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# AGING AND INEQUALITY: THE PERSPECTIVE OF LABOR INCOME SHARE

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**Abstract**

Despite a growing literature on population aging, empirical studies exploring mechanisms between aging and income inequality are scarce. This paper estimates the impact of aging on inequality via the perspective of labor income share, based on cross-country information covering the period 1990–2010. Two transmission mechanisms are examined—aging leads to a declining labor share and affects the average wage. Our robust finding shows that (i) there is a positive impact of aging on income inequality, (ii) this positive impact is because aging leads to a lower share of labor income, and (iii) more specifically, the labor share–reducing effect of aging comes from the shrinking labor force rather than the lowering of the average wage.

**Keywords:** income inequality; aging; labor share; functional distribution of income

**JEL Classification:** E25; J11; J14; J21

# Contents

# 1. INTRODUCTION

Population aging is taking place in every country in the world due to significant increased longevity and declining fertility. The world's population is growing older, leading us into uncharted demographic waters. In 2014, there were 868 million people over the age of 60 in the world – 12% of the total population. By 2030, the number of aging people will increase to 1.2 billion or 16% of the population (OECD 2015).[1] Both industrialized nations such as the US and Japan and emerging economies like the People's Republic of China (PRC) have been experiencing the process of population aging. In particular, much of the swing toward a graying population is taken up by the PRC – home to 130 million people older than 65 (World Bank 2016).

Population aging may lead to several adverse socioeconomic consequences. Firstly, as noted by Bloom, Canning and Fink (2010), aging tends to lower both the labor supply and saving rates, thereby inducing concerns about a future slowing of economic growth. This could be more challenging in developing countries if they become "old" before they become "rich." Secondly, aging increases demographic stress, as aging results in a higher dependency ratio and leads to a decreased standard of living for the noneconomically active, with fewer to care for them (Goldin 2016). Thirdly, aging brings in fiscal pressure (OECD 2007). On average, from 2010 to 2014, the growth rate in per capita health spending in real terms was 4.7% per year in Asia, which is higher than the 4.0% observed for gross domestic product (GDP). Meanwhile, 61.6% of total health spending per capita is funded by government sources in Asia (OECD 2016). As another example, the Greek sovereign debt crisis is caused by an aging population and the huge welfare spending.

Another adverse consequence raised by aging is the potential widening inequality (Deaton and Paxson 1994). A positive linkage between aging and income inequality has been found for both developed and developing countries (Lam and Levison 1992; Cameron 2000; Zhong 2011; Van Vliet and Wang 2015). However, although a vast amount of literature has examined the relationship between aging and income inequality, the mechanism behind the relationship is still unclear. Razin, Sadka and Swagel (2002) argued that aging can lead to less generous social transfers, if any, especially with democratic voting. However, the research of Razin, Sadka and Swagel (2002) does not analyze the impact of aging itself, but points to its policy reflection instead. Another argument is that, since the elderly group has limited income from work, they usually stay in the lower part of the income ladder, and therefore the increase in the share of this group may lead to higher income disparity (Gustafsson and Johansson 1999). However, this argument could not explain why demographic changes are not important for the development of inequality (Tsakloglou 1997).

In this paper, we intend to analyze the distributive impact of population aging on inequality from the perspective of labor income share. On the one hand, aging is closely related to functional distribution of income. In fact, aging means less supply of labor and is expected to be associated with a change in labor share if the elasticity of the labor supply curve is not unity. In particular, when the reduced labor supply does not cause a sufficient increase in labor income, aging will be negatively correlated with labor income and labor share. On the other hand, as Piketty (2014) has argued, a decline in the labor share to the benefit of capital share implies increasing inequality. Therefore, if aging has a reduced labor share, it will have an adverse effect on

[1] With regard to people aged 100 years and over, the number was 570 in 1961 in England and Wales while, by 2012 the number had climbed to 12,318, and by 2050 the number is expected to be close to 300,000.

inequality. It is obvious that we are analyzing the direct impact of aging on income inequality, rather than its policy reflection, as the first consequence of aging is the reduction of the labor supply.

Our empirical results firstly confirm that aging is positively associated with income inequality. We then find that aging is negatively correlated with labor share. These results are robust under different model specifications and data samples. We further examine the impact of aging on labor share via two channels: employment and wage – the two components of labor income. We discovered that aging is found to significantly reduce employment. The relationship between aging and wage is found to be negative and insignificant. These results explain why there is a negative relationship between aging and labor share.

This paper is organized as follows. In Section 2, we review the literature. In Section 3, we discuss our empirical strategy. In Section 4, we introduce our data. In Section 5, we present estimation results. Finally, in Section 6, we provide concluding remarks.

# 2. LITERATURE REVIEW

## 2.1 Aging and Inequality

The relationship between population aging and income inequality has been well documented. Early research has pointed out that the larger the share of elderly people, the more unequally income is distributed, indicating a positive correlation between aging and inequality (Lindert 1978; Repetto 1978). Later studies mostly focus on within-country evidence, including developed economies such as the United States, the United Kingdom, Taipei,China (Lam and Levison 1992; Deaton and Paxson 1994), Japan (Ohtake and Saito 1998), and OECD countries (Van Vliet and Wang 2015), as well as developing economies such as Java (Cameron 2000) and the PRC (Zhong 2011).

Despite the positive relationship, there are several studies suggesting that the contribution of aging to inequality is limited. For example, the empirical evidence from Australia, Canada, Greece, the Netherlands, Sweden, the United Kingdom, and the United States does not show any major contribution from demographic shifts to inequality changes (Jenkins 1995; Jantti 1997; Tsakloglou 1997; Barrett, Crossley |and Worswick 2000). Gustafsson and Johansson (1999)'s evidence from 16 OECD countries does not show a significant effect of aging on income inequality either. The evidence from Biewen and Juhasz (2012), who examine the driving forces behind the rising income inequality in Germany from around 2000 to around 2005, show that although aging makes a positive contribution to the total increase of income inequality, the extent of the effect is only limited. For developing economies, Qu and Zhao (2008) and Liu (2014) decompose the consumption and income inequality by age group and find that the effect of aging on income inequality is also limited.

There are a few studies suggesting that aging reduces inequality. Chu and Jiang (1997) estimate the impact of demographic transition on the changes in income inequality in Taipei,China from 1978 to 1993. They find that population aging is negatively associated with income inequality. However, as Zhong (2011) has argued, the source-specific Gini decomposition approach that Chu and Jiang (1997) have applied could not control the effect of the development and prevalence of the education system, industrialization, and establishment of social security systems that occurred during the corresponding period.

Obviously, most previous studies find a positive relation between aging and inequality, while the economic significance is controversial. Most studies focus on country-specific evidence, though such evidence is not convincing to the extent that the effect from the stage of economic development on inequality cannot be controlled for thoroughly. Moreover, analysis of the mechanism behind aging and inequality is still lacking, let alone from the perspective of labor income share. In this paper, we fill in these research gaps.

## 2.2 Aging and Labor Income Share

Since we have argued that the mechanism behind the potential relationship between aging and inequality lies in labor income share, this paper is also closely related to research on aging and labor income share. However, although a vast amount of literature has studied the determinants of labor income share, such as economic growth (Raffalovich, Leicht and Wallace 1992), structural transformation (Luo and Zhang 2009), globalization (Decreuse and Maarek 2015; Jaumotte and Tytell 2007), technology progress, and capital intensity, little has been done regarding the effect of aging on labor income share.

Alternatively, based on the definition of labor income share, which is constituted by labor income (or labor productivity) and labor supply, the relationship between aging and labor income share is thus related to aging and labor income, as well as labor supply. Firstly, most studies demonstrate that aging will reduce the labor supply. In fact, demographic aging represents a process in which a country progressively contains a larger group of elderly people (Hanoch and Honig 1983; Cheal 2002) and thus directly reduces the labor supply.

Therefore, the relationship between aging and labor income share depends on the effect of aging on labor income (or labor productivity), while previous studies do not come to a conclusion. On the one hand, Bauer (1990) projected that the median ages of labor forces in Japan; Singapore; the Republic of Korea; and Taipei,China would increase rapidly, suggesting a positive impact of aging on labor income. On the other hand, there are studies arguing that population aging erodes labor productivity. Using the US Retirement history survey data of 1969–1975, Hanoch and Honig (1983) show that wages decrease with age. Prskawetz, Fent, and Guest (2008) find that aging lowers labor productivity due to the shrinkage of the labor force. Furthermore, Clark and Spengler (1980) and Feyrer (2007) suggest an inverted-U relation between aging and labor productivity, arguing that labor productivity first increases with age as human capital accumulates, and then declines.

Finally, there are studies exploring the effect of aging on capital. Aging results in more healthcare and elderly care spending and less capital investment (Bloom, Canning and Fink 2010). However, as Mitchell, Piggott, Sherris and Yow (2006) have argued, capital flows are more flexible than labor flows, resulting in a balanced global capital market. Therefore, capital is hardly affected by aging in a globalizing era.

Based on the reviews above, it is also interesting to explore the effect of aging on labor income share in a global context, so that we can give a comprehensive picture of the relationship between aging and inequality. In fact, as suggested by Piketty (2014), the direction of aging towards inequality and labor income share is expected to be the opposite: If aging tends to reduce labor income share, inequality will increase, and vice versa.

# 3. MODEL

Before estimating the impact of population aging on the labor share, we first examine the relationship between aging and income inequality, applying the most updated information for a large set of countries. The estimations are based on the following type of equation following Gustafsson and Johansson (1999):

$$I_{it} = \alpha + \beta' aging_{it} + \delta' Z_{it} + \lambda_t + \mu_i + \varepsilon_{it} \quad (4.1)$$

Here, *I* is the dependent variable income inequality (the Gini coefficient) for country *i* in year *t*. Aging contains two indicators – the share of people aged 65 and over relative to the total population and the dependency ratio. *Z* represents three sets of socioeconomic control variables describing demographic factors, macroeconomic variables, and globalization. As regards demographic factors, the share of the population aged 14 and below is used. Macroeconomic variables include GDP per capita and the share of the manufacturing industry. In terms of globalization, export, import, and outward and inward Foreign Direct Investment (FDI) as shares of GDP are considered.

To account for the fact that the variation in income inequality may be related to unobserved country- and year-specific effects, country (i) and year (t) effects are modeled by μ and λ, respectively. With the inclusion of country-specific effects, the estimator is focused on the variation within countries. ε describes the error term. The study covers 67 developed and developing countries during the period from 1990 to 2010 for which a reasonable number of observations are available.

With regard to the relationship between aging and labor share, we follow the modeling strategy of Decreuse and Maarek (2015), which focuses on the effect of globalization on the labor share. We simply extend their model by adding aging as the key variable:

$$S_{it} = \alpha + \beta' aging_{it} + \theta' X_{it} + \lambda_t + \mu_i + \varepsilon_{it} \quad (4.2)$$

where $S$ denotes the labor share, and $X$ contains labor share-related control variables. Since the labor income is a product of the labor supply and wage, we further estimate the labor supply and average wage functions by examining the following two regressions:

$$L_{it} = \alpha + \beta' aging_{it} + \theta' X_{it} + \lambda_t + \mu_i + u_{it} \quad (4.3)$$

$$W_{it} = \alpha + \beta' aging_{it} + \theta' X_{it} + \lambda_t + \mu_i + u_{it} \quad (4.4)$$

where $L$ and $W$ denote total employment and average wage, respectively. Based on our literature review of the linkage between aging, labor supply, and wage, the relationship between aging and labor quantity is expected to be negative. The relationship between aging and average wage is undetermined, since on the one hand, a declining labor supply increases the average wage, while on the other hand, aging erodes labor productivity and thereby reduces the average wage. If the productivity effect is larger than the supply effect so that aging is negatively associated with the average wage, the effect of aging on the labor share will also be negative, and vice versa.

# 4. DATA

The income inequality data are sourced from World Bank PovcalNet and the World Income Inequality Database (WIID), with the latter being used for robustness checks. Income inequality is measured by the widely used Gini coefficient, ranging from 0 to 1. The factor income share data are collected from the Penn World Table version 8.1 where value added in agriculture is counted as labor compensation while the labor income of the self-employed outside agriculture is counted as capital income (Feenstra, Inklaar and Timmer 2015; Gollin 2002).

Aging will be indicated by the share of the population aged 65 and above. For checking robustness, we use the elderly dependency ratio of the population older than 64 over the working-age population of 15–64 years of age. This ratio can be called "demographic stress" (Goldin 2016), indicating the number of economically inactive elderly people supported by each individual in the economically active group. When this ratio increases, the older individuals may face a lower living standard and fewer economically active individuals to care for them. Both the aging indicators are available from the World Development Indicators (WDI).

## 4.1 Control Variables for the Aging and Inequality Estimation

The aging-inequality model explicitly controls for a number of other determinants of income inequality. First, the composition of the population plays a role in the income (re)distribution (Lam 1997; Gustafsson and Johansson 1999). Since the elderly and young population have limited income from work, the increasing share of these groups may induce higher total income inequality. Therefore, besides our aging indicator, we control for the percentage of the population aged 14 and younger, sourced from the WDI.

Our second set of control variables consists of the logarithm of GDP per capita and the share of secondary industry, sourced from the WDI. The former is included in the model to control for the economic development of a country. In some studies (e.g. Galor and Zeira 1993; Alesina and Rodrik 1994) it has been found that economic growth is related to less inequality. However, in other studies (e.g. Li and Zou 1998; Forbes 2000) a positive relationship between growth and inequality has been found, suggesting that there is a trade-off between growth and inequality. As for the share of secondary industry, this is measured as the ratio of value added from the manufacturing industry to the total GDP.

Furthermore, the study controls for the possible impact of globalization. The linkages between international economic integration and income distributions have been analyzed extensively (Çelik and Basdas 2010; Figini and Görg 2006; Zhou et al. 2011). From the Stolper-Samuelson theorem, we should expect the exposure to international markets to lead to a higher skill demand, which causes higher income inequality. To account for the effect of globalization, two sets of measures are included, namely trade openness and financial openness. The first set of variables are measured as imports and exports as a percentage of GDP. The second set of variables are measured as inward and outward flows of foreign direct investment (FDI) as a percentage of GDP. These globalization indicators are obtained from the Penn World Table version 8.1.

## 4.2 Control Variables for the Aging and Labor Share Estimation

With respect to control variables for the aging-inequality model, the globalization indicators are export (% of GDP), import (% of GDP), and inward and outward FDI stock (% of GDP). FDI may induce a higher labor share via increased competition. It may also help lower the labor share due to an improvement in labor productivity induced by FDI-related technology changes (Decreuse and Maarek 2015). Intuitively, importing labor-intensive goods erodes the labor share while exporting labor-intensive goods can increase it (Jaumotte and Tytell 2007). However, as pointed out by Melitz (2003), exports in general may help improve aggregate productivity by increasing the market share of more productive firms, resulting in a lower labor share.

Other determinants of the labor share include economic growth, which raises the demand for labor but also increases labor cost and profits (Raffalovich et al. 1992). To capture the effect of structural transformation on the labor share, the manufacturing share in GDP is included. Since capital intensity captures the extent of factor endowment, defined as real capital stock per laborer, it is also controlled in our model. Finally, biased technological changes naturally affect the labor share. Therefore, TFP is included, which is available from the Penn World Table version 8.1, based on 2005 prices.

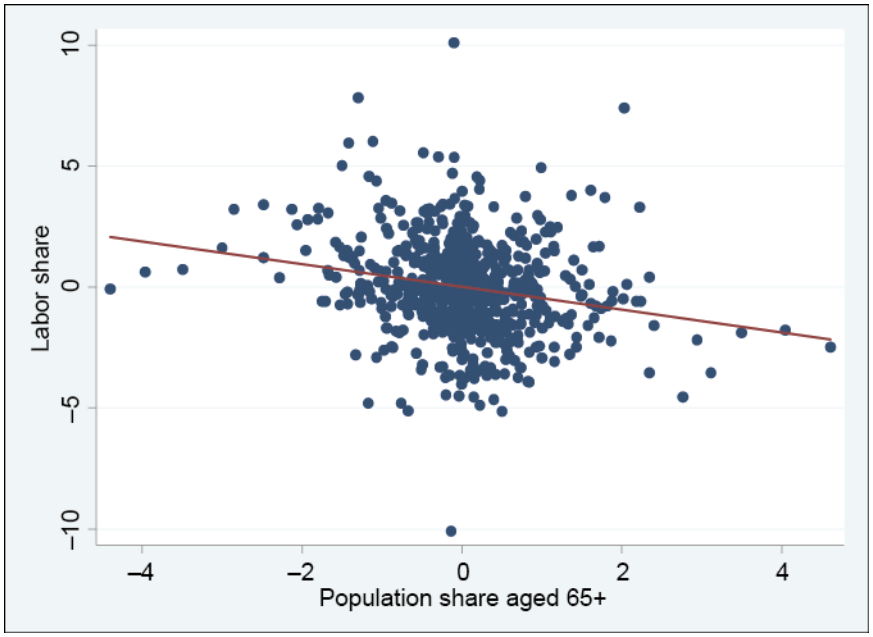
Our data cover 67 countries for the period 1990–2000. Table 1 presents the summary statistics. Figure 1 plots the correlation between population aging and labor share, with the country mean of both variables subtracted. It can be seen that, in line with earlier discussions, aging appears to be negatively correlated with the labor share.

**Table 1: Summary Statistics**

| Variable | Observations | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| Gini_POVCAL | 232 | 42.88 | 10.50 | 24.93 | 70.81 |
| Gini_WIID | 561 | 36.99 | 8.85 | 21.60 | 60.70 |
| Labor share | 748 | 42.35 | 10.48 | 14.00 | 62.30 |
| Ln(average wage) | 739 | 8.96 | 1.55 | 3.92 | 10.98 |
| Ln(total employment) | 958 | 1.69 | 1.79 | –2.01 | 6.66 |
| Share of population (65+) | 958 | 9.58 | 5.10 | 2.47 | 20.96 |
| Old dependency ratio | 958 | 14.63 | 7.28 | 4.52 | 32.01 |
| Share of population (0–14) | 958 | 26.55 | 9.75 | 13.58 | 49.96 |
| Ln(GDP per capita) | 944 | 8.69 | 1.52 | 4.95 | 11.36 |
| TFP | 958 | 0.97 | 0.12 | 0.32 | 1.90 |
| Manufacturing, value-added (% GDP) | 958 | 17.72 | 5.79 | 2.41 | 33.33 |
| Export (% GDP) | 958 | 40.36 | 31.65 | 4.69 | 230.27 |
| Import (% GDP) | 958 | 42.64 | 29.96 | 6.87 | 209.39 |
| Inward FDI stock (% GDP) | 958 | 1.96 | 16.37 | 0.00 | 412.58 |
| Outward FDI stock (% GDP) | 958 | 3.79 | 5.05 | 0.00 | 64.45 |
| Capital intensity | 958 | 103,580.70 | 82,122.25 | 1,732.44 | 320,911.80 |

Source: the Penn World Table version 8.1, POVCAL, WDI, and WIID.

**Figure 1: Correlation between Labor Share and Aging**




Source: the Penn World Table version 8.1 and WDI; own calculation.

# 5. ESTIMATION RESULTS

## 5.1 Aging and Inequality

Table 2 presents the relationship between aging and income inequality based on equation (4.1). The population aged 65 and above as a percentage of the total population is positively and significantly related to income inequality. This result is robust when we add different sets of control variables. More specifically, a 1% increase in the elderly population share leads to a 2.343% increase in the Gini coefficient. Moreover, FDI inward is found to be significantly and negatively related to income inequality, which is attributable to the increased employment brought by FDI inward.

We then perform robustness checks on our findings by using another aging indicator, the dependency ratio, and another source of the Gini coefficient, WIID, as presented in Tables 3 and 4, respectively. It could be argued that the elderly dependency ratio directly describes the demographic stress on society (Goldin 2016). The analyses show that the results for the effect of aging on income inequality are unchanged. Furthermore, a 1% increase in the elderly dependency ratio leads to a 1.385% increase in the Gini coefficient. Moreover, the results do not alter using the Gini coefficient from WIID.

To reduce the reverse causality, we use the lagged independent variables for our aging-inequality baseline model (4.1) to test robustness. One may argue that the relative wages of women and men may affect the fertility rate, since increasing women's wages reduces fertility by raising the cost of children relatively more than household income (Galor and Weil 1993; Polachek and Xiang 2015). The results in Table 5 show that the positive and significant linkage between aging and income inequality does not alter.

**Table 2: Relationship between Aging and Income Inequality**

| | M 2.1 | M 2.2 | M 2.3 | M 2.4 |
|---|---|---|---|---|
| | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL |
| Share of population aged 65 and above | 2.412*** | 2.847*** | 2.745*** | 2.343*** |
| | [2.90] | [3.46] | [3.15] | [3.99] |
| Share of population aged 14 and below | 0.153 | 0.260 | 0.303 | 0.188 |
| | [0.50] | [0.91] | [1.00] | [0.41] |
| GDP per capita | –6.995** | –5.642* | –5.674* | 0.605 |
| | [–2.33] | [–1.92] | [–1.91] | [0.19] |
| Share of manufacturing industry | | 0.252* | 0.205 | 0.231 |
| | | [1.82] | [1.14] | [1.33] |
| Export | | | 0.031 | 0.036 |
| | | | [0.53] | [0.58] |
| Import | | | 0.017 | 0.036 |
| | | | [0.26] | [0.77] |
| FDI outward | | | | 0.006 |
| | | | | [1.67] |
| FDI inward | | | | –0.050*** |
| | | | | [–2.80] |
| Constant | 74.826** | 52.600* | 51.770* | 6.193 |
| | [2.63] | [1.88] | [1.80] | [0.19] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 227 | 227 | 227 | 227 |
| r2_w | 0.109 | 0.139 | 0.143 | 0.390 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

**Table 3: Relationship between Aging and Income Inequality, Old Dependency Ratio**

| | M 3.1 | M 3.2 | M 3.3 | M 3.4 |
|---|---|---|---|---|
| | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL |
| Share of population aged 65 and above | 1.531** | 1.682** | 1.578** | 1.385*** |
| | [2.58] | [2.71] | [2.37] | [3.59] |
| GDP per capita | –6.379*** | –5.437** | –5.817** | 1.097 |
| | [–3.04] | [–2.52] | [–2.59] | [0.39] |
| Share of manufacturing industry | | 0.225 | 0.178 | 0.205 |
| | | [1.59] | [1.01] | [1.18] |
| Export | | | 0.026 | 0.038 |
| | | | [0.46] | [0.61] |
| Import | | | 0.020 | 0.042 |
| | | | [0.28] | [0.88] |
| FDI outward | | | | 0.005** |
| | | | | [2.29] |
| FDI inward | | | | –0.048*** |
| | | | | [–3.13] |
| Constant | 74.566*** | 60.839*** | 64.577*** | 9.690 |
| | [5.69] | [3.73] | [3.53] | [0.47] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 227 | 227 | 227 | 227 |
| r2_w | 0.107 | 0.132 | 0.136 | 0.383 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

**Table 4: Relationship between Aging and Income Inequality, Gini from WIID**

| | M 4.1 | M 4.2 | M 4.3 | M 4.4 |
|---|---|---|---|---|
| | Gini_WIID | Gini_WIID | Gini_WIID | Gini_WIID |
| Share of population aged 65 and above | 1.179*** | 1.133*** | 0.957** | 1.063*** |
| | [2.94] | [2.97] | [2.62] | [2.75] |
| Share of population aged 14 and below | 0.139 | 0.142 | 0.104 | 0.020 |
| | [0.62] | [0.63] | [0.48] | [0.09] |
| GDP per capita | –1.861 | –2.045 | –3.896 | –3.001 |
| | [–0.63] | [–0.67] | [–1.46] | [–1.08] |
| Share of manufacturing industry | | –0.051 | –0.123 | –0.149* |
| | | [–0.64] | [–1.60] | [–1.91] |
| Export | | | 0.011 | 0.015 |
| | | | [0.18] | [0.24] |
| Import | | | 0.093 | 0.098 |
| | | | [1.50] | [1.29] |
| FDI outward | | | | 0.004 |
| | | | | [0.68] |
| FDI inward | | | | –0.016 |
| | | | | [–0.48] |
| Constant | 37.039 | 40.150 | 56.937** | 50.345* |
| | [1.32] | [1.40] | [2.18] | [1.85] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 554 | 554 | 554 | 554 |
| r2_a | 0.062 | 0.062 | 0.099 | 0.153 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

**Table 5: Relationship between Aging and Income Inequality, Lagged Independent Variables**

| | M 5.1 | M 5.2 | M 5.3 | M 5.4 |
|---|---|---|---|---|
| | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL | Gini_POVCAL |
| Share of population aged 65 and above | 2.328*** | 2.448*** | 2.262** | 2.236*** |
| | [2.79] | [2.92] | [2.62] | [3.39] |
| Share of population aged 14 and below | 0.175 | 0.205 | 0.266 | 0.350 |
| | [0.59] | [0.73] | [0.94] | [0.75] |
| GDP per capita | –6.948** | –6.602** | –6.489** | –0.725 |
| | [–2.36] | [–2.33] | [–2.31] | [–0.21] |
| Share of manufacturing industry | | 0.081 | 0.038 | 0.051 |
| | | [0.71] | [0.31] | [0.46] |
| Export | | | 0.042 | 0.049 |
| | | | [0.94] | [1.07] |
| Import | | | 0.030 | 0.016 |
| | | | [0.48] | [0.33] |
| FDI outward | | | | 0.014*** |
| | | | | [3.81] |
| FDI inward | | | | –0.004 |
| | | | | [–0.17] |
| Constant | 74.791*** | 68.692*** | 65.929** | 15.006 |
| | [2.80] | [2.74] | [2.63] | [0.42] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 213 | 213 | 213 | 213 |
| r2_a | 0.094 | 0.097 | 0.109 | 0.406 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

## 5.2 Aging and Labor Share

Table 6 presents our results for the baseline model (4.2). Three features are worth noting. First, population aging has a negative and significant impact on the labor share. A one percentage point increase in the share of the population aged 65 and above leads to an approximately 0.532 percentage point decrease in the labor share. This impact could be attributable either to the shrinking labor supply or decreasing average wage or both and will be further explored in the following subsection. The parameter estimates are quite stable when including different sets of control variables and country and year fixed effects. Second, export significantly depresses the labor share while import significantly increases the labor share, which is in line with Melitz (2003). This effect could be caused by the improvement in productivity from export or exporting productions becoming more capital-intensive. Third, FDI outflow has a positive effect on the labor share, as shown in Model 6.3 and Model 6.4. Fourth, the impacts of other control variables are insignificant, including GDP per capita, TFP, share of manufacturing industry, FDI inward, and capital intensity.

**Table 6: Relationship between Aging and Labor Share**

| | M 6.1 | M 6.2 | M6.3 | M 6.4 |
|---|---|---|---|---|
| | Labor Share | Labor Share | Labor Share | Labor Share |
| Share of population aged 65 and above | –0.448** | –0.634*** | –0.503** | –0.532** |
| | [–2.03] | [–2.92] | [–2.41] | [–2.29] |
| GDP per capita | 0.176 | –0.537 | 1.965 | 1.576 |
| | [0.06] | [–0.19] | [0.60] | [0.35] |
| TFP | –2.197 | –3.077 | –4.908 | –3.640 |
| | [–0.44] | [–0.64] | [–1.04] | [–0.63] |
| Share of manufacturing industry | | –0.281*** | –0.173* | –0.134 |
| | | [–2.70] | [–1.71] | [–1.31] |
| Export | | | –0.123*** | –0.133*** |
| | | | [–3.47] | [–4.04] |
| Import | | | 0.063** | 0.063** |
| | | | [2.16] | [2.11] |
| FDI outward | | | 0.007*** | 0.008*** |
| | | | [3.21] | [2.91] |
| FDI inward | | | –0.012 | –0.006 |
| | | | [–0.74] | [–0.35] |
| Capital intensity | | | | 0.000 |
| | | | | [1.41] |
| Constant | 47.696** | 62.062*** | 40.355 | 40.969 |
| | [2.16] | [3.00] | [1.61] | [1.19] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 739 | 739 | 739 | 739 |
| r2_w | 0.051 | 0.102 | 0.174 | 0.204 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

The labor share may reversely affect other socioeconomic variables. To alleviate possible endogeneity, we lag all independent variables by one year and the results are tabulated in Table 7. The results are largely consistent with those in Table 6 except for Model 7.4, which is also broadly significant (t=1.48). As regards export and outflow FDI, they also exert negative and significant effects on the labor share.

**Table 7: Relationship between Aging and Labor Share, Lagged Independent Variables**

| | M 7.1 | M 7.2 | M 7.3 | M 7.4 |
|---|---|---|---|---|
| | **Labor Share** | **Labor Share** | **Labor Share** | **Labor Share** |
| Lagged share of population aged 65 and above | –0.511** | –0.580** | –0.474** | –0.348 |
| | [–2.08] | [–2.33] | [–2.08] | [–1.42] |
| Lagged GDP per capita | –0.027 | –0.201 | 2.525 | 3.192 |
| | [–0.01] | [–0.06] | [0.66] | [0.59] |
| Lagged TFP | 1.513 | 1.125 | –0.923 | –1.335 |
| | [0.27] | [0.20] | [–0.17] | [–0.20] |
| Lagged share of manufacturing industry | | –0.098 | 0.026 | 0.037 |
| | | [–0.99] | [0.27] | [0.38] |
| Lagged export | | | –0.174*** | –0.170*** |
| | | | [–5.14] | [–5.11] |
| Lagged import | | | 0.126*** | 0.116*** |
| | | | [3.61] | [3.25] |
| Lagged FDI outward | | | 0.008*** | 0.007*** |
| | | | [3.94] | [2.83] |
| Lagged FDI inward | | | 0.010 | 0.007 |
| | | | [0.54] | [0.35] |
| Lagged capital intensity | | | | 0.000 |
| | | | | [0.52] |
| Constant | 46.507* | 50.973* | 26.816 | 18.790 |
| | [1.84] | [1.99] | [0.93] | [0.43] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 693 | 693 | 693 | 693 |
| r2_a | 0.039 | 0.045 | 0.153 | 0.187 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

Now, we consider another indicator of aging, the elderly dependency ratio. The results reported in Table 8 are in line with our baseline results. That is, aging has a negative and significant effect on the labor share, with the magnitude of the coefficient slightly lower than that in the baseline model.

**Table 8: Relationship between Aging and Labor Share, Old Dependency Ratio**

| | M 8.1 | M 8.2 | M 8.3 | M 8.4 |
|---|---|---|---|---|
| | Labor share | Labor share | Labor share | Labor share |
| Old dependency ratio | –0.248* | –0.352*** | –0.279** | –0.288** |
| | [–1.88] | [–2.72] | [–2.22] | [–2.06] |
| GDP per capita | –0.504 | –1.452 | 1.285 | 0.987 |
| | [–0.17] | [–0.55] | [0.41] | [0.22] |
| TFP | –1.776 | –2.497 | –4.495 | –3.324 |
| | [–0.36] | [–0.52] | [–0.97] | [–0.58] |
| Share of manufacturing industry | | –0.275** | –0.167 | –0.129 |
| | | [–2.62] | [–1.65] | [–1.26] |
| Export | | | –0.125*** | –0.134*** |
| | | | [–3.52] | [–4.04] |
| Import | | | 0.064** | 0.065** |
| | | | [2.21] | [2.17] |
| FDI outward | | | 0.006*** | 0.007*** |
| | | | [3.02] | [2.80] |
| FDI inward | | | –0.011 | –0.005 |
| | | | [–0.72] | [–0.32] |
| Capital intensity | | | | 0.000 |
| | | | | [1.38] |
| Constant | 52.616** | 68.514*** | 45.099* | 43.528 |
| | [2.53] | [3.48] | [1.85] | [1.23] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 739 | 739 | 739 | 739 |
| r2_a | 0.048 | 0.097 | 0.171 | 0.201 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

## 5.3 Further Discussions

By definition, labor income is the product of total employment and average wage. It is thus useful to explore the correlation of aging with total employment and average wage, respectively.

Table 9 shows that aging has a negative and significant effect on total employment, which is in line with Hanoch and Honig (1983), who concluded that aging directly erodes labor force participation. The finding is also consistent with our illustrating model. Also, GDP per capita and FDI outward are found to be positively correlated with total employment while TFP has an employment-reducing effect.

**Table 9: Relationship between Aging and Total Employment**

| | M 9.1 | M 9.2 | M 9.3 | M 9.4 |
|---|---|---|---|---|
| | Ln(Total Employment) | Ln(Total Employment) | Ln(Total Employment) | Ln(Total Employment) |
| Share of population aged 65 and above | –0.033*** | –0.027*** | –0.029*** | –0.032*** |
| | [–3.79] | [–4.25] | [–4.22] | [–2.94] |
| GDP per capita | 0.981*** | 0.982*** | 0.939*** | 0.441*** |
| | [8.11] | [8.09] | [7.38] | [2.85] |
| TFP | –1.215*** | –1.194*** | –1.153*** | –0.691*** |
| | [–6.19] | [–6.63] | [–6.55] | [–3.24] |
| Share of manufacturing industry | | 0.005 | 0.005 | 0.007** |
| | | [1.51] | [1.21] | [2.33] |
| Export | | | 0.000 | 0.001 |
| | | | [0.22] | [0.62] |
| Import | | | 0.001 | 0.001 |
| | | | [0.51] | [0.62] |
| FDI outward | | | 0.000*** | 0.000*** |
| | | | [3.45] | [4.33] |
| FDI inward | | | 0.001 | –0.000 |
| | | | [1.32] | [–0.56] |
| Capital intensity | | | | –0.000** |
| | | | | [–2.01] |
| Constant | –5.309*** | –5.495*** | –5.180*** | –0.910 |
| | [–6.30] | [–6.07] | [–5.42] | [–0.76] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 944 | 944 | 944 | 944 |
| r2_a | 0.559 | 0.568 | 0.578 | 0.738 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

With regard to the impact of aging on the average wage, there is not a consistent significant relationship, as shown in Table 10. According to our illustrating model, the result indicates that the human capital effect and the supply effect may offset each other, leading to an insignificant relationship. This finding suggests that the negative effect of aging on the labor share does not come from the lowering of the average wage. Rather, it comes from the reduction of total employment. Table 10 also shows that GDP per capita, TFP, and capital intensity have positive effects on the average wage.

**Table 10: Relationship between Aging and Average Wage**

| | M 10.1 | M 10.2 | M 10.3 | M 10.4 |
|---|---|---|---|---|
| | Ln(Wage) | Ln(Wage) | Ln(Wage) | Ln(Wage) |
| Share of population aged 65 and above | 0.009 | 0.004 | 0.006 | –0.005 |
| | [1.49] | [0.65] | [1.13] | [–0.72] |
| GDP per capita | 0.547*** | 0.529*** | 0.584*** | 0.596*** |
| | [6.56] | [5.80] | [6.18] | [5.95] |
| TFP | 0.522*** | 0.500*** | 0.454*** | 0.532*** |
| | [3.65] | [3.59] | [3.20] | [3.57] |
| Share of manufacturing industry | | –0.007** | –0.005* | –0.003 |
| | | [–2.46] | [–1.89] | [–1.38] |
| Export | | | –0.002 | –0.003*** |
| | | | [–1.13] | [–2.67] |
| Import | | | 0.000 | 0.001 |
| | | | [0.20] | [0.44] |
| FDI outward | | | –0.000 | 0.000 |
| | | | [–0.93] | [1.50] |
| FDI inward | | | –0.001 | –0.000 |
| | | | [–1.50] | [–0.59] |
| Capital intensity | | | | 0.000*** |
| | | | | [6.36] |
| Constant | 3.446*** | 3.809*** | 3.354*** | 2.975*** |
| | [5.68] | [5.45] | [4.65] | [3.82] |
| Country dummy | Y | Y | Y | Y |
| Year dummy | N | N | N | Y |
| N | 739 | 739 | 739 | 739 |
| r2_a | 0.802 | 0.809 | 0.813 | 0.836 |

Note: *t* values in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01.

# 6. CONCLUDING REMARKS

This paper aims to investigate the relationship between population aging and income inequality through the perspective of the labor share of income, based on data covering 67 countries over the period from 1990 to 2010. Our main findings firstly confirm the positive relationship between aging and income inequality. Secondly, they show that population aging is negatively and significantly associated with labor share. This finding remains valid under different model specifications (and using lagged independent variables) and when different sources of inequality (sourced from WIID) and different measures of aging (the elderly dependency ratio) are used. With respect to the two possible mechanisms from aging to labor share, our findings show that the negative effect comes from the shrinking labor force due to aging rather than the lowering of the average wage.

Based on our findings, we suggest two policy implications. Firstly, the provision of sufficient child care programs and family benefit. Such social programs may help to increase both the probability of working and the fertility rate, and thereby induce more labor force participation in both the short and long run (Del Boca 2002). Secondly, ensuring that older workers have sufficient access to further education and training. Such opportunities create incentives for older workers to improve their skills and remain active in the labor market.

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