[Table 5B] Error correction-type regression results, PIT, GMM, 1982–2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample		All			OECD		Non-OECD	
$PIT_{i,t-1} - \overline{PIT}_{-i,t-1}$	-0.054^{**}	-0.038						
	(0.026)	(0.027)						
$\max\{0, IT_{i,t-1} - \overline{PIT}_{-i,t-1}\}$			-0.062^{*}	-0.045	-0.058^{*}	-0.046	-0.111^{*}	-0.087
			(0.033)	(0.033)	(0.031)	(0.031)	(0.060)	(0.061)
$\min\{0, PIT_{i,t-1} - \overline{PIT}_{-i,t-1}\}$			-0.052^{*}	-0.033	-0.005	0.005	-0.040	-0.020
			(0.030)	(0.030)	(0.035)	(0.035)	(0.051)	(0.053)
$\overline{PIT}_{-i,t-1} - \overline{PIT}_{-i,t-2}$		0.202^{***}		0.202^{***}		0.282^{***}		0.150^{**}
		(0.053)		(0.053)		(0.072)		(0.074)
$PIT_{i,t-1}$	0.893^{***}	0.888^{***}	0.911^{***}	0.889^{***}	0.882^{***}	0.863^{***}	0.881^{***}	0.858^{***}
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.027)	(0.049)	(0.051)
$CIT_{i,t}$	0.037^{**}	0.025	0.020	0.024	0.035^{**}	0.039^{**}	0.083^{**}	0.083^{**}
	(0.018)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)	(0.032)	(0.032)
$GDP_{i,t}$	-1.164	-1.326	-1.070	-1.386	1.006	0.384	-3.076^{*}	-3.298^{*}
	(1.061)	(1.072)	(1.080)	(1.086)	(1.447)	(1.460)	(1.730)	(1.738)
$GDPPC_{i,t}$	0.713	0.557	0.567	0.606	-1.139	-0.729	2.396	2.425
	(1.151)	(1.160)	(1.166)	(1.169)	(1.615)	(1.624)	(2.021)	(2.026)
$OPN_{i,t}$	-0.001	-0.002	-0.000	-0.002	0.001	-0.002	-0.008	-0.010
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)
$URB_{i,t}$	0.048	0.047	0.048	0.047	0.077^{**}	0.075^{**}	0.009	0.009
	(0.030)	(0.030)	(0.030)	(0.030)	(0.035)	(0.036)	(0.048)	(0.048)
$POP_{i,t}^{0-14}$	0.050	0.035	0.042	0.035	0.199^{***}	0.179^{***}	-0.088	-0.078
	(0.056)	(0.056)	(0.056)	(0.056)	(0.063)	(0.064)	(0.099)	(0.100)
$POP_{i,t}^{65}$	0.081	0.044	0.076	0.043	0.046	0.002	0.210	0.198
	(0.077)	(0.078)	(0.077)	(0.078)	(0.069)	(0.070)	(0.228)	(0.228)
$MAJ_{i,t}^{R}$	-0.240	-0.143	-0.197	-0.145	0.017	0.055	-0.647	-0.587
	(0.225)	(0.228)	(0.227)	(0.228)	(0.211)	(0.211)	(0.493)	(0.495)
$MAJ_{i,t}^{C}$	-0.215	-0.147	-0.249	-0.151	-0.370	-0.207	0.131	0.117
	(0.375)	(0.379)	(0.378)	(0.380)	(0.372)	(0.375)	(0.744)	(0.746)
$MAJ_{i,t}^{L}$	0.261	0.275	0.250	0.270	-0.057	-0.044	1.100^{**}	1.127^{**}
	(0.249)	(0.252)	(0.252)	(0.252)	(0.235)	(0.236)	(0.541)	(0.543)
Observation	1,993	1,993	1,993	1,993	1,065	1,065	928	928
Test of max{} − min{} = 0			-0.010	-0.011	-0.053	-0.051	-0.070	-0.067
(p-value)			(0.758)	(0.734)	(0.160)	(0.180)	(0.144)	(0.163)
AR(2) test†	0.524	0.549	0.523	0.547	0.392	0.384	0.896	0.929
OID test‡	0.922	0.946	0.886	0.944	0.002	0.006	0.448	0.521

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$; Country dummy variables and constants are included but not reported.
†p-value of z in Arellano-Bond test for AR(2) in first differences. H0, no autocorrelation.
‡p-value of Sargan χ^2 in overidentifying restriction test. H0, Instrumental variables are uncorrelated with the error term.

The last two tables report PMG and mean group (MG) regression results. The PMG model (Pesaran, Shin, and Smith, 1999) assumes a common long-term relationship while allowing an individual country to undergo short-run dynamics. Our sample consists of 67 countries, and each country has an average of 30 observations. Hence, the condition required to apply the PMG model is well satisfied. We report PMG and MG regression results without other control variables because results with other control variables have several estimates with wrong signs and unexpected magnitudes. PMG and MG estimations are sensitive to controls. Table 6A reports CIT regression results for three samples: all, OECD, and non-OECD countries. Hausman's specification test results show that PMG estimations are preferred over MG estimations. Estimates generally take the expected sign and magnitude. The estimated coefficient of $\overline{CIT}_{-i,t-1}$ is significantly positive and close to 1, implying that the long-term correlation between $CIT_{i,t}$ and $\overline{CIT}_{-i,t-1}$ is strong. The estimated coefficient of the error-correction term is significant. Again, we find that CIT tax competition in non-OECD countries is estimated to be almost as strong as that in OECD countries.

Table 6B reports PMG and MG regression results for PIT. Similar to CIT regression results, PIT regression results show that PMG estimations are preferred over MG estimations. The estimated coefficient of $\overline{PIT}_{-i,t-1}$ takes values slightly smaller than that of corresponding $\overline{CIT}_{-i,t-1}$. The error correction term is significant. PMG regression results indicate tax competition in PIT, but this result appears to be caused by excluding other controls. These results are consistent with the results in Table 2.

[Table 6A] Pooled mean regression results of CIT, 67 countries, 1982–2015

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	PMG	MG	PMG	MG	PMG	MG
Sample	All	All	OECD	OECD	Non-OECD	Non-OECD
$\overline{CIT}_{-i,t-1}$	0.823***	0.709***	0.880***	0.575**	0.779***	0.855***
	(0.028)	(0.147)	(0.038)	(0.241)	(0.044)	(0.158)
ECM term regression						
$\overline{CIT}_{-i,t-1} - \overline{CIT}_{-i,t-2}$	0.294**	0.330***	0.426***	0.452***	0.140	0.197
	(0.117)	(0.120)	(0.151)	(0.129)	(0.181)	(0.207)
Error correction term	−0.211***	−0.311***	−0.187***	−0.301***	−0.239***	−0.320***
	(0.017)	(0.020)	(0.023)	(0.031)	(0.024)	(0.026)
Constant	1.031***	1.164	0.581***	2.267*	1.508***	−0.043
	(0.195)	(1.052)	(0.198)	(1.193)	(0.349)	(1.769)
No. of observations	1,965	1,965	1,051	1,051	914	914
Hausman' test p-value	0.468		0.243		0.646	

Notes: Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

[Table 6B] Pooled mean regression results of PIT, 67 countries, 1982–2015

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	PMG	MG	PMG	MG	PMG	MG
Sample	All	All	OECD	OECD	Non-OECD	Non-OECD
$\overline{PIT}_{-i,t-1}$	0.736***	1.049***	0.792***	0.623***	0.525***	1.514***
	(0.039)	(0.198)	(0.041)	(0.175)	(0.072)	(0.352)
ECM term regression						
$\overline{PIT}_{-i,t-1} - \overline{PIT}_{-i,t-2}$	0.263**	0.145	0.310**	0.265*	0.213	0.014
	(0.106)	(0.110)	(0.146)	(0.139)	(0.156)	(0.173)
Error correction term	−0.208***	−0.312***	−0.222***	−0.314***	−0.189***	−0.310***
	(0.017)	(0.024)	(0.024)	(0.031)	(0.024)	(0.038)
Constant	1.944***	−5.677	2.681***	2.319	2.037***	-14.423
	(0.355)	(4.757)	(0.507)	(2.176)	(0.449)	(9.512)
No. of observations	1,993	1,993	1,065	1,065	928	928
Hausman's test p-value	0.138		0.371		0.008	

Notes: Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

VI. Summary and Discussion

We find evidence of strong tax competition for CIT in developing and developed countries using the sample of 67 OECD and non-OECD countries covering 1981–2015. We find that tax competition in PIT is weaker than that in CIT, and various domestic considerations appear to strongly influence PIT rates. In CIT and PIT regressions, we find that rigidity is a significant factor affecting tax rates. We find evidence that the systemic complementarity of PIT and CIT work more strongly from CIT to PIT than from PIT to CIT.

In addition to estimating the response function with the lagged dependent variables, we explore the possibility of adjustment cost and rigidity by estimating ECM-type and PMG regressions. Both estimations provide evidence of a partial adjustment instead of an instant full adjustment of tax rates. In addition, we find evidence that countries tend to adjust more promptly when lowering than raising rates, which is in agreement with the kinked demand curve model.

The decrease in CIT came in two waves in 1985–1995 and 2000–2010. A large decrease in PIT occurred from 1985 to 1995. CIT became stable after 2010, and PIT became stable after 2000. Hence, "racing to the bottom" has been weakened in the 2010s. Our empirical investigation provides an explanation to the weakening of "racing to the bottom:" tax competition in PIT is not as severe as that in CIT, and the systemic complementarity of PIT and CIT assures positive tax rates.[11] We find

[11] Revenue must provide public goods which are underlying forces to collect any taxes. Equity

that tax competition in PIT is less salient, and other considerations appear important in adjusting PIT.

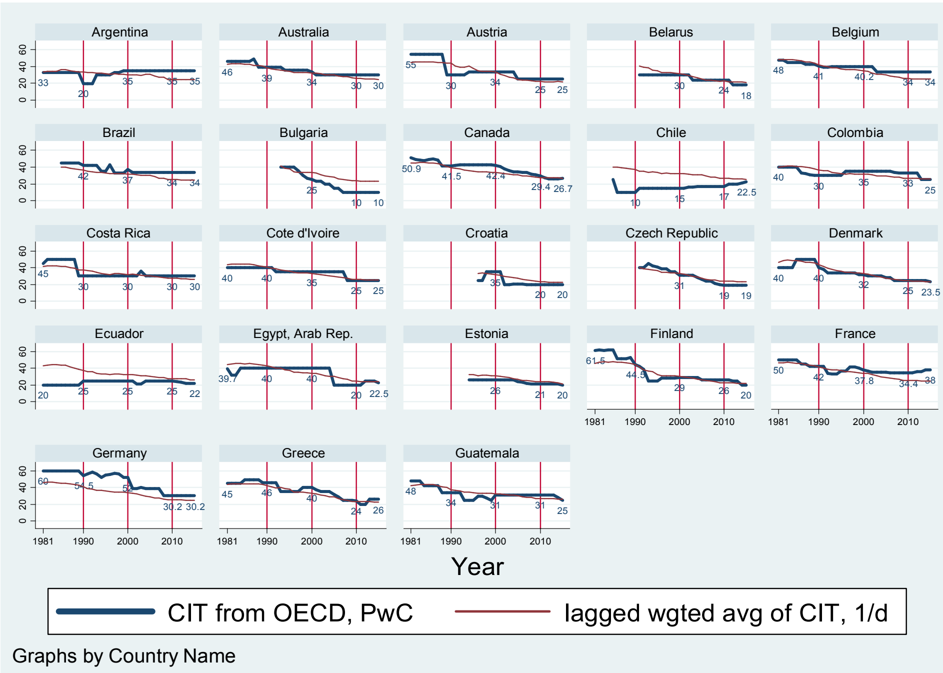
Further determinants of PIT, such as government expenditure, government debt, and equity consideration, are intriguing topics for future research. In the investigation with additional government finance variables, one must pay attention to the endogeneity of these government finance variables and carefully design the structure of empirical specifications.[12]

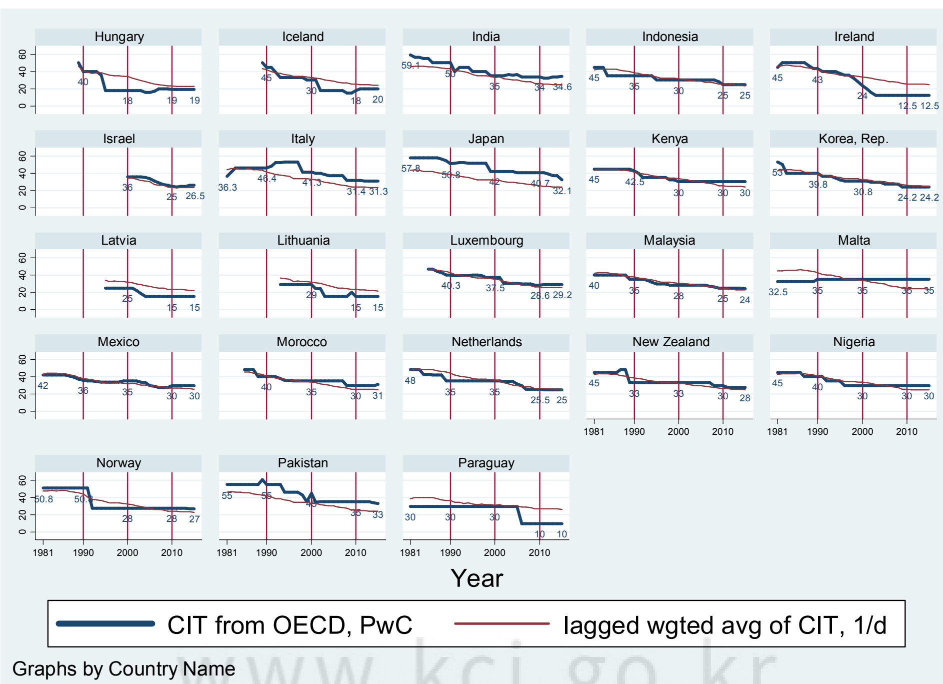
consideration is also important in designing PIT.

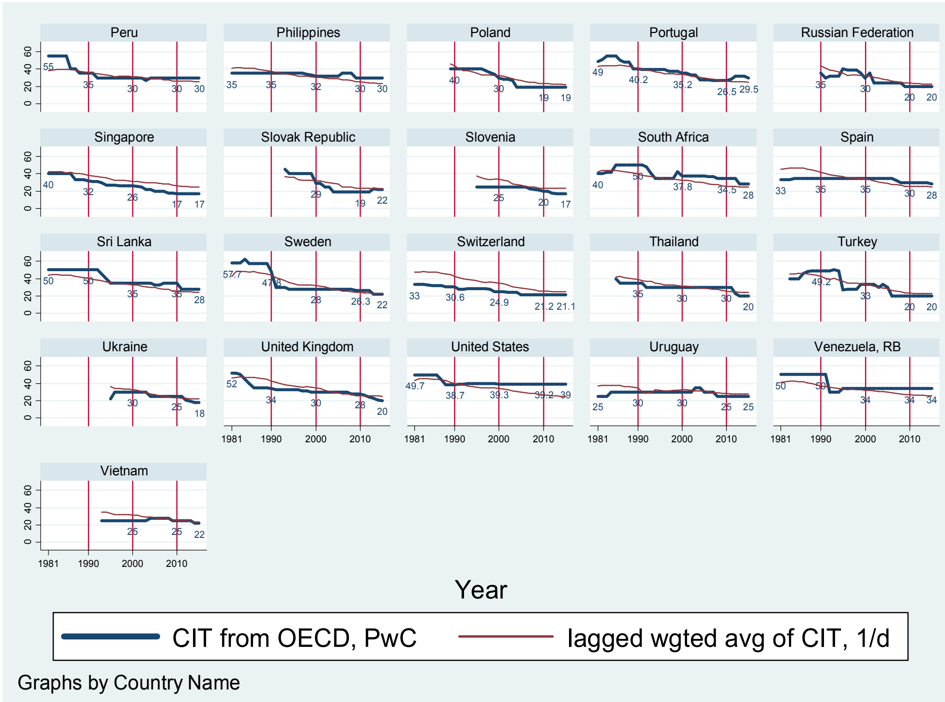
[12]When we use the ratio of government expenditure to GDP as an additional control variable, we find that our results are robust to the added variable. The inclusion of government expenditure reduces the number of countries from 73 (as in Column (4) of Table 2) to 69 and that of observations from 2,152 to 1,723. When the ratio of central government debt to GDP is added, the tax competition of PIT remains significant but that of CIT becomes insignificant. The inclusion of government debt reduces the number of countries to 61 and that of observations by half to 1,078. The government finance variables are endogenous and have many missing values. Thus, we decide not to include the regression results with these additional government finance variables in the study.

Appendix

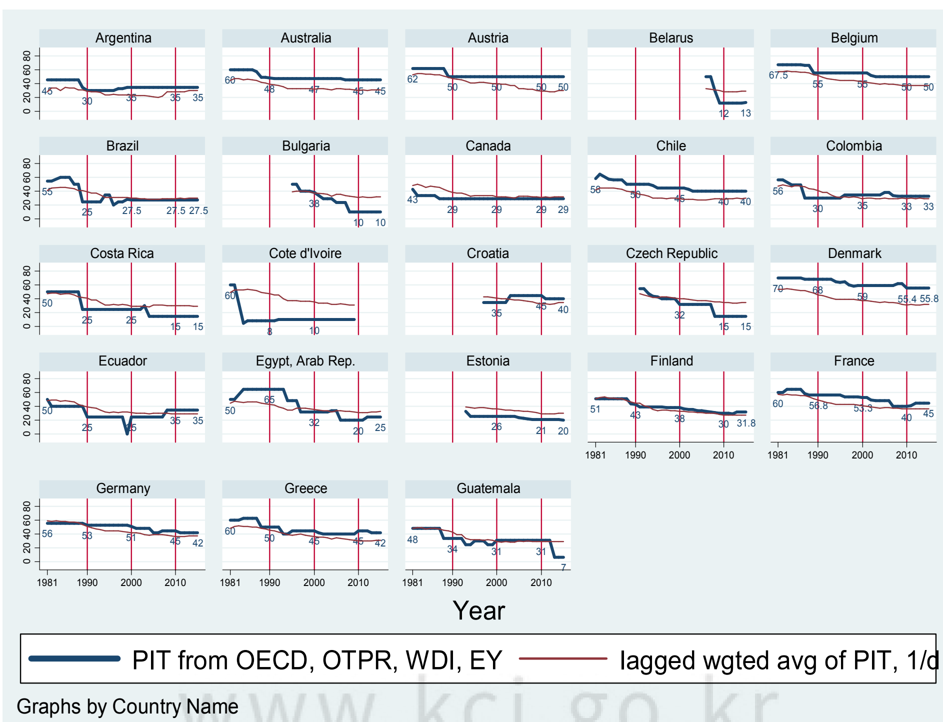
[Figure A] Trends in $CIT_{i,t}$ and $\overline{CIT}_{-i,t}$ by Country from 1981 to 2015

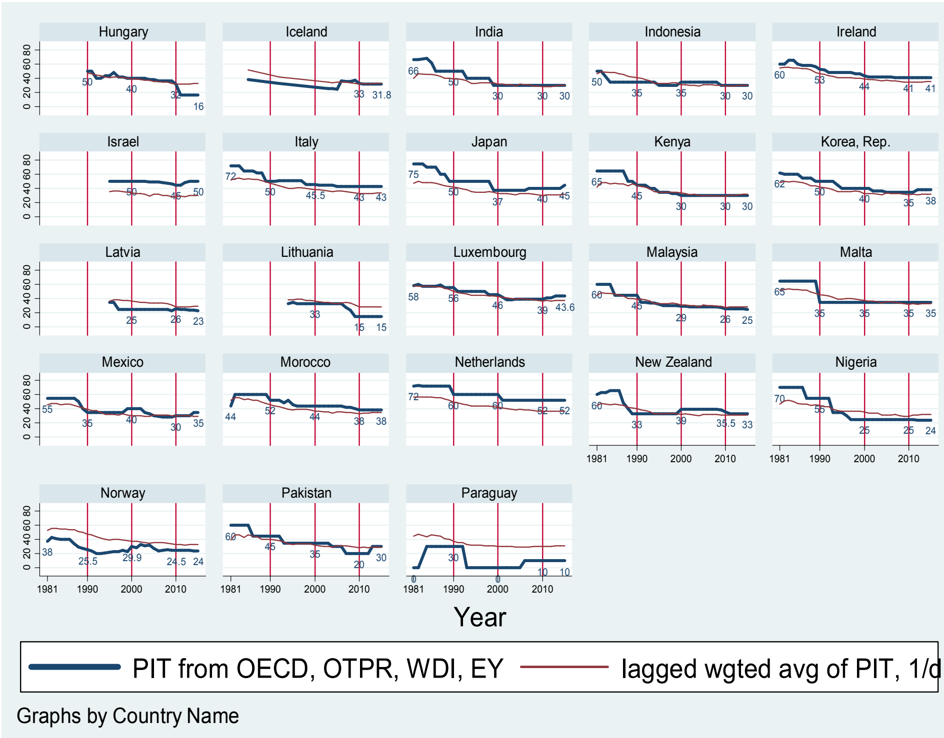






[Figure B] Trend in $PIT_{i,t}$ and $\overline{PIT}_{-i,t}$ by Country from 1981 to 2015

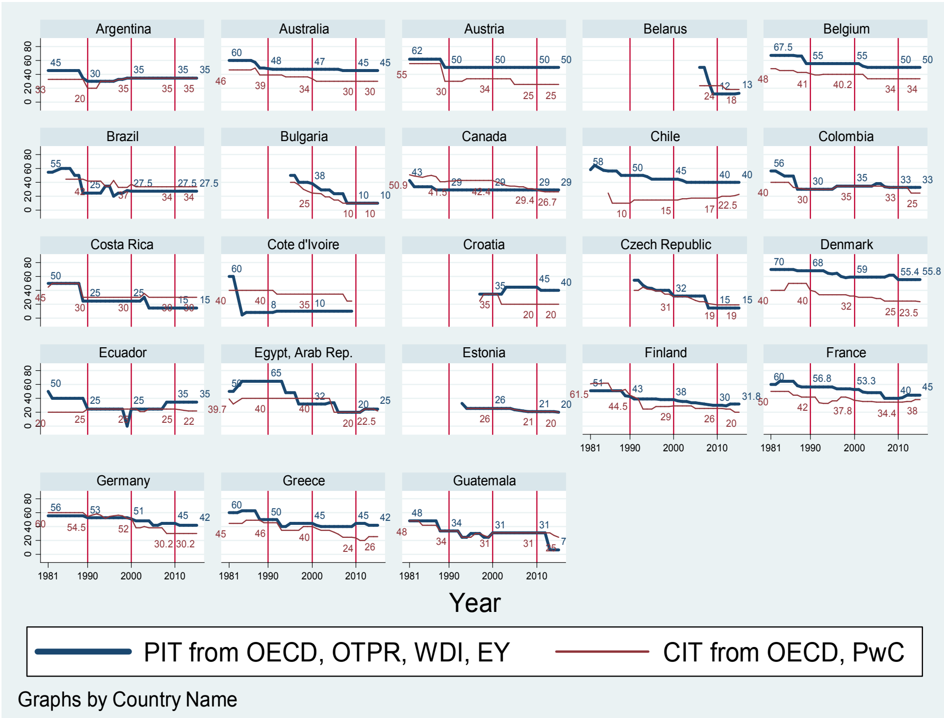


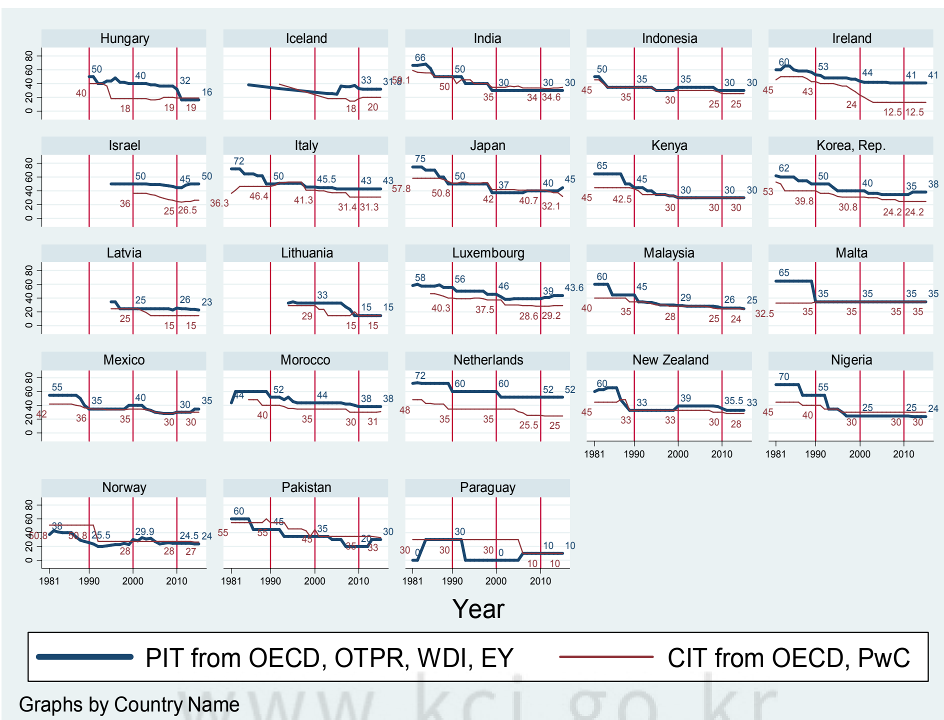


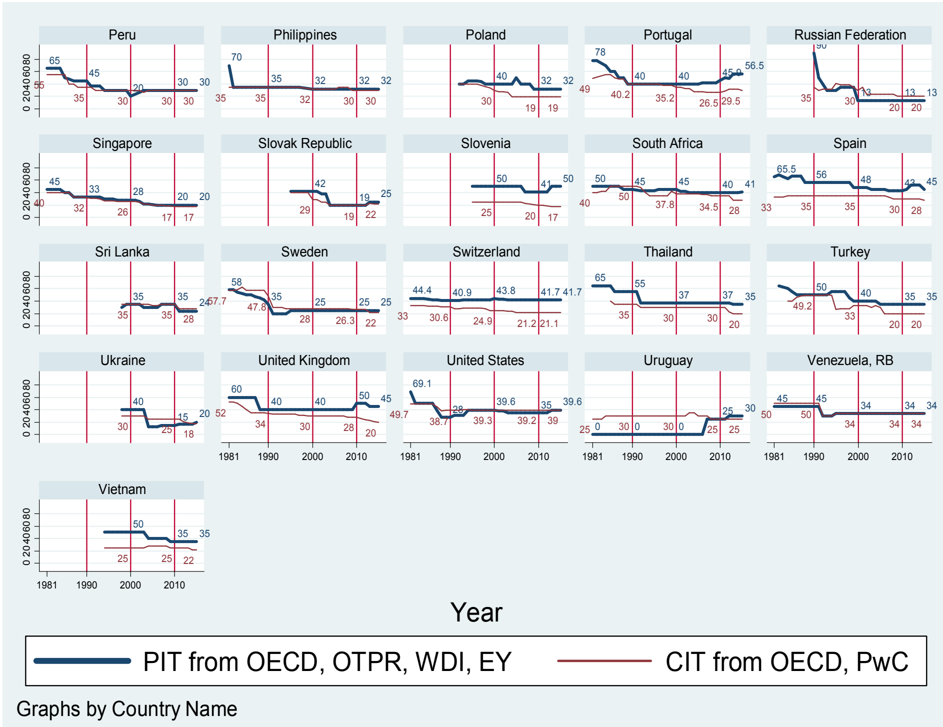
Hungary
Iceland
India
Indonesia
Ireland
Israel
Italy
Japan
Kenya
Korea, Rep.
Latvia
Lithuania
Luxembourg
Malaysia
Malta
Mexico
Morocco
Netherlands
New Zealand
Nigeria
Norway
Pakistan
Paraguay
0 20 40 60 80
1981 1990 2000 2010
Year
PIT from OECD, OTPR, WDI, EY
lagged wgted avg of PIT, 1/d
Graphs by Country Name

Peru
Philippines
Poland
Portugal
Russian Federation
Singapore
Slovak Republic
Slovenia
South Africa
Spain
Sri Lanka
Sweden
Switzerland
Thailand
Turkey
Ukraine
United Kingdom
United States
Uruguay
Venezuela, RB
Vietnam
0 20406080
1981 1990 2000 2010
Year
PIT from OECD, OTPR, WDI, EY
lagged wgted avg of PIT, 1/d
Graphs by Country Name

[Figure C] Trend in $CIT_{i,t}$ and $PIT_{i,t}$ by Country from 1981 to 2015






Peru
Philippines
Poland
Portugal
Russian Federation
Singapore
Slovak Republic
Slovenia
South Africa
Spain
Sri Lanka
Sweden
Switzerland
Thailand
Turkey
Ukraine
United Kingdom
United States
Uruguay
Venezuela, RB
Vietnam
0 20 40 60 80
1981 1990 2000 2010
Year
PIT from OECD, OTPR, WDI, EY
CIT from OECD, PwC
Graphs by Country Name

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