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Demographic Changes and Direct Tax Dynamics in OECD and non-OECD Markets: A Revisit

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Abstract

This study investigates the dynamic relationship between demography and direct taxes on income, profit, and capital gains. The data, for the period 1990–2017, encompass 89 OECD and non-OECD countries. The study employs generalized method of moments (GMM) estimation to identify the relationships. The findings suggest a U-shaped correlation in OECD countries, which supports the argument that a rise in the aging population initially decreases taxes on income, profit, and capital gains. Conversely, any further rise in the aging population after reaching a certain threshold leads to increased taxes on income, profit, and capital gains. Furthermore, across non-OECD countries, the findings suggest an inverted U-shaped relationship implying that the labor income tax rate will fall with a rise in the dependency ratio until the aged population constitutes half of all voters, but the correlation between these variables becomes positive if the number of aged people reaches 50% of voters or more. The findings lead to the suggestion that other potential factors, such as empathy among family members, as opposed to political muscle only may affect voters' behavior in a median voter model.

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1. Introduction

The prior literature has provided inadequate and contradictory evidence for determining the relationship between demographic change and direct taxes. For instance, Razin, Sadka, and Swagel (2002) assessed their theoretical predictions and found a U-shaped relationship between the labor income tax rate and the dependency ratio. They argued that a rise in the relative share of retirees (people aged 65 or over) leads to a reduction in the labor income tax rate as long as the median voter is young. Once the median voter is a retiree, any further rise in the relative share will lead to increased direct taxes. However, Bryant (2003) criticized Razin et al. (2002) for failing to disaggregate the dependency ratio into the shares of the population aged between 0–14 and 65 and above. Moreover, their theory's assumption that the benefit payments are the same for everyone were challenged. The study replicated the empirical work of Razin et al. (2002) by disaggregating the dependency ratio. The results of the study by Bryant (2003) indicated that a rise in the share of youth dependency leads to a decrease in the labor income tax rates. In addition, Bryant (2003) challenged the prediction of Razin et al. (2002) regarding the future size of the welfare state. The study found instead that upward pressure on taxes and benefits increases with a decrease and an increase in the young and the old population, respectively. Likewise, Shelton (2007) criticized Razin et al. (2002) for not disaggregating the dependency ratio and found a positive correlation between income taxes and the share of retirees. Furthermore, Facchini, Razin, and Willmann (2004) estimated that the government size, measured as the labor income tax rate, decreases if there is an increase in unskilled immigration or low-skilled immigration as the immigrants add to the working-class group and strengthen it politically. In a similar vein, Disney (2007) and Galasso and Profeta (2007) opposed Razin et al.'s (2002) theory and concluded that demographic aging is linked with a larger welfare state considering the social security design.

This study contributes to the economics literature in several ways. First, although the relationship between demography and taxes was investigated by Razin et al. (2002), our study is, to the best of our knowledge, the first empirical work to apply both linear and non-linear approaches in determining the dynamics of the demography–tax association. Second, it segregates and breaks up the dependency ratio into the young and the old population, which was neglected by Razin et al. (2002). It is necessary to decompose the demographic structure

because the results cannot be generalized when differences in the direction and magnitude of the dependency ratio are visible. Third, our study makes use of additional policy variables (such as tax revenue as a fraction of the GDP and public debt as a share of the GDP) in addition to the labor income tax rates to provide detailed insights into the demography–tax relationship. Last but not least, this study provides new theoretical and empirical evidence from both OECD and non-OECD countries using an extended dataset.

The results from the data of 15 OECD countries suggest a positive relationship between an aging population and taxes on income, profit, and capital gains. This is in contrast to what Razin et al. (2002) theoretically argued and empirically found in their study. In addition, the estimation results from the data of 74 non-OECD countries depart from the results of Razin et al. (2002). However, our findings substantially support Bryant (2003) and Shelton (2007) in terms of decomposing the dependency ratio into the young and the aging population.

The findings suggest that, across OECD countries, the relationship is U-shaped, which supports Razin et al.'s (2002) assertion that a rise in the aging population initially decreases taxes on income, profit, and capital gains, but this relationship becomes positive after the aging population crosses a certain threshold. However, the estimated threshold ranges from 14.12 to 16.04, which is lower than the aging population constituting at least half of the total population as suggested by Razin et al. (2002). Moreover, an inverted U-shaped correlation is found between the aging population and taxes on income, profit, and capital gains across non-OECD countries, which is in contrast to the findings for OECD countries. The estimated threshold also ranges between 14.15 and 18.03, being closer to the estimated threshold for OECD countries, unlike that in Razin et al.'s (2002) study. The remainder of this paper is structured as follows. First, an overview of the theoretical background on the aging population and direct taxes is presented. Next, the data and variables are described and discussed. The results obtained are then analyzed and the key findings are discussed. Finally, the conclusions of the study are drawn.

2. Theoretical framework

The literature has provided various theories to explain the relationship between demography and direct taxes. This section presents the theoretical framework of the study,

including a discussion of each theory/hypothesis followed by the theoretical linkages of demography and direct taxes

2.1 Theory: Household-level utility maximization

In contrast to Razin et al. (2002), this study posits that individuals work and vote to maximize the household-level utility rather than their individual utility. The key argument is that voters maximize their household utility and not their individual utility. Consequently, different family types are assumed to vote collectively for the same candidate. Glaser (1959) provided evidence for similarity in voting behavior within households as a result of close family ties or other types of close attachments that may affect the attitude of family members. Niemi, Hedges, and Jennings (1977) found the presence of broad congruence in voting behavior within couples. The agreement may be attributed to the couple's selection or mutual socialization or the similar experiences that they encounter every day. Huckfeldt and Sprague (1991) discovered that political discussions among households, people residing nearby, or like-minded people exert a considerable social influence on people's voting preferences. Nickerson (2008) concluded, in a placebo-controlled experiment, that the propensity to vote passed onto other household members is 60% as the preferences of couples become more similar as time lapses.

Based on the empirical evidence that families vote collectively, our study argues that families share empathy with each other (within households). Hence, a household with many elderly relatives will be more predisposed to support material interests benefitting the elderly. It is noticeable that this argument does not imply that all household members perfectly align their interests with the elderly household member(s). All that is assumed is that collective voting takes place at the level of the household. Hence, a household with elderly relatives will be more sympathetic to the needs of the elderly than one without elderly relatives. The budget constraint applies at the level of the household, not individuals, so improvements in the income of the elderly (via redistribution) will benefit all the members of the household, assuming that everything else remains constant. Therefore, the key argument is that working-age adults support elderly household members when the pension provision is limited. This aligns their interests with those of the elderly.

One could question the argument that self-interested adults will put weight on possible utility when old if the chance of survival is low. However, even here, a self-interested adult will care about the utility of the elderly when there are elderly relatives currently within his or her household.

In the analysis, the proportion of retired people in society is assumed to grow exogenously over time. Increased aging corresponds to a rise in life expectancy. This means that the proportion of families with elderly relatives grows over time. Oeppen and Vaupel (2002) also attributed increases in life expectancy in industrialized countries to medical progress, social improvements, and economic development.

2.2 Model

It is assumed that there are three family types in the model, defined as a family with two children and two retirees, a family with two children and no retirees, and a family with two children and one retiree. The family with two children and two retirees consists of six individuals: two workers (parents), two non-working individuals (children/youths), and two retirees (aged 65 and above). The family with two children and no retirees contains four individuals. Of them, two are workers and two are children. This family type thus includes no retirees. The family with two children and one retiree consists of five individuals: two workers (parents), two non-working individuals (children), and one retiree (old). Children are unable to vote. Hence, there are four voters in the family with two children and two retirees, two voters in the family with two children and no retirees, and three voters in the family with two children and one retiree. In such a demographic structure, retirees constitute half of the adult population (electorate) in the family with two children and two retirees and one-third in the family with two children and one retiree, whereas the family with two children and no retirees includes no old people. The family structure is endogenous to changes in the mortality or “survival” ratio between the second and the third generation.

Before discussing the model formally, this study first discusses the divergence of interests between workers and elderly people. Retirees prefer higher income taxes as they no longer work. On the other hand, workers support lower income taxes as their incomes are deducted in the form of income taxes to finance redistribution to the elderly. When the relative proportion of the elderly in the population increases, so does the burden on workers as now a smaller quantity of workers will be taxed to cater to the social security needs of a larger proportion of retirees. Nonetheless, in our model, the interests of households are taken as a whole.

Because of empathy within households, it is concluded that families that include older members would vote for higher income taxes in order for greater redistribution to be made to the elderly. It is evident that empathizing with the elderly also potentially serves their own self-interest as workers may themselves survive to be old in the future. Moreover, higher income taxes would

ensure the extraction of more income from families that do not include retirees for families with elderly relatives.

Increasing life expectancy is modeled as an increased probability of surviving into retirement. It is assumed that there is around a 10% probability of workers surviving into retirement from all three demographic structures in our model; retirees constitute 3.9% of the total population. The method of this calculation is given below:

First, consider a family with two children and two retirees as well as a family with two children and no retirees to calculate their proportions. Given a 10% survival rate, the proportion of the family with two children and two retirees is:

$$P^2 = \frac{1}{10} * \frac{1}{10} = 0.01 \quad (1)$$

On the other hand, the proportion of the family with two children and no retirees is:

$$(1 - P)^2 = \frac{9}{10} * \frac{9}{10} = 0.81 \quad (2)$$

From these proportions, the proportion of the family with two children and one retiree is calculated, which is 0.18. It is shown below:

$$1 - P^2 - (1 - P)^2 = 1 - 0.01 - 0.81 = 0.18 \quad (3)$$

To simplify the whole argument, this suggests clear distinction between families in terms of their behavior when the aged population constitutes 10% of the population as opposed to when the ratio is 30%. The rationale is given below.

This study determines which family type holds the majority in the given population. Families with two children and no retirees, at a 10% survival rate, make up 81% of the total population when there is a 10% probability that workers will be able to reach retirement age. Since families with two children and no retirees share no empathy with the elderly, they will vote in favor of low taxes. Owing to more political power resting with families with two children and no retirees, the preferences of the anti-tax coalition dominate the preferences of the pro-tax coalition. Thus, a rise in the share of retirees would lead to lower income taxes.

Even when taking 20% and 25% probabilities of workers reaching retirement age, the majority share (64% and 56.25%, which are more than 50%) of the population consists of families with two children and no retirees. In both cases, the shares of retirees in the population are calculated to be 7.7% and 9.5%, respectively. The anti-tax coalition still dominates the pro-tax coalition as families with two children and no retirees share no empathy with the elderly. Hence, a

negative relationship between income taxes and the proportion of retirees in the population would emerge with a rise in the relative share of elderly people.

A negative correlation corresponds to the argument that the preferences of the working class dominate the preferences of retirees. The working population here is more powerful and influential politically than the retirees. Moreover, the allocation of an increasing amount of the budget expenditure to their healthcare and security needs causes this negative association between the two variables.

Only when the survival probability is taken to be 30% do families with two children and two retirees and families with two children and one retiree (9% and 42%) jointly make up more than 50% of the total population. Both these family types are empathetic toward the elderly. Given that more political power rests with these families, a positive relationship between income taxes and the relative proportion of elderly people would exist. To determine the threshold level at which the relationship between these two variables becomes positive is of the utmost importance. In this case, the critical point is 8.4%. The critical point comes when voters who are empathetic toward the elderly start to outnumber voters who are not. This threshold is calculated as follows:

$$2(1-P)^2 = 4P^2 + 3(2P(1-P)) \quad (4)$$

The term on the left-hand side of equation (4) is the proportion of families with two children and no retirees multiplied by two adult voters. On the right-hand side, the first term is the proportion of families with two children and two retirees multiplied by four voters. The second term is the proportion of families with two children and one retiree multiplied by three adult voters. The solution to this formula is the root of

$$4P^2 - 10P + 2 \quad (5)$$

Hence, $P \approx 0.219$. This means that the proportion of old people is calculated as follows:

$$\frac{(0.219)^2}{3} + \frac{2(0.219)(1-0.219)}{5} = 0.0159 + 0.0684 = 0.084 = 8.4\%. \quad (6)$$

In equation (6), $\frac{1}{3}$ refers to the share of youths in a family with two children and two retirees whereas $\frac{1}{5}$ refers to the share of elderly members in a family with two children and one retiree. To sum up, a rise in the share of retirees would lead to a decrease in income taxes, but the correlation between the two variables becomes positive once the elderly constitutes 8.4% of the population. This argument challenges the theory of Razin et al. (2002), who concluded that a positive

relationship exists between income taxes and retirees only once the retirees constitute half of the total voters. This study proposes, on the other hand, that a rise in the relative proportion of retirees would initially decrease income taxes.

Nonetheless, a further increase in their share would be positively associated with income taxes once the proportion of retirees in the population becomes 8.4% due to empathy within households. The empathy factor, which Razin et al. (2002) failed to acknowledge, is crucial to our result. Although the theory in this section argues for a U-shaped relationship between the labor income tax rates and the share of the retired population, following Razin et al. (2002), the critical mass is still far below that in their argument. The theory suggests that the interests of retirees prevail well before they account for 50% of the population, as opposed to Razin et al.'s (2002) argument that the possibility of such a relationship holds only once the median voter is the retiree.

3. Data and variables

The study makes use of an annual dataset for the period 1990–2017 from 89 countries. The sample is then decomposed into 15 OECD and 74 non-OECD countries. The sample includes countries that are at different stages of development. Some countries can be categorized as developed, some as emerging, and the rest as developing. To paint a better picture, the study performs an analysis by decomposing the sample into OECD and non-OECD countries for two reasons. First, breaking up the sample into two sub-samples is important because the demographic composition varies substantially between OECD and non-OECD countries. The rationale for decomposing the sample into subsamples is also justified when the descriptive statistics of our main policy variable are analyzed. On average, the proportion of the aged population in the total population is almost 200% higher among OECD countries than among non-OECD countries. In Table 1, the mean values of these sub-samples are reported as 5.73 and 15.31, respectively. Furthermore, the divergence from the mean is lower across OECD countries than across non-OECD countries when the standard deviation values from Table 1 are extracted. In addition, non-OECD countries collect higher taxes through taxes on income, profit, and capital gains than OECD countries. The mean value of taxes on income, profit, and capital gains of OECD countries is 30.56, whereas it is 24.027 for non-OECD countries. Consequently, the findings limited to OECD countries cannot be generalized to the whole sample.

Table 1: Summary Statistics

	Non-OECD Countries					OECD Countries				
	Obs.	Mean	St. Dev.	Minimum	Maximum	Obs.	Mean	St. Dev.	Minimum	Maximum
Direct Taxes	1049	24.027	14.89	-1.34	79.53	386	30.56	12.46	5.54	57.46
Aged Pop.	2044	5.73	3.94	2.07	27.04	420	15.31	3.46	4.60	23.02
Young Pop.	2044	34.51	10.12	12.88	51.88	420	18.27	3.94	13.07	35.79
GDP per Capita	1961	9352.88	10219.58	354.28	50723.71	420	36431.37	9649.48	11289.91	67335.29
Trade (% GDP)	1926	68.14	36.07	.02	311.35	419	76.80	40.25	19.73	221.15
Unemployment	1971	8.56	6.74	.16	37.25	405	8.39	4.35	1.78	27.47
Inequality	897	46.53	5.68	24.92	62.85	359	38.61	4.07	29.30	50.75
GDP Growth	1968	2.20	7.40	-64.99	122.96	420	1.58	2.81	-8.99	24.37

3.1 Main variables

The World Development Indicators database is used to collect data for taxes on income, profit, and capital gains following Pickering and Rajput (2018). The mean value of the OECD countries suggests that their reliance on collecting revenues from taxes on income, profit, and capital gains is 30.56 whereas the reliance of non-OECD countries on taxes on income, profit, and capital gains to collect revenue is 24.02% of the total revenues. Nevertheless, the standard deviation values indicate that the divergence of OECD countries from the mean, 12.46, is lower than that of non-OECD countries, which is 14.89. Data for the fraction of the population consisting of people aged 65+ are collected using the World Development Indicators. Respectively, the mean values for OECD and non-OECD countries, 15.31 and 5.73, show that OECD countries have more than twice the aged population of non-OECD countries, whereas the standard deviations, 3.46 and 3.94, indicate that the variance from the mean between these two decomposed groups is not considerably different.

3.2 Control variables

The data for all the control variables used in this study (such as youths as a share of the total population, trade openness, the unemployment rate, income inequality, and per capita GDP growth) are also collected from the World Development Indicators database. The share of youths of the total population is used as a control variable. It is included to split the dependency ratio into young and aged populations. Rodrick (1998) found that an upsurge in openness leads to growth in the size of the government. Following Razin et al. (2002), trade openness is included to assess the hypothesis of Rodrick (1998). It is measured as the sum of imports and exports to the GDP. As tax rates affect the unemployment rate, unemployment can also affect tax rates. For example,

Daveri and Tabellini (2000) found reverse causation between the unemployment rate and the labor income tax rates. Following Daveri and Tabellini (2000), unemployment as a share of the total labor force is taken as a control variable.

Income distribution has also been cited as a potential determinant of taxes in the economics literature. Meltzer and Richard (1981), in their study, found a positive correlation between the pre-tax income inequality, measured as the ratio of the mean income level of voters to the median income of voters, and the government size, measured as the fraction of income redistributed. Pursuant to the above evidence, income inequality is included as a control variable. The data for income inequality are extracted from the University of Texas Inequality Project's estimate of household income inequality. Finally, it is important to consider cyclical variations, especially when dealing with panel data. Following Persson and Tabellini (2005) and Razin et al. (2002), per capita GDP growth is included in the model specification to control for business cycle variation across the sample.

4. Results and discussion

This section offers a discussion of the estimation results. Since panel data are used, it is important to control for differences in economic development. Therefore, this sort of data may be confronted by unobserved heterogeneity across time, and cross-sections are taken in the sample along with omitted variable bias. Furthermore, there are endogenous variables in our model, such as the GDP growth per capita, GDP per capita, trade as a share of the GDP, unemployment, and inequality. These endogenous variables may also potentially be affected by taxes on income, profit, and capital gains. To deal with concerns like omitted variable bias, endogeneity, and unobserved heterogeneity across panel sets, the study uses the generalized method of moments (GMM). However, there is a problem in that the number of countries included in our sample is greater than the number of years. For such cases, difference GMM is applied. Difference GMM is designed for use when the data face problems such as endogeneity, arbitrarily distributed fixed effects, heteroscedasticity, and autocorrelation within panels or groups. Therefore, keeping these issues in view, the difference GMM estimation technique is applied using country and year fixed effects for empirical analysis. It apparent from the prior literature that most studies have examined and confined their empirical work to the linear relationship between demography and direct taxes on income, profit, and capital gains (Razin et al., 2002).

The linear regression results for OECD countries are shown in Table 2 and Table 3. In Table 2, the estimated coefficients for the aged population are positive and statistically significant. This implies that an increase in taxes on income, profit, and capital gains is due to the rise in the share of the population composed of aged people. This result considerably contradicts Razin et al. (2002). This is in accordance with conventional wisdom, unlike Razin et al.'s (2002) argument. This is due to the fact that aged people are usually expected to support increases in direct taxes (taxes on income, profit, and capital gains) because they are in their self-interest as opposed to supporting decreases. Moreover, this finding justifies the importance of segregating the dependency ratio into the aged and the young population to analyze the response of aging societies to direct taxes.

Table 2: Aging Population and Taxes on Income, Profit, and Capital Gains (OECD Countries)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	.792	.856	1.44	1.55	1.01	1.36	1.33
	(.273)**	(.266)***	(.277)***	(.289)***	(.317)***	(.351)***	(.344)***
Youths		1.11	1.34	1.38	1.48	1.63	1.54
		(.192)***	(.191)***	(.195)***	(.203)***	(.264)***	(.272)***
GDP (PPP) per Capita			.0003	.0004	.0001	.0003	.0002
			(.00007)***	(.00008)***	(.00009)*	(.0001)**	(.0001)**
Trade Openness				-.016	.006	.014	.016
				(.021)	(.021)	(.024)	(.024)
Unemployment					-.336	-.274	-.303
					(.074)***	(.083)***	(.085)***
Income Inequality						.029	.085
						(.178)	(.182)
GDP Growth per Capita							-.147
							(.104)
Observations	386	386	386	385	372	331	331
Countries	15	15	15	15	15	15	15

Note: This table shows the estimation results of the generalized method of moments (GMM) model for 15 OECD countries. Annual data are used from 1990 to 2017. Standard errors are reported in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

The estimation results of the control variables are presented in Table 2. The coefficients for the young population are positive and significant. Again, there is enough support for the

assertion that the dependent population favors the imposition of direct taxes owing to empathy within the household. The coefficients for the GDP per capita are positive and significant across all the columns, suggesting that richer countries collect more taxes, whereas the coefficients for the unemployment rate are negative and significant, discerning no reverse causation between unemployment and taxes. The other controls are not statistically significant.

Table 3 displays the estimation results for non-OECD countries. Although the coefficients for the aged population are negative, there are no statistically significant ones throughout the table. Once again, there is no support for Razin et al. (2002) across non-OECD countries. This may also indicate that their findings were confined to a limited sample and time period for OECD countries and hence cannot be generalized.

Table 3: Aging Population and Taxes on Income, Profit, and Capital Gains (non-OECD Countries)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	-.276	-.291	-.177	-.451	-.198	-.262	-.263
	(.211)	(.281)	(.111)	(.312)	(.150)	(.199)	(.228)
Young Population		-.159	-.146	-.020	-.020	-.364	-.376
		(.130)	(.131)	(.133)	(.134)	(.168)**	(.168)**
GDP (PPP) per Capita			-.0002	-.0002	-.0001	-.00003	-.00002
			(.0001)	(.0001)**	(.0001)	(.0001)	(.0001)
Trade				.048	.044	.031	.031
				(.014)***	(.014)***	(.021)	(.021)
Unemployment					.379	.090	.073
					(.092)***	(.122)	(.124)
Income Inequality						-.201	-.191
						(.141)	(.141)
GDP Growth per Capita							-.057
							(.074)
Observations	1418	1410	1400	1380	1367	918	918
Countries	74	73	73	73	73	68	68

Notes: See Table 2.

In Table 4, the non-linear relationship between taxes on income, profit, and capital gains and the aging population is assessed. Quite interestingly, the results are similar to those reported in Table 3. They suggest a U-shaped relationship across OECD countries. This implies that a surge

in the population constituted by aged people leads initially to a decline in taxes on income, profit, and capital gains. However, a similar relationship between these two variables is not discerned inversely after a certain benchmark. The relationship between variables becomes positive after reaching the threshold.

The results substantially support our proposed theory as well as the theoretical argument of Razin et al. (2002). However, the estimated threshold differs substantially from what Razin et al. (2002) proposed because the range of calculated thresholds across Table 3 is from 14.12% to 16.04%. This entails the aged population favoring lower taxes on income, profit, and capital gains until their relative share of the total population constitutes 14.12% to 16.04%. Regarding our proposed threshold, it is witnessed that, as an increase in the size of the aged population as a share of the population leads to lower taxes on income, profit, and capital gains as long as elderly people compose 8.4% of the total population, the estimated threshold is considerably closer. The interesting observation to note here is that retirees/members of the aged population start supporting taxes on income, profit, and capital gains well before they are the median voter, which challenges the proposition of Razin et al. (2002), who argued that such a relationship exists only once the median voter is aged.

Table 4: Aging Population and Taxes on Income, Profit, and Capital Gains (OECD Countries)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	-6.74	-6.16	-5.65	-5.68	-4.92	-5.68	-5.57
	(.811)***	(.972)***	(.937)***	(.935)***	(.959)***	(1.22)***	(1.23)***
Aged Population Squared	.210	.195	.197	.201	.170	.193	.190
	(.021)***	(.026)***	(.025)***	(.025)***	(.026)***	(.032)***	(.033)***
Youths		.230	.455	.499	.698	.623	.601
		(.214)	(.210)**	(.210)**	(.226)***	(.303)**	(.305)**
GDP (PPP) per Capita			.0003	.0004	.0003	.0002	.0002
			(.00006)***	(.00008)***	(.00009)***	(.0001)*	(.0001)
Trade				-.033	-.014	-.016	-.014
				(.019) *	(.020)	(.023)	(.023)
Unemployment					-.206	-.199	-.212
					(.073)***	(.079)**	(.082)***
Income Inequality						-.011	.012
						(.169)	(.173)

GDP Growth per Capita							-.059
							(.100)
Observations	386	386	386	385	372	331	331
Threshold	16.04	15.79	14.34	14.12	14.47	14.34	14.65

Notes: See Table 2.

Table 5 reports the estimation results for the decomposed sample comprising non-OECD countries. The estimated coefficients suggest rather an inverted U-shaped correlation between taxes on income, profit, and capital gains and the aged population. An increase in the share of old-aged people in the population initially escalates taxes on income, profit, and capital gains. Nevertheless, after reaching a certain benchmark, any further increases in the share of the elderly lead to decreased taxes on income, profit, and capital gains. These findings substantially contrast with the findings of Razin et al. (2002) along with our theoretical proposition.

Table 5: Aging Population and Taxes on Income, Profit, and Capital Gains (non-OECD Countries)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	1.80	2.02	2.49	2.18	2.32	4.58	4.57
	(.638)***	(.733)***	(.758)***	(.761)***	(.763)***	(1.23)***	(1.23)***
Aged Population Squared	-.063	-.069	-.078	-.077	-.073	-.127	-.127
	(.017)***	(.020)***	(.021)***	(.021)***	(.021)***	(.034)***	(.034)***
Youths		.095	.148	.272	.257	.020	.008
		(.150)	(.152)	(.154)*	(.155)*	(.196)	(.197)
GDP (PPP) per Capita			-.0002	-.0003	-.0002	.00009	.00009
			(.0001) **	(.0001)***	(.0001)*	(.0001)	(.0001)
Trade				.048	.044	.038	.038
				(.014)***	(.014)***	(.021)*	(.021)*
Unemployment					.392	.163	.147
					(.092)***	(.122)	(.124)
Income Inequality						-.098	-.089
						(.142)	(.142)
GDP Growth per Capita							-.053
							(.073)
Observations	1418	1410	1400	1380	1367	918	918
Threshold	14.28	14.63	15.96	14.15	15.89	18.03	17.99

Notes: See Table 2.

From the totally opposite findings across non-OECD and OECD countries, it can be inferred that segregating the dependency ratio into the young and the aged population is valid and justified. Moreover, it is pertinent to analyze the impact of changes in the population of retirees/elderly people across different sub-samples on direct taxes on income, profit, and capital gains to seek reliable results.

The possible rationale for such findings is that the empathy factor within families across OECD countries is stronger than that across non-OECD countries since the aged population constitutes more than 15% of the total population on average. People in the same family share empathy with each other and hence may vote based on that empathy factor. This finding is in line with the findings of studies by Glaser (1959), Huckfeldt and Sprague (1991), Nickerson (2008), and Niemi et al. (1977), which provide evidence that a family association influences individuals' decision making with regard to voting.

To summarize the overall findings, the study concludes that a rise in the share of retirees would lead to a decrease in income taxes but that the correlation between the two variables becomes positive once elderly people constitute 8.4% of the population. This argument challenges the theory of Razin et al. (2002), who concluded that a positive relationship exists between income taxes and retirees only once the retirees constitute half of the total voters. On the other hand, our study proposes that an increase in the relative share of the elderly would initially decrease income taxes. Nonetheless, a further increase in their share would be positively associated with income taxes once the proportion of retirees in the population becomes 8.4% due to empathy within households. The empathy factor, which Razin et al. (2002) failed to acknowledge, is crucial to our result.

5. Conclusion and implications

This study extends the work of Razin et al. (2002) and examines both linear and non-linear relationships between the aging population and taxes on income, profit, and capital gains in OECD and non-OECD countries. The findings for the OECD suggest a U-shaped relationship between the aging population and taxes on income, profit, and capital gains, whereas the findings across non-OECD countries present an inverted U-shaped correlation. These findings cast serious doubts on and challenge the argument proposed by Razin et al. (2002), who suggested a U-shaped

relationship once the aged population comprises at least half of the total population in a median voter model. Furthermore, the estimated threshold differs substantially from what they suggested. This study postulates that the majority of the population is not the only variable that determines changes in direct taxes but that other factors, such as empathy among family members, might influence their voting behavior.

The result provides policy implications for policy makers, governments, and stakeholders to handle when facing the issue of an increasingly aging population. A larger share of elderly people implies greater redistribution of income in terms of direct taxes from the young population to the aged population. A higher demand for redistribution and lower income generation may exert considerable pressure on fiscal policy and, hence, may lead to budget deficits. Even more alarming statistics are apparent. The ratio of the mean value of the young population to the mean value of the old population is 1.19 across the OECD countries. However, putting more burdens through direct taxation on working-age people, whose share in the population is already declining, may create a disincentive to supply labor. It must be quite challenging for policy makers to strike a balance by catering to the demand for redistribution without creating a disincentive for labor. Unlike the situation in OECD countries, the policy making does not seem as challenging for non-OECD countries when observing the summary statistics. The ratio of the mean value of the young population to the mean value of the old population is 6.02 across non-OECD countries. Keeping in view increasing life expectancy due to scientific advancement and falling fertility rates across non-OECD countries, the aged population is expected to outnumber the young population in the future. Thus, non-OECD countries will face similar challenges.

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