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Demography and Inequality: The Effect of Tax Composition

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ABSTRACT

This paper investigates how aging societies lead to worsen distribution of income through tax composition measured by ratio of direct taxes to indirect taxes. The rationale follows: due to the political power of working age population emanating from majority of their share in the population, in a median voter model, they manage to shift the tax burden on aged population in an aging society through increasing direct taxes more than indirect taxes. This results in elevating income inequality in society. To estimate our hypothesis, we apply panel data using time and country fixed effects. Based on sample covering 110 countries from 1990-2020 and applying different inequality measures and robustness check, the empirical evidence considerably supports this hypothesis. The results hold firmly across the OECD and non-OECD countries together with strong and weak democracies.

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1. Introduction

According to estimates reported in the UN report regarding population forecast, the fraction of aging population (population aged 65 years or over) out of total population will rise up to 16% by 2050 globally in comparison to 9% in 2019 as a consequence of declining fertility rates and rising life expectancy. Northern Africa and Western Asia, Central and Southern Asia, Eastern and South-Eastern Asia, and Latin America and the Caribbean are regions where the aging population is projected to double during this period. The aged population is predicted to constitute almost 25% share of total population inhabited across Europe and Northern America, by 2050. Furthermore, quite unprecedented, population aged 80 years or over is estimated to rise by 298% between 2019 and 2050 – from 143 million to 426 million. Aging population composing a rising share of total population every year or falling proportion of working-age population implies growing dependency ratio. The potential support ratio – comparison of young population aging 14 or over to old population aging 65 or over – is estimated to decline globally. For example, according to UN projection, the potential support ratio is forecast to fall below two in 48 countries by half of the 21st century. The majority of these countries is constituted by Eastern and South-Eastern Asia, North America, and Europe. The dependency ratio is not costless, to say the least.

An aging society may potentially lead to adverse socio-economic outcomes. A rising dependency ratio is already exerting considerable pressure and triggering policy challenges to set up and perpetuate public provisioning of health care, pensions, and social protection for the aged population. In Japan between 1990 and 2000, aging society has resulted in 0.3%-point deflationary pressures on year-to-year inflation. In addition, it has caused the

unemployment rate to rise 0.3% to 0.4% point along with 1.8%-point fall in real GDP (Katagiri, 2018). The health expenditures due to aging population, in Sweden, are estimated to rise by 13% from 1970 to 1985 (Gerdtham, 1993). According to OECD's projections, almost 50% of the rise in total public expenditures is forecast to be attributable to aging population from 2000 to 2050. One of major implications of an aging population is income inequality. Quite interestingly, the literature on how changes in demographic structure affect income distribution are mixed. The studies conducted for Brazil and the US, for China and the UK, for Canada, Netherlands and Sweden, for Japan, for Indonesia, for China and for 13 OECD countries including the US by (Cameron, 2000; Chien et al., 2021; Deaton & Paxson, 1994; Jätti, 1997; Lam & Levison, 1992; Ohtake & Saito, 1998; Razin, Sadka, & Swagel, 2002; Zhong, 2011) respectively find substantial evidence that aging population leads to higher income inequality. On the contrary, studies conducted for China and Australia by Chu and Jiang (1997) and Barreti, Crossley, and Worswick (2000) respectively established negative correlation between aging population and income inequality. Another effect attributed to aging population is that its effect on distribution of income is limited in studies conducted by (Jenkins, 1995; Liu, 2014; Nawaz, Ahmad, Hussain, & Bhatti, 2020; Qu & Zhao, 2008; Tsakloglou, 1997).

This paper develops on Luo (2019) who establishes that a rise in aging/retired population (aging 65 and over) leads to increase tax composition – ratio of direct taxes (taxes on income, profit, and capital gains) to indirect taxes (taxes on goods and services). The main theoretical contribution of this paper is the application of tax composition as a channel to examine how income inequality is affected through tax composition in an aging society. The justification is quite simple. A working age individual – aged between 14 and 65 years – prefers indirect taxes because these taxes are paid by everyone whether young or old. However, an old/retiree would prefer direct taxes because these will be imposed on the working age population. In an aging society, an increase in the share of the aged population implies more burden on workers since they will be taxed more to finance higher redistribution towards retirees. In the median voter model, if the working/young population accounts for majority in total population, they will vote for increasing indirect taxes against direct taxes as it works in their self-interest. Their demands ultimately prevail as they are politically more powerful. Given this, higher indirect taxes relative to direct taxes will raise income inequality because direct taxes are progressive and indirect taxes are regressive in nature. Consequently, in a median voter model with young population as majority, an aging society with higher indirect taxes relative to direct taxes will widen gaps of income inequality.

To examine this argument, annual panel data is collected for 110 countries from 1990-2020. Owing to differences across time and countries in the data sample, time and country fixed effects are applied throughout empirical analysis. The evidence considerably supports the main hypothesis developed in this paper. The data sample is also decomposed into the OECD and non-OECD countries because the OECD countries are found to receive more effects of aging population. The hypothesis is confirmed across non-OECD and OECD countries. Furthermore, the data is also disintegrated among weak and strong democracies as the median voter model is more applicable in democratic regimes as opposed to autocratic regimes. The empirical evidence throughout weak and strong democratic countries is substantially consistent with the main argument of this paper.

2. Literature Review

The relationship between aging population and income inequality is thoroughly researched. There are proponents of demographic structure as well as opponents regarding its impact on income inequality. For example, few studies find aging population to lead to higher income inequality whereas literature also establishes that both variables are inversely related. However, few studies find both variables independent of each other. Deaton and Paxson (1994) find that inequality relating to consumption and income rises with an aging population. Furthermore, the rate at which inequality rises due to aging does not differ much across the United States, United Kingdom, and Taiwan. Their finding is derived using cohort data assembled through 11 years of household surveys from the United States, 22 years of household surveys from the United Kingdom and 14 years of household surveys from Taiwan. Similarly, Ohtake and Saito (1998) derive some interesting findings. Replicating the method developed by Deaton and Paxson (1994) and constructing data from Japanese household microdata, they find that consumption inequality increases once people attain 40 years of age.

Beside this, they attribute almost 50% of the rapid rise in consumption inequality during 1980 in Japan to aging population. Luo (2023) also discuss our main hypothesis. Another study conducted by Jätti (1997) examining the level of and trend in income inequality for 5 industrial economies, the United States, the United Kingdom, Canada, Netherlands, and Sweden, suggests that inequality increases with aging population across Sweden, the United States and the United Kingdom. According to their analysis, in fact, inequality increases due to inequality the earnings of head of family and earnings of spouse as they grow old. Nonetheless, the results were inconsistent across other two industrialized countries – Canada and Netherlands.

Owing to one child policy imposed in 1979, China has witnessed relatively fewer young children reaching the working age. This has led to a rise in the aging population. Resultant shortage in labor force in the wake of expansion of industrialization has caused higher income inequality because the returns of higher ratio of working adults in the total family are higher (Zhong, 2011). On the other side of spectrum, there are studies which establish that an aging population lowers income inequality. For example, applying the source-specific Gini decomposition and Lorenz comparison approaches and dealing every age-specific income-earning family member as a source of income, Chu and Jiang (1997) examine how changes in demographic structure in Taiwan affect family income inequality. The results suggest that the family income inequality throughout developing countries, which experienced rapid demographic transition, is not affected with aging societies. Collecting data from Australian Bureau of Statistics Household Expenditures Survey from 1975-1993, Barrett, Crossley and Worswick (2000) find that aging population does not contribute to aggravating income inequality issues. Another perspective regarding aging population and income inequality is that the latter remains unaffected by demographic transitions. Jenkins (1995), for illustration, after disaggregating the inequality index by age-specific and income specific establishes that changes in demographic structure is an insignificant determinant of income inequality. Another study, Tsakloglou (1997), examines the effect of aging population on income inequality in Greece. The data over the period from 1974 to 1988 finds aged population an insignificant contributor to income inequality.

3. Research Design/Methodology

In this study the empirical analysis investigates a panel data set comprising 110 countries over the period from 1990-2020. The dependent variable chosen for this study is income inequality following Meltzer and Richard (1981). However, the big question that surfaces is how is it measured? What proxy is used as a measure of income inequality? Based on equivalence scale, income concepts and coverage, the dataset is harmonized to attain comparability objective. University of Texas Inequality Project (UTIP) is developed comparing household income inequalities against industrial pay inequalities as suggested by (Galbraith, Choi, Halbach, Malinowska, & Zhang, 2016). Due to broader coverage of country-year observations, this study aims to collect dataset for inequality from WDI, SWIID and UTIP. The key explanatory variable is the percentage of population constituted by aged population – People aging 65 or over as a fraction of total population following (Luo, 2019). For measuring dependency ratio, on the other hand, Razin, Sadka and Swagel (2002) used the share of aged and young - population aged from 0 to 14 and people aged 65 or over - in the total population which was criticized by Shelton (2007) for not disaggregating dependency ratio between aged and young population.

Figure 1: average of young population (% of population) across the sub-sample for 90 countries from 1990-2017.

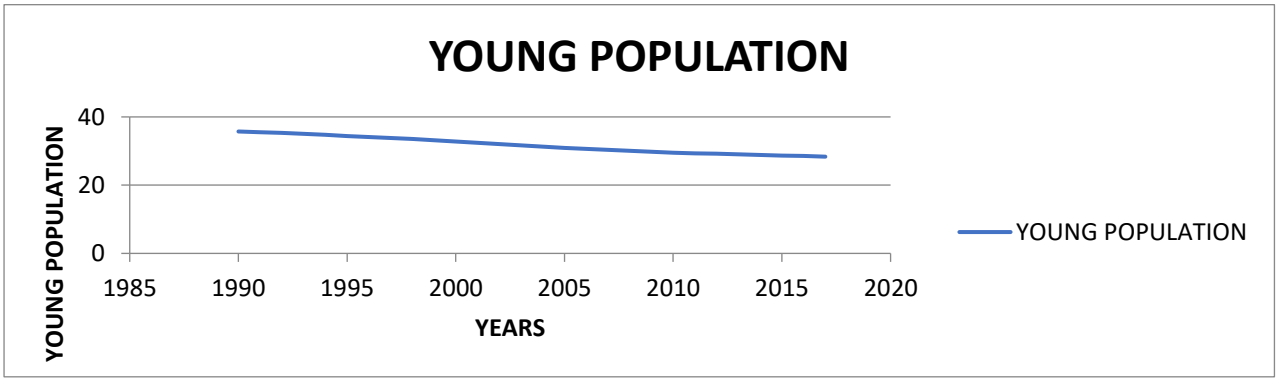
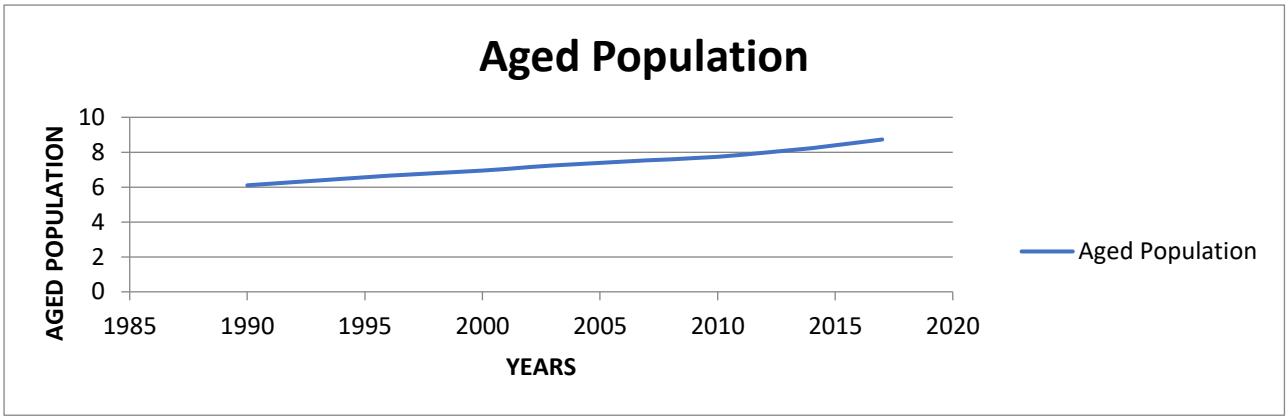


Figure 2: average of aged population (% of population) across the sub-sample for 90 countries from 1990-2017



The decomposition of dependency ratio into young and aged population is justified through Figure 1 and Figure 2. The trend of aged population is rising from 1990-2020 whereas young population is found to decline during the same period. Table 1 reports summary statistics for aged and young population along with other control variables. Furthermore, the variables are decomposed into the OECD and non-OECD countries in Table 2.

Table 1: Summary Statistics

	Observations	Mean	St: Deviation	Minimum	Maximum
Inequality (UTIP)	1945	49.65	7.63	28.74	70.29
Aged Population	1884	7.09	5.95	1.98	31.56
Young Population	1884	34.67	13.67	11.86	58.94
Direct Taxes	1975	19.48	16.68	-2.38	83.48
Indi: Taxes	1947	24.81	11.96	9.74	35.76
Trade Openness	1725	64.25	38.45	1.86	95.44
Unemployment Rate	1702	9.45	7.42	.14	43.85
GDP Growth per capita	1625	1.78	8.56	-2.43	22.29
Inflation Rate	1437	12.47	7.79	4.37	78.21
Ln(Population)	1443	4.91	3.49	.08	12.09
Democracy	1586	5.76	7.86	-10	10
Government Size	1641	28.37	36.40	12.75	75.80

Table 2: Summary Statistics

Non-OECD Countries						OECD Countries				
	Observations	Mean	St: Dev:	Minimum	Maximum	Observations	Mean	St: Dev:	Minimum	Maximum
Inequality (UTIP)	1465	27.46	5.23	21.46	50.98	412	15.68	4.82	4.59	30.87
Aged Population	1021	2.21	3.05	1.06	35.08	422	4.67	4.23	2.07	45.44
Young Population	1015	23.54	7.79	8.56	60.65	436	13.65	6.56	6.75	48.75
Direct Taxes	1312	7.25	5.63	1.12	45.44	418	12.53	8.91	6.20	38.63
Indi: Taxes	1314	17.86	9.96	10.86	55.64	464	11.32	9.67	4.56	41.57
Trade Openness	1312	20.48	17.78	5.74	80.99	426	29.96	13.54	15.65	77.65
Unemployment Rate	1056	5.98	4.89	2.03	18.95	448	3.23	4.40	.07	11.13
GDP Growth per capita	1139	0.69	1.02	-1.28	18.97	437	2.63	3.89	.09	14.16
Inflation Rate	1235	8.97	7.78	2.49	52.36	429	5.64	7.72	1.45	18.45
Ln (Population)	1399	3.06	2.85	1.11	9.65	431	2.53	1.25	1.02	4.98
Democracy	1142	3.42	1.84	-10	10	423	6.75	.45	6.28	10
Government Size	1253	16.52	10.71	6.52	92.15	445	11.35	6.95	2.61	22.86

Following Pickering and Rajput (2018), another important variable included is tax composition – the ratio of taxes on income, profit and capital gains to taxes on goods and services. In fact, applying tax composition channel, this study aims to determine the effect of demographic changes on inequality. In Economics literature, direct taxes are progressive whereas indirect taxes are found to be regressive in nature. A rise (fall) in tax composition implies that the fraction of direct taxes (indirect taxes) as compared to indirect taxes (direct taxes) increases (decreases). Consequently, a rise in composition of taxes is hypothesized to improve income distribution whereas a fall in it may lead to worsen income inequality. The econometrics specifications also include control variables which include GDP per capita (constant chained PPP US$) to measure economic development and fully capture tax base

effects following Kenny and Winer (2006), trade openness (export and imports as percentage of GDP) to measure growth of government size following Rodrik (1998), unemployment rate to measure reverse causation between unemployment and tax rate following Daveri and Tabellini (2000), GDP growth per capita to control for variations in business cycle following Persson and Tabellini (2005); Razin et al. (2002), inflation, population to capture economics/diseconomies of scale, democracy following Pickering and Rajput (2018) and government expenditures as a share of GDP to measure government size following (Rodrik, 1998).

4. Results and Discussion

In this section we estimate the effect of aging population on income inequality by applying tax composition channel. The rationale is quite simple. Higher direct taxes, taxes on income, profit, and capital gains (% of total tax revenue), lead to decrease income inequality since direct taxes are progressive. On the contrary, indirect taxes – taxes on goods and services as a fraction of total tax revenue – worsen income distribution for these are regressive in nature. So, the tax composition is measured as the ratio of direct to indirect taxes. In the median voter model where working population – people aging between 14 and 65 years of age - constitutes majority, the political pressure will be exerted towards higher indirect taxes in comparison to direct taxes if the proportion of aging people in the total population is on rise (Luo, 2019). The logic is simple: it is the worker who is supposed to pay direct taxes whereas the indirect taxes are supposed to be paid by everyone across generations whether young or old. In fact, an aging society implies fewer workers responsible to contribute even more to ensure social security to the elderly.

Table 3: Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	.837	.66			.38	.49	.47
	(.265)***	(.19)***			(.10)***	(.24)**	(.07)***
Young Population		-2.12			-1.69	-1.86	-1.83
		(.1.01)**			(.812)**	(.92)**	(.92)**
Direct Taxes			-1.54	-1.46	-1.32	-1.62	
			(.032)***	(.058)**	(.031)***	(.71)**	
Indi: Taxes			.0098	.0097	.0091	.0072	
			(.0038)**	(.0036)**	(.0033)***	(.0035)**	
Aged Population*Direct Taxes						-1.38	
						(.041)***	
Aged Population*Indirect Taxes						.248	
						(.0082)***	
Tax Composition							-.0064
							(.0021)***
Trade Openness		-.502		-.322	-.306	-.208	-.202
		(.128)**		(.118)***	(.872)	(.096)**	(.094)**
Unemployment Rate		2.35		1.86	1.72	1.69	1.68
		(.1.18)**		(.923)**	(1.04)*	(6.66)	(6.47)
GDP Growth per capita		-.0038		.0178	-.0167	-.0245	-.0144
		(.0018)**		(.0177)	(4.09)	(7.56)	(8.41)
Inflation Rate		.027		1.90	1.82	1.85	1.69
		(.12)**		(.904)**	(.634)***	(.498)***	(.472)***
Ln(Population)		.456		2.305	2.156	2.66	2.84
		(8.96)		(1.150)**	(1.061)**	(1.28)**	(1.22)**
Democracy		-.046		-1.95	-1.726	-1.238	-1.219
		(2.78)		(1.12)*	(1.88)	(2.69)	(2.21)
Government Size		-1.91		-2.20	-2.05	-1.48	-1.86
		(3.9)		(1.96)	(2.98)	(1.93)	(1.66)
Fixed Effects	NO	NO	NO	NO	NO	NO	NO
Observation	1227	1265	1248	1197	1188	1176	1176
Countries	110	110	110	110	110	110	110
R^2	.45	.82	.59	.85	.86	.88	.9

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

Given population aging, the working population, since they form the majority, will exercise their political muscle, and prefer higher indirect taxes relative to direct taxes in the median voter model of political economy. Consequently, income inequality will worsen because

indirect taxes are regressive. Ordinary Least Squares (OLS) estimation technique is a good starting point to examine correlation between policy variables. Column 1 of Table 3 reports a simple regression with the share of aged population and income inequality as regressors. Robust standard errors are clustered over by country in the specification. The estimated coefficient of retirees (aged population) is positive and significant at 1% level of significance. The implication is that as the fraction of aged population increases, it leads to increase income inequality. This is consistent with previous literature, for example, (Cameron, 2000; Deaton & Paxson, 1994; Jätti, 1997; Ohtake & Saito, 1998; Razin et al., 2002; Zhong, 2011). Column 2 repeats the specification of column 1 including control variables. The finding is still consistent with the one we found for column 1. The following column 3 reports specification with both taxes, direct and indirect taxes, and income inequality as regresseors. The result derived through negative sign of the estimated coefficient for direct taxes substantially confirms that income inequality decreases with a rise in direct taxes. Nevertheless, positive sign of the estimated coefficient relating to indirect taxes implies that a rise in indirect taxes leads to an increase in income inequality. Column 4 replicates column 3 with full controls and the relationship between taxes and inequality becomes even more substantive. Column 5 mimics column 4 adding old and young population. The results are like the precious columns and even more reliable as the estimated coefficients relating to direct and indirect taxes retain even more significance at 1% level. In the next column, column 6, direct and indirect taxes are interacted with aged population.

Table 4: Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aged Population	.725	.47			.41	.51	.39
	(.199)***	(.15)***			(.11)***	(.23)**	(.08)***
Young Population		-.342			-.291	-.311	-.181
		(.164)**			(.124)**	(.221)	(.09)**
Direct Taxes			-.091	-.096	-.126	-.156	
			(.042)**	(.047)**	(.039)***	(.076)**	
Indi: Taxes			.0042	.0048	.0051	.0061	
			(.0018)**	(.0021)**	(.0017)***	(.0027)**	
Aged Population*Direct Taxes						-1.13	
						(.019)***	
Aged Population*Indirect Taxes						.647	
						(.0029)***	
Tax Composition							-.0012
							(.0004)***
Trade Openness		-.251		-.211	-.203	-.223	-.195
		(.125)**		(.110)***	(.098)**	(.432)	(.09)**
Unemployment Rate		1.24		.961	1.11	1.19	1.14
		(.361)***		(.242)***	(.521)**	(3.98)	(.41)***
GDP Growth per capita		-.0033		.0062	-.0042	-.0048	-.0045
		(.0016)**		(.0028)**	(.0015)***	(.0017)***	(.0022)**
Inflation Rate		.022		.017	.018	.021	.027
		(.13)*		(.21)	(.13)	(.002)***	(.12)**
Ln(Population)		.222		.198	.203	.233	.212
		(.075)***		(.071)**	(.085)**	(.062)***	(.055)***
Democracy		-.025		-.035	-.037	-.045	-.039
		(.084)		(.019)*	(.021)*	(.048)	(.019)**
Government Size		-.034		-.022	-.062	-.061	-.048
		(1.8)		(.088)	(.027)**	(.028)**	(.023)**
Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observation	1227	1265	1248	1197	1188	1176	1176
Countries	110	110	110	110	110	110	110
R^2	.45	.83	.55	.85	.87	.88	.92

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

The application of interaction provides us with an alternative method to investigate how changes in aging societies with a rise in direct and indirect taxes affect inequality. As hypothesized, the sign of coefficient of interaction term between direct taxes and aged population is negative whereas the sign of the estimated coefficient is positive when indirect taxes are interacted with aged population. The findings suggest that a rise in direct taxes in aging societies leads to lower income inequality. However, higher indirect taxes are estimated

to enhance income inequality in aging societies. Column 7 repeats column 5 replacing direct and indirect taxes with tax composition – the ratio of direct to indirect taxes. The negative sign of tax composition coefficient suggests that a rise in tax composition (higher direct taxes relative to indirect taxes) leads to reduced income inequality. Relating to control variables, the estimated coefficients of trade as a share of GDP, inflation rate and population growth rate are statistically significant (column 7). The results suggest that more trade leads to reduced income inequality whereas a rise in inflation rate and population growth rate would aggravate income inequality. Since this study deals with panel data, OLS as an estimation technique is not enough. The panel data deals with cross-sectional and time-series dimensions of the data. Thus, it confronts issues which are specific to cross-country and time-series dimensions. To get reliable results, it becomes pertinent to control for time invariant and country specific factors applying fixed effects. Table 4 duplicates Table 3 applying time and country fixed effects. The results reported in Table 4 validate and simultaneously enhance the reliability of the findings suggested by the previous table. Further, the specifications are also run disintegrating the sample into the OECD and non-OECD countries as well as weak and strong democracies[1] reported in Table 5. This is important once we have a look at the summary statistics in Table 2. The severity of problems caused by aging population is far higher among the OECD countries. For example, on average, the fraction of aged population among OECD countries is 4.67 whereas it is less than half for non-OECD countries. Similarly, fraction of young population and share of tax revenue collected through indirect taxes are far higher in non-OECD countries in comparison to the OECD countries. On the contrary, the OECD countries collect a higher fraction of their total tax revenue through direct taxation.

Table 5: Estimation Results

	Non-OECD	**OECD**	**Weak Democracy**	**Strong Democracy**
Aged Population	.11	.20	.08	.13
	(.05)**	(.07)***	(.04)**	(.06)**
Young Population	-.752	-.653	-.934	-.52
	(.354)**	(.245)**	(.426)**	(.243)**
Direct Taxes				
Indi: Taxes				
Tax Composition	-.0004	-.0011	-.0051	-.0031
	(.0001)***	(.0003)***	(.0016)***	(.0014)**
Trade Openness	-.191	-.225	-.155	-.45
	(.111)*	(.106)**	(.134)	(.21)**
Unemployment Rate	.073	.093	.014	.456
	(.91)	(.46)**	(.41)	(.183)**
GDP Growth per capita	-.0021	-.0032	-.0145	-.00734
	(.0138)	(.0013)**	(.11)	(.0006)***
Inflation Rate	.021	.011	.023	1.13
	(.08)**	(.701)*	(.119)	(..494)***
Ln(Population)	.199	.193	.141	.109
	(.085)**	(.091)**	(.0713)**	(.051)**
Democracy	-.031	-.019	-.043	-1.83
	(.019)*	(.016)**	(.025)*	(1.10)
Government Size	-.034	-.035	-.041	-1.92
	(.020)*	(.029)	(.0193)**	(2.43)
Fixed Effects	YES	YES	YES	YES
Observation	965	215	928	414
Countries	90	20	75	35
R^2	.84	.83	.89	.94

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

The rationale for splitting the sample into stronger and weaker democracies is borrowed from (Luo, 2019). According to this study, the median voter is capable of influencing policy making where institutions are of high quality and democracies are stronger. Quite interestingly, according to coefficient estimates the results confirm that a rise in aging population causes income inequality to reduce (rise) if direct taxes (indirect taxes) are increased across not only the OECD and non-OECD countries but also stronger and weaker democracies.

[1] Data for democracy is collected from Polity IV database. It ranges from -10 to +10 where -10 demonstrate absolute dictatorship and +10 absolute democracies. For our sample the median value for democracy is 8. Hence stronger democracy in this study refers to Polity2 >= 8, weaker democracy otherwise.

Table 6: Estimation Results

	Full Sample	Non-OECD	OECD	Weak Democracy	Strong Democracy
Aged Population	.691	.214	.413	1.092	.069
	(.253)***	(.092)**	(.209)**	(.453)**	(.0213)***
Young Population	-.041	-.0129	-.942	-2.424	-1.938
	(.035)	(.0314)	(.361)**	(1.11)**	(.976)**
Direct Taxes					
Indi: Taxes					
Tax Composition	-.0493	-.0314	-.0539	-1.453	-1.894
	(.0238)**	(.0149)**	(.0197)**	(.346)***	(.916)**
Trade Openness	-1.38	-.249	-1.32	1.992	1.362
	(.674)**	(.134)*	(.843)*	(.342)**	(.432)***
Unemployment Rate	.845	.453	.842	2.04	1.956
	(.386)**	(.786)	(.771)	(1.01)**	(1.23)
GDP Growth per capita	-.0991	-1.79	-.896	.092	.0489
	(.0521)*	(.862)	(.688)	(1.86)	(.0052)***
Inflation Rate	.079	.489	.0318	.432	1.081
	(.69)	(.241)**	(.012)***	(2.67)	(9.04)
Ln(Population)	1.05	.0032	1.378	1.659	1.881
	(1.03)	(.092)	(.876)*	(.702)**	(.069)**
Democracy	-.072	-.032	-.0849	2.431	1.345
	(.034)**	(1.88)**	(.0227)***	(2.113)	(4.018)
Government Size	-.084	.064	.0196	1.089	2.437
	(.024)***	(.031)**	(.0489)	(.042)**	(1.091)
Fixed Effects	YES	YES	YES	YES	YES
Observation	845	648	204	833	266
Countries	110	90	20	75	35
R^2	.8	.85	.86	.88	.95

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

Table 7: Estimation Results

	Full Sample	Non-OECD	OECD	Weak Democracy	Strong Democracy
Aged Population	1.692	.043	1.21	.920	1.972
	(.391)***	(.008)***	(.041)***	(.356)**	(1.001)**
Young Population	-2.129	-1.323	-1.884	-.543	-.896
	(.459)***	(.469)**	(.948)**	(.323)*	(.244)***
Direct Taxes					
Indi: Taxes					
Tax Composition	-.462	-.213	-.386	-.139	-.498
	(.173)***	(.104) **	(.092) ***	(.062) **	(.219) **
Trade Openness	-.985	-.443	-.541	-.339	-.234
	(.491)**	(.478)	(.447)	(.159)**	(.098)**
Unemployment Rate	1.274	1.096	1.278	2.186	1.898
	(.609)**	(2.886)	(3.986)	(1.110)**	(6.412)
GDP Growth per capita	2.842	1.478	1.984	2.869	3.964
	(1.023)***	(.672)**	(.984)**	(1.345)**	(.2.019)**
Inflation Rate	.846	.356	.289	1.938	1.456
	(4.84)	(.321)	(4.21)	(5.890)	(2.431)
Ln(Population)	.0967	.0634	.0541	1.091	1.773
	(2.48)	(3.89)	(6.77)	(4.801)	(2.178)
Democracy	-1.536	-.961	-.365	-.342	-2.028
	(.43)***	(.23)***	(.137)***	(3.398)	(3.856)***
Government Size	.728	.436	.328	2.024	1.968
	(1.889)	(1.589)	(2.736)	(.968)**	(1.589)
Fixed Effects	YES	YES	YES	YES	YES
Observation	645	444	206	437	301
Countries	110	90	20	75	35
R^2	.82	.82	.84	.84	.88

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

Table 6 mimics only column 7 of Table 4 and Table 5 using income inequality data collected through World Development Indicators. Following this, Table 7 reproduces Table 6 using data gathered from *Standardized World Income Inequality Database. The results found are in absolute conformity with the ones already found.*

4.1. Robustness Check

4.1.1. Generalized Method of Moments (GMM) Estimation

There are explanatory variables which may be endogenous with income inequality. For example, as suggested by Pickering and Rajput (2018) that changes in income inequality affect tax composition. Along these lines, income inequality may also affect GDP growth per capita. Many studies, for example (Alesina & Rodrik, 1994; Easterly, 2001; Perotti, 1996; Persson & Tabellini, 2005), establish that there is a trade-off between income inequality and economic growth. Furthermore, government size measured by government expenditures as a share of GDP often confronts endogeneity problems with income inequality. As per the literature of political economy, the demand for government spending may be higher in societies suffering through inequality issues. However, Mallo and Tiongson (2006) conclude that unequal societies spend less. Owing to endogeneity issues confronted by the data, Two-Step Difference Generalized Method of Moments (Two-Step Difference GMM) estimation technique is also applied as a robustness check. Table 8 replicating Table 7 with Two-Step Difference GMM reports results which are consistent with previous findings.

Table 8: Estimation Results

	Full Sample	**Non-OECD**	**OECD**	**Weak Democracy**	**Strong Democracy**
Aged Population	1.843	.0756	1.265	.841	.986
	(.649)***	(.0381)**	(.439)***	(.429)**	(.361)**
Young Population	-1.751	-.413	-1.414	-.325	-.872
	(.428)***	(.196)**	(.236)***	(.184)*	(.319)***
Direct Taxes					
Indi: Taxes					
Tax Composition	-1.029	-.376	-.556	-.248	-.455
	(.198)***	(.198)***	(.198)***	(.198)***	(.198)***
Trade Openness	-1.214	-.894	-.652	-.674	-.452
	(.573)**	(.501)*	(.326)**	(.326)**	(.194)**
Unemployment Rate	2.934	1.872	2.231	2.335	1.789
	(1.325)**	(2.132)	(1.096)**	(.801)***	(.495)***
GDP Growth per capita	3.856	2.123	1.812	1.785	2.056
	(2.319)*	(1.307)*	(4.819)	(1.685)	(3.896)
Inflation Rate	.894	1.856	3.442	1.156	2.389
	(.398)**	(.854)**	(1.165)**	(.949)	(2.579)
Ln(Population)	1.432	.756	1.953	1.226	2.228
	(.694)**	(1.634)	(2.532)	(1.216)	(3.103)
Democracy	-1.724	-2.413	-2.211	-.896	-1.065
	(.834)**	(1.745)	(2.163)	(3.425)	(1.895)
Government Size	2.059	1.721	1.412	.986	2.135
	(.992)**	(.994)*	(1.359	(1.532)*	(.886)**
Fixed Effects	YES	YES	YES	YES	YES
Observation	945	440	306	637	301
Countries	110	90	20	75	35
R^2	.9	.91	.93	.95	.95

*, **, *** respectively denote statistical significance respectively at 10%, 5% and 1%.

5. Conclusion

How aging societies affect distribution of income through tax composition is analyzed in this paper. The proposed hypothesis is empirically supported with data sample covering 110 countries from 1990-2020. The evidence is supported when the sample is broken up into the OECD and non-OECD in addition to strong and weak democratic regimes. Consequently, this has created various policy challenges for the governments such as opting for indirect taxes causing inequality whereas imposing direct taxes is distortionary. Given the exceedingly

challenging environment for policy making in the wake of aging population, the governments are advised to find a mix where inequality reduces without generating distortionary effects on the economy.

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