The Effect of Demographic Transition on Savings, Investment, and Capital Flows

Misnilawaty Sidabutar a

a Universitas Indonesia, Depok, West Java, Indonesia

INFORMASI ARTIKEL

Article history:
Date Submission: 15 September 2020
First revision: 26 November 2020
Accepted: 30 November 2020
Available online: 14 December 2020

Keywords: demographic transition, savings, investment, current account balance

ABSTRACT

The world population, as well as Indonesia, is aging and this demographic transition influences saving, investment, and capital flows. By looking at data from 1973 to 2017, this paper finds two things. First, the relationship between age groups and saving exhibits the inverted U-shape, but only old dependency impact negatively on investment based on 104 countries’ data. The capital flows represented by current account is deficit in the young dependency, but surplus in the old dependency. Second, demographic transition in Indonesia induced an increase in savings by a higher rate than investment and caused current account surplus in this period.

INTISARI

Dunia dan juga Indonesia menghadapi aging population dan perubahan demografis ini mempengaruhi tabungan, investasi, dan aliran modal. Berdasarkan data dari 1973 hingga 2017, tesis ini menemukan dua hal, Pertama, hubungan antara kelompok usia dan tabungan memperlihatkan bentuk punuk, tetapi hanya kelompok usia tua yang berpengaruh negatif terhadap investasi berdasarkan data 104 negara. Aliran modal yang direpresentasikan oleh neraca transaksi berjalan mengalami defisit pada kelompok usia muda tetapi surplus pada kelompok usia tua. Kedua, Perubahan demografis di Indonesia menyebabkan kenaikan pada tabungan dengan lebih tinggi daripada kenaikan pada investasi dan juga menyebabkan surplus pada neraca transaksi berjalan selama periode ini.

1. Introduction

The world’s population structure is changing due to increasing life expectancy and decreasing fertility rate. The lower fertility rate causes a decrease of young population proportion, while the higher life expectancy induces an increase of the share of old population. All countries face this aging population but in different staging, where high-income countries face it first, followed by middle and low-income countries.

The change in population structure is driving the changes in national income levels and the allocation of money through savings, investment, and the gap between them, known as the current account. Most literature discussing demographic transition focus on savings rather than on investment or the current account. The direction of the relationship between demographic transition and savings is still in dispute. However, most studies find that a high dependency ratio, both youth and old, lowers the savings rate such as argued by (Higgins, 1998); (Bosworth & Keys, 2004); (Guest & McDonald, 2004); (Curtis et al., 2015); (Curtis et al., 2017). In contrast, (Doker et al., 2016) argue that only the old-dependency ratio has a negative relationship with savings, while young-dependency ratio has a positive
relationship with savings. (Cavallo et al., 2018) find that low young dependency rate and high old dependency rate that caused by more prolonged longevity increase the savings rate, but this is only robust in Asia countries, not Latin America countries.

The different findings on savings are possibly caused by the difference in demographic variables used in the model. Doker et al. (2016) and Cavallo et al., (2018) only use the dependency ratio, without adding the working-age ratio, in their model. Other studies by Higgins (1998), Bosworth and Keys (2004) include all age groups in their models. For studying the holistic impact of demographic transition, the model must take account of all population groups because the change in savings rate is determined not only by the change of dependency ratio but also working-age ratio.

As well as on savings, the demographic transition also impacts on investment and current account balance. The effect of demographic transition in investment is negative in the case of a high-dependency ratio that leads to capital account deficits (Higgins, 1998). The result aligns with the finding of Bosworth and Keys (2004) that the increasing dependency rate lowers investment and causes current account deficits.

The purpose of this paper is to examine the relationship between age distribution and savings, investment, and capital flows by using 104 countries’ data from 1973 to 2017. Moreover, this paper investigates the demographic transition’s effect on all dependent variables in Indonesia across 1973-2017 and estimates the effect in the future.

This paper takes Indonesia as a focus of studying the demographic effect because Indonesia is a country that faces the sign of an aging population. Furthermore, Indonesia is a developing country which needs both saving and investment to maintain capital accumulation and to boost economic growth. A change in demographic structure would impact on capital accumulation and output through saving and investment rates. However, there is lack of research that analyses the relationship between demographic transition and savings, investment, and current account in Indonesia. Higgins (1998) calculates the demographic effect on savings, investment, and capital flows in some countries, including Indonesia but he does not examine Indonesia’s case in detail.

This paper finds that the relationship between age distribution and saving exhibits the inverted U-shape that means both young and old dependency group influence savings negatively. Meanwhile, only the old dependency population have negative demand for investment. As a result, the age distribution shows deficit current account balance in the young age population and a surplus balance in the old dependency. Subsequently, this paper investigates the effect of demographic transition in Indonesia in the period from 1973 to 2017 and in the future. Along 1973 to 2017, this paper finds that the demographic transition caused an increase in savings and investment in which the change in savings is bigger than the change in investment. However, until 2050, the demographic transition will lower the savings and investment in which the change in savings is much smaller than the change in investment.

The result about the effect of demographic transition in Indonesia is important for policy in Indonesia, especially related to pension plan and the investment level. Indonesia must consider a policy that support the longer retirement period. Moreover, Indonesia enjoy the demographic bonus nowadays, so this is the perfect time to boost investment level.

This paper comprises seven sections start with the introduction. The second part describes the theoretical framework and literature review. Explanation about the data, model and methodology takes the third, fourth and fifth section. The last section of paper analyses empirical result, and then the paper is closed with a conclusion.

2. Theory

2.1 Demographic Transition and Savings

The discussion about the relationship between demographic structure and savings, investment, and current account balance can be found in some theories and prior works. This section explains the theory and literature that talk about the relationship between demographic and savings, investment, and current account balance. Theory about saving is related to the utility maximization theory because people choose the best consumption pattern and saving to get the optimum utility (Romer, 2012). People prefer smooth consumption rather than a fluctuated one. They use savings to help establish the preferred consumption pattern, as argued by the permanent-income hypothesis (Romer, 2012). When income is higher than the average income, the saving rate will increase. Savings are essential to help pay for consumption when income is lower than average, hence smoothing out consumption. The Solow growth model defines the golden rule savings rate as the level of savings that maximizes consumption level. When labor growth decreases, the level of savings also decreases (Romer, 2012).

According to the life-cycle theory, the proportion of savings varies with age follows the cycle of life, such as work and retirement. When people work, they save some money for future consumption (Modigliani, 1986). Therefore, the relationship between saving and age exhibits an inverted-U shape in which people start dissaving in the early of life, then people have the maximum saving when working, and they dissaving again while getting older.
Households’ savings behaviour forms the picture of savings at the national level. When the population structure of a country changes, it can change the aggregate consumption and the savings pattern. Given the decrease in fertility rates and the increase in life expectancy and, most countries face a shrinking population in the youth age group from zero years old to 15 years old and a rising in the old age group from 65 years old and older. This condition, especially a high old age group population, depends on the support from the working group population and impact the national savings rate.

Some literature also explains the inverted-U shape of savings-age share relationship as being the lower dependency ratio boosting the savings rate. Higgins (1998) finds that high youth and old-dependency ratio suppress the saving rate. This result aligns with the study by Bosworth and Keys (2004) in which the increasing dependency rate lowers the saving rate. Bosworth and Keys (2004) refers to Higgins’ model and produces relatively similar results. However, Curtis et al. (2015; 2017) find that a shrinking in population, which leads to lower young dependency ratio, increases the saving rate, while a rising of the elderly population causes negative savings.

Guest and McDonald (2004) also study the relationship of dependency population and savings by examining the future saving based on future demography in Philippines, Malaysia, Singapore, and Hong Kong. The authors find that the dependency ratio will decrease in the Philippines and Malaysia so both countries anticipate it by lowering savings rate until reach the minimum peak and rising the savings when the dependency population will increase again, so the savings-age group has a trough shape. While, when the dependency ratio will increase in Hong Kong and Singapore, then the savings-age shares relationship has a hump shape because both countries will rise the savings to cope with the increase of dependency until reach the maximum point, then they will reduce the savings to anticipate the decrease of dependency.

As well as age distribution, savings is also determined by labour productivity as argued by the variable rate-of-growth effect model (Higgins, 1998). The rise of labour productivity allows the younger generation to earn a higher income and then higher consumption than the older one. As a result, the demographic structure and labour productivity impact the savings rate negatively. The variable rate-of-growth effect model assumes that the relationship between dependency ratio and savings is steady state (Higgins, 1998).

2.2 Demographic Transition and Investment

Different from the savings, the relationship between demography and investment is understandable through the neo-classical model of economic growth. The growth of output depends on the growth of capital, labour, and technological progress. The reduction in labour growth affects the negative growth of output that leads to lower investment rate (Romer, 2012). By combining to lifecycle theory, the shifting of population from or to working-age causes the changing in the output and investment rate.

The previous literature that examines the investment relationship between demographic transition and investment mostly discuss physical investment. The high young population has a favourable demand for investment, while the old population has negative demand for investment (Higgins, 1998; Bosworth & Keys, 2004). Higgins (1998) argues that each age group have a different type of demand for investment, and when the demography changed, then the investment also changes. Moreover, Lee and Mason (2010) find that the demand for investment is rising because the demographic transition encourages wealth accumulation which is important to support the retirement age. However, they find that public transfer through the social welfare system and private transfer through bequest reduce the demand for investment.

The investment demand depends on not only the demographic transition but also the relative price of investment. This correlation works as the standard theory of Marshallian supply and demand law (Nicholson, 2008). When the price is low, the investment demand is high, vice versa. The price of investment alters the decision about money allocation for investment.

2.3 Demographic Transition and Capital Flows

Since the demographic transition impacts the savings and investment, it also impacts the current account balance. The current account is the sum of the trade balance, net income, and net transfers. This measurement is important to see the country’s position, whether as net lender or borrower. There are three implications of current account balance, such as the net international investment position, trade balance, and the gap between savings and investment (Schmit-Grohé & Uribe, 2011). When saving is higher than investment, the economy faces the current account surplus, or the country lends to the rest of the world, vice versa. In the case of a closed economy, the level of savings is equal with investment because the country does not interact with another country (Mankiw, 2009), or the current account is zero. In the closed economy, there is no impact of demography transition on the current account balance. While in the open economy, a country can lend or borrow to any other countries with a given interest rate that impact on current account balance (Mankiw, 2009). On the other word, the demographic transition will impact
the current account balance through savings and investment.

Some research that studied the relationship between demographic transition and current account balance through savings and investment is Higgins (1998) and Bosworth and Keys (2004). Both find that the early ages have negative current account balance while the older phase of life has the current account surplus.

3. Research Method

This paper studies the impact of the demographic transition on savings, investment, and capital flows and uses the model specification as follow:

\[ S_{it} = \beta_0i + \beta_1D_{it} + \beta_2GROWTH_{it} + \beta_3D_{it}GROWTH_{it} + \beta_4RPI_{it} + \mu_{it} \]

\[ I_{it} = Y_{it} + Y_{1D_{it}} + Y_{2GROWTH_{it}} + Y_{3D_{it}GROWTH_{it}} + Y_{4RPI_{it}} + \nu_{it} \]

\[ CAB_{it} = \lambda_0i + \lambda_1D_{it} + \lambda_2GROWTH_{it} + \lambda_3D_{it}GROWTH_{it} + \lambda_4RPI_{it} + \alpha_{it} \]

where \( i \) indicates the country, \( t \) indicates year, while \( \mu_{it}, \nu_{it}, \alpha_{it} \) indicates error term including individual effect, time effect and random effect.

The current account balance equation is redundant equation since current account balance is the gap between savings and investment. This paper still analyses the current account balance through savings and investment. This paper follows the model developed by Higgins (1998).

The sample for this research includes a mix of 104 developed and developing countries. The data are taken from three resources, as shown in Table 1, and then the author compiles and processes the data to be ready for the estimation stage. These countries include 37 high-income countries, 49 lower-middle and upper-middle, and 18 low-income countries following the World Bank’s income categorization. The selection of the sample is based on the best available data for all variables. The data ranges between the period from 1973 to 2017. Dividing into nine groups of five-years, then the total number of observations is 936.

There are three dependent variables in this research, namely, savings, investment, and current account balance as a proxy of capital flows. Besides, this model uses three independent variables, namely demographic variable, productivity growth, and the relative price of the investment, the detail of all variables shown in Table 1 below.

Table 1 The Variables Description and Data Source

| Variable Name | Description | Data Source |
|---------------|-------------|-------------|
| \( S_{it} \) | The savings variable is the percentage of gross domestic savings to GDP, in which the gross domestic saving is calculated as the gap between GDP and final consumption expenditure (total consumption). | World Bank |
| \( I_{it} \) | The investment variable is the proportion of gross fixed capital formation or investment to GDP. The fixed capital includes residential and non-residential structures, computers, communication equipment, other machinery, transport equipment, software, other intellectual property products and cultivated assets. | Penn World Table (PWT) version 9.1 |
| \( CAB_{it} \) | The ratio of the current account balance to GDP, in which the current account balance is the sum of trade balance and net factor income. | World Bank |

Independent Variables:

| Variable Name | Description | Data Source |
|---------------|-------------|-------------|
| \( D_{it} \) | The geometric average of the 15 age-group that calculated by using degree three-polynomial specification. The mechanism to calculate this variable is explained more detailed below this table. The 15 age groups can be divided into three groups which is young group population from 0-15 years old, working-age group population from 16 to 64 years old, and the old group population from 65 years old and older. | United Nations (for the share of each age group) |
| \( GROWTH_{it} \) | The growth of GDP per worker, in which the GDP per worker is the real GDP (output) per the number of workers. | PWT version 9.1 |
| \( RPI_{it} \) | The relative price level of capital formation or investment relative to price level of GDP (output) (Taylor 1995). | PWT version 9.1 |

Sumber: analytical resulted, 2020

\[ \alpha_j = \gamma_0 + j\gamma_1 + j^2\gamma_2 + j^3\gamma_3 \quad (j = 1, 2, \ldots, 15) \]  

The second assumption is that the total coefficient of all age group is zero. This restriction infers that because the total age shares are one, there is colinearity with the intercept, so if no effect of age distribution on the
dependent variables, then the intercept unchanged (Higgins, 1998).
\[ a_1 + a_2 + a_3 + \cdots + a_{15} = 0 \] (5)

By substituting the first to the second assumption, this paper has
\[ 0 = \gamma_0 j + \gamma_1 \sum_{j=1}^{j} j + \gamma_2 \sum_{j=1}^{j} j^2 + \gamma_3 \sum_{j=1}^{j} j^3 \]
\[ -\gamma_0 j = \gamma_1 \sum_{j=1}^{j} j + \gamma_2 \sum_{j=1}^{j} j^2 + \gamma_3 \sum_{j=1}^{j} j^3 \]
\[ \gamma_0 = -\left( \frac{\gamma_1}{j} \right) \sum_{j=1}^{j} j - \left( \frac{\gamma_2}{j} \right) \sum_{j=1}^{j} j^2 - \left( \frac{\gamma_3}{j} \right) \sum_{j=1}^{j} j^3 \] (6)

where \( X' \) is a vector of others explanatory variable.

Then, the savings equation can re-write as
\[ S_t = \delta + \beta X' t + \gamma_1 \sum_{j=1}^{j} p_j + \gamma_2 \sum_{j=1}^{j} j p_j + \gamma_2 \sum_{j=1}^{j} j^2 p_j + \gamma_2 \sum_{j=1}^{j} j^3 p_j + \mu_t \]

where \( X' \) is a vector of others explanatory variable.

\[ S_t = \delta + \beta X' t + \gamma_1 \left( \frac{1}{j} \sum_{j=1}^{j} j - \left( \frac{1}{j} \right) \sum_{j=1}^{j} j \right) \]
\[ + \gamma_2 \left( \frac{1}{j} \sum_{j=1}^{j} j^2 p_j - \left( \frac{1}{j} \right) \sum_{j=1}^{j} j^2 \right) \]
\[ + \gamma_3 \left( \frac{1}{j} \sum_{j=1}^{j} j^3 p_j - \left( \frac{1}{j} \right) \sum_{j=1}^{j} j^3 \right) + \mu_t \] (7)

The three calculations inside the bracket in the equation (7) are the demographic variables, called D1, D2, and, D3, which represents the geometric average of the fifteen age groups.

\[ S_t = \delta + \beta X' t + \gamma_1 D1 + \gamma_2 D2 + \gamma_3 D3 + \mu_t \] (8)

These variables do not have direct interpretation but show the implicit coefficient of age distribution validates the coefficients of 15 groups of age distribution. Based on estimated coefficients \( y_1, y_2, y_3 \), the coefficient \( y_0 \) can be counted by using equation (6) above to get the implicit coefficient \( y_j \) by using equation (4) above.

The model uses the interaction between demographic variable and growth as variable-rate-of-growth effect model (Higgins, 1998). Since labour productivity is rising, the younger cohorts earn more income and save more than the previous generation. It implies that the savings rate is determined by demographic variable and labour productivity.

The variables of savings, investment, and current account have a possibility of the existence of serial correlation, and then the test uses five-years-average for all variables (Higgins, 1998). The range of data, that consists of 45 years from 1973 to 2017, is grouped into nine periods, namely (1) from 1973 to 1977, (2) from 1978 to 1982, (3) from 1983 to 1987, (4) from 1988 to 1992, (5) from 1993 to 1997, (6) from 1998 to 2002, (7) from 2003 to 2007, (8) from 2008 to 2012, and (9) from 2013 to 2017.

Due to the type of data, this paper use panel data, which is a combination of nine periods series and 104 countries of cross-section data. There are three types of model estimation, namely: pooled ordinary least square, fixed-effect model, and random effect model. This paper runs the Hausman test (Wooldridge, 2016) to see the correlation between error and independent variable to choose between the fixed-effect model and random effect model. The null hypothesis is the random effect model or no correlation between regressors and error term, while the alternative hypothesis is the fixed-effect model. The results of the Hausman test that the null hypothesis can be rejected meaning that this paper use the fixed-effect model.

The next step is to test whether ordinary least square (OLS) is a suitable model by relying on Breusch and Pagun Lagrangian multiplier test. The null hypothesis is that there is no variance between entities or the OLS regression is the best model. For all dependent variables, the results show that we can reject the null hypothesis meaning that there is a variance between entities. As a result, the model estimation uses a fixed-effect model to see the relationship between the dependent and independent variable.

After choosing the fixed-effect specification, this paper examines the relationship between distribution of age groups, without and with interaction term by using the data of 104 countries. The coefficient of demographic variables from both models is a base to calculate the estimated coefficient of the relationship between 15 age groups and dependent variables. Based on these estimated coefficients, the paper calculates the demographic effect in Indonesia along the sample period and in the future.

For robustness check, this paper identifies an outlier from the country-specific intercept. There is one country with relatively high intercept compare to the country base which is country with individual intercept 0.5 or higher. This paper runs regression by excluding this country from the sample. For the second running of regression, the paper finds that the sign of all independent variables does not change. This paper uses the result of the first regression with 104 countries.
4. Results and Discussion

Table 2 shows the description of savings, investment, current account balance, labour productivity, the relative price of investment, and the proportion of all age groups. On average, the level of investment is higher than the level of saving, by 23.8% to 20.2%. The deviation of savings rate is larger than the deviation of investment rate. The current account balance is in deficit, on average, by 2.22%, that confirms the definition of the current account balance as the gap between savings and investment. The average labour productivity growth is 1.72%, while the mean of the relative price of the investment is 0.5341.

The average of the share age group globally cannot capture the phenomena of decreasing fertility rate. This average is calculated from the percentage of age groups for all countries that makes the possibility of high shares of young population in the low-income countries outweigh the shares of middle and high-income countries. The results of average shows that the highest share of 12.11% is for those in the age group from 0 to 4. The proportion is decreasing smoothly over age groups until the lowest level for 65-69 years by 2.41%, and then the share increases for the population aged 70 years old or older.

Table 2 Statistics Descriptive Results

| Variable | Observation | Mean | Std. Dev. | Min | Max |
|----------|-------------|------|-----------|-----|-----|
| S        | 922         | 0.201| 0.136     | -   | 0.869|
| I        | 936         | 0.238| 0.078     | 0.045| 0.684|
| CAB      | 855         | 0.022| 0.078     | 0.480| 1    |
| GROWTH   | 917         | 0.017| 0.041     | 0.174| 5    |
| RPI      | 936         | 0.534| 0.295     | 0.048| 3.116|

Age

|       | Observation | Mean | Std. Dev. | Min | Max |
|-------|-------------|------|-----------|-----|-----|
| [0-4] | 936         | 0.121| 0.047     | 0.032| 0.208|
| [5-9] | 936         | 0.110| 0.034     | 0.036| 0.167|
| [10-14]| 936         | 0.102| 0.025     | 0.036| 0.145|
| [15-19]| 936         | 0.094| 0.018     | 0.045| 0.132|
| [20-24]| 936         | 0.086| 0.012     | 0.048| 0.132|
| [25-29]| 936         | 0.078| 0.011     | 0.050| 0.159|
| [30-34]| 936         | 0.070| 0.012     | 0.040| 0.146|
| [35-39]| 936         | 0.061| 0.013     | 0.035| 0.124|

Sources: Author’s calculation

The statistic descriptive of the data above does not give a clear illustration of the trend of demographic transition. By taking the share of age groups of all years into a graph, it clarifies the existence of demographic transition by changing the shares of age groups as illustrated in Figure 1 below. Taking Indonesia in detail, the aging population can also be seen. The figure shows that both globally and Indonesia itself faces the young dependency ratio, which goes down over time, while the old dependency ratio which rises over time.

This section includes four sub-section, which are the relationship between age and dependent variables by using a model without interaction term, then followed by a model with interaction. Both models use the data from 104 countries. The third sub-section estimates the effect of demographic transition in Indonesia along 1973 to 2017 and in the future. The last sub-section contains a few policy implications in Indonesia.

Figure 1 Demographic Transition in All Sample and Indonesia (%)

Source: Author based on United Nations data

4.1 Relationship Between Age and Dependent Variables by Using Model Without Interaction Term

The first regression is to see the relationship between demographic variables and the control variables with all dependent variables without the interaction terms. Three regressions represent each dependent variable, namely
savings, investment, and current account balance. This model examines the direct effect of demographic variables in the dependent variables.

All these regressions show that demographic variables (D1, D2, and D3) jointly have a significant impact on savings, investment, and current account, as shown in Table 3. By having the coefficient of D1, D2, and D3, the paper calculates the coefficient of each age distribution (aj). The step to get the coefficient aj is (i) calculate γ0 according to equation (3.6), then (ii) calculate each coefficient by using the equation (3.4). Moreover, this paper uses Delta Method to find the estimated coefficient and standard error of each age groups to decide the significance of each age groups coefficient in the step (ii).

The research finding in Table 3 displays that the movement of age distribution’s impact on savings has inverted U-shape as illustrated by the life-cycle theory. The high dependency ratio, both young and old dependency, has a negative impact on savings. This finding matches with the argument by Higgins (1998), Bosworth and Keys (2004), Curtis et al. (2015), and Cavallo et al., (2018). The savings start from a negative number at an early age, then increase until reach the maximum point at the age 40 to 44 years old, and then the ratio goes down to the negative level when mature. Based on the result of estimated standard error, this paper finds that the coefficient of age distribution is significant for the age group of 5-9 years old in 10% significance level. The impact of the growth of labour productivity is positive and statistically significant and in line with the theory that productivity rising has a positive impact on savings. The relative price of investment has a positive but does not significantly impact on savings.

| Savings                      | GROWTH  | (0.0563)  |
|------------------------------|---------|-----------|
| RPI                          | 0.0035  | (0.0108)  |
| D1                           | -0.0005 | (0.0234)  |
| D2                           | 0.0079  | (0.0054)  |
| D3                           | -0.0006 | (0.0003)  |
| Demographic Effects (F-stat) | 2.23*   |           |
| Observations                 | 907     |           |
| R-Sq.                        | 0.1579  |           |

| Investment                   | GROWTH  | (0.0462)  |
|------------------------------|---------|-----------|
| RPI                          | -0.0080 | (0.0089)  |
| D1                           | -0.0261 | (0.0194)  |
| D2                           | 0.0087**| (0.0044)  |
| D3                           | -0.0006**| (0.0003)  |
| Demographic Effects (F-stat) | 3.98*** |           |
| Observations                 | 917     |           |
| R-Sq.                        | 0.0049  |           |
The coefficient of the age distribution for investment in Table 3 shows that the young population has favorable demand on investment, but relatively small. The investment demand increases when people get older until reaching a peak level at 35 to 39 years old. The investment demand drops smoothly and reaches the negative level for old age distribution. The results are determined with the type of investment that measured by the variable, which is fixed capital investment such as building, computers, transportation, intellectual property. The age coefficient is statistically significant for 30-34 (5% significance level), 35-39 (5% significance level), and 55-59 (5% significance level), 65-69 (1% significance level).

The labour productivity growth has a positive and significant coefficient, while the coefficient of the relative price of investment is negative but statistically insignificant. The coefficient of labour productivity growth implies that when productivity increases, then the investment also increases. The price coefficient infers that when the price increased, then the investment demand decreased, which aligns with the law of supply and demand. Compare to the finding by Higgins (1998), the result is relatively different because he argues that high demand on investment correlated with young dependency while this paper finds that a high demand on investment is related to working-age.

The regression for the current account balance in Table 3 confirms the theory that the current account balance is the gap between savings and investment. The current account balance is a deficit for young dependency because the savings rate is lower than the investment rate. In contrast, in the old dependency, the savings rate goes down at a lower rate than the investment rate, it leads to a positive current account balance. This result is relatively in line with finding by Higgins (1998) and Bosworth and Keys (2004). According to the estimated standard error, the coefficient of age distribution is significant for 5-9 (1% significance level) and 10-14 (10% significance level). The results of R-squared convey that the model only explains the little variance of savings, investment, and current account balance, which is 15.79, 0.49%, 4.85%, respectively. It means that other factors influence the dependent variables do not include in the model.

4.2 Relationship Between Age and Dependent Variables by Using Model With Interaction Term

The next regression includes the interaction between demographic variables with labour productivity in the model. Based on the regression results of the savings and investment specification, the demographic variables have a jointly significant impact only for investment (1% significance level), and current account balance (10% significance level), but not for savings. Moreover, the interaction term of demographic variables and labour productivity shows a statistically significant relationship with savings, investment, and current account balance in a 5% significance level.

The movement of age distribution coefficient, including direct demographic effect and interaction effect, is as shown by Table 4. In this paper, the interaction effect is calculated by using 1.72% of the growth of labour productivity which is the mean of the GROWTH variables for all samples. Table 4 makes a comparison between the estimated coefficient of age distribution without interaction term (dashed line) and the estimated coefficient with the interaction term (full line). The graph of estimated age distribution includes the direct effect of demographic variable and interaction effect between demographic variable and labour productivity growth.

The comparison of the estimated age distribution between two models, which are with and without interaction, shows that the impact of demographic
transition is relatively similar for all dependent variables. The interaction term only has a small impact on savings, investment, and current account balance, so do not change the distribution of age group significantly. The interaction term adds a negative impact on savings and lowers the estimated coefficient of age groups on a small scale. The sign of control variables, both labour productivity and the relative price of investment, do not change from the model without the interaction terms. The growth of labour productivity has a positive impact on savings, investment, and CAB, while the relative price of investment has a positive effect only for savings.

The estimated coefficient of age distributions on savings in Table 4 shows that the interaction of young dependency ratio and labour productivity has a negative relationship with savings. This negative impact is illustrated by the shift of savings curve down, although only by a little. This result is in line with the theory of the variable rate-of-growth effect model (Higgins, 1998) that with given labour productivity, the young dependency ratio causes dissaving. The variable rate-of-growth effect model argues that the younger generation earns larger income than the older cohorts which push them to consume more but save less.

| Table 4 Fixed Effects Estimates (With Interaction) |
|----------------------------------------------------|
| **Savings**                                        |
| GROWTH  | 0.5355*** (0.2008) |
| RPI     | 0.0064 (0.0108)    |
| Demographic Effects     | 1.53                |
| Interaction with GROWTH Effects | 2.73**              |
| Joint Effects            | 2.49**              |
| Observations            | 907                 |
| R-Sq.                 | 0.1457              |

| **Investment**                                      |
|----------------------------------------------------|
| GROWTH  | 0.1244 (0.1662) |
| RPI     | -0.0080 (0.0089) |
| Demographic Effects     | 4.58***           |
| Interaction with GROWTH Effects | 2.70**             |
| Joint Effects            | 3.35***            |
| Observations            | 917                |
| R-Sq.                 | 0.0073              |

| **Current Account Balance**                         |
|----------------------------------------------------|
| GROWTH  | 0.3910** (0.1924) |
| RPI     | -0.0060 (0.0105)  |
| Demographic Effects     | 2.23*              |
| Interaction with GROWTH Effects | 2.95**             |
| Joint Effects            | 2.92***            |
| Observations            | 845                |
| R-Sq.                 | 0.0533              |

Notes: ***1% significance; **5% significance; *10% significance
Source: Author’s estimation
4.3 Demographic Effect in the Past and the Future in Indonesia

Demographic effect defines as how the transition of demographic structure impact on savings, investment, and current account balance. In this section, the paper only focuses on Indonesia to see the scale of demographic transition across period 1973-2017 and in the future. The first sub-section analyses the demographic transition in the past, then it follows by the effect of demographic transition in the future.

The scale of demographic effect captures the impact of the demographic transition on the deviation of saving, investment, and current account from the average. The steps of calculating the demographic effect follow Higgins’ (1998) approach, which start by calculating the deviation from the average for the share of each age group at each period, then multiplying the gap with the estimated coefficient age groups of savings, investment, and current account balance for all periods, and lastly finding the biggest gap between periods as demographic effect. In calculating the demographic effect, this paper uses the model without interaction rather than the model with interaction terms. The model without interaction terms is the best since all demographic variables have a jointly significant impact on all dependent variables. Moreover, the assumption of estimating future demographic effect is that there is no change in labour productivity, or the growth of labour productivity is zero.

The result of the demographic effect calculation between the first five-years-average of 1973-1977 and the last five-years-average of 2013-2017 is shown in Table 5. The young dependency ratio in Indonesia is decreasing for 14.68 percentage point from 42.55% the average of 1973-1977 to 27.86% the average of 2013-2017. On the other hand, the working-age and old dependency group rise by 13.02 percentage point and 1.67 percentage point, respectively.

This demography transition causes an increase in savings by 2.03 percentage point because the decrease of young dependency ratio and the increase of the working-age ratio reduces dissaving, while the increase of old dependency ratio is still low and causes a small impact on dissaving. However, the impact’s magnitude on savings is relatively lower than that in the finding by Higgins (1998), where the increase of savings is 3% and associated with the lowering of young groups by 4.7%, the increase of the working-age group by 1.7%, and the increase of old age groups by 0.6%. However, the demographic transition induces a negative impact in investment by 0.33 percentage point from the period 1973-1977 to the period 2013-2017. On average, the impact of demographic transition induces the positive change of current account balance by 1.96 percentage point along the sample period.

| The Change in Age Distribution | Demographic Effect |
|--------------------------------|--------------------|
| Young Dependency (0-14 years old) | Working age (15-64 years old) | Old Dependency (≥65 years old) | Savings | Investment | CAB |
| -14.68% | 13.02% | 1.67% | 2.03% | -0.33% | 1.96% |

Source: Author’s calculation

The starting of the aging population in the past keeps going in the future, as shown in Figure 2. Based on the data of the United Nations (2019), the structure of the Indonesian population shows a movement towards the aging population. From 2018 to 2050, the old population grows enormously about 170.8% times, while the young and working-age population decrease by lower rate, which is 26.8% and 4.3% respectively. In other words, the proportion of the working-age population will not change much, but the dependency population changes significantly, as shown by Figure 2.

Figure 2 The Demographic Transition in the Future (Indonesia)
Source: United Nation data (2019)
The method of calculating demographic effect for the past period from 1973 to 2017 is used to estimate the expected value of savings, investment, and current account balance in the future. To simplify, the assumption here is ceteris paribus, that is no change in labour productivity and the relative price of investment, and other variables. This future demographic effect calculation is the gap between the demographic effect of each year in the future with the average amount for 2013-2017. The calculation uses the estimated age-distribution coefficient from the period 1973 to 2017.

The result of the calculation of the demographic effect in 2025 and 2050 is shown in Table 6. The finding shows clearly that Indonesia also will face the aging population where young dependency ratio will decrease by 3.17 percentage point in 2025 and by 8.44 percentage point in 2050, compared to the mean of 2013 to 2017. Overall, the working-age group would increase by 0.69 percentage point in 2025 but then decrease in 2050 by 2.3 percentage point. The old dependency group shows an increasing trend with the level of growth 2.8 percentage point in 2025 and 13.27 percentage point in 2050 from the average of age shares in 2013-2017.

The change in population structure would be lowering demand for investment over time, which declined by 1.31 percentage point in 2025 and 5.52 percentage point by 2050. The current account balance is to be in surplus overtime because the decrease in saving is lower than the increase in investment. This result is different from the previous result suggested by Higgins (1998) in which the working-age is rising as well as the old dependency and harms investment.

If the demographic effect in the past and future are put together, the results are as drawn in Figure 3. The base for this estimation is the average age-shares of the ninth period. It means that all change in savings, investment, and current account balance is compared to the average value of 1973-2017. From Figure 3, the change of population structure in the past caused an increase in the savings rate, but in the future, the demographic change will lower the savings rate. The investment rate also increased in the past but has a declining trend in the future. In the future, the decreasing investment will be higher than the decreasing of savings, which will end up with the current account surplus.

Table 6 Demographic Effect in Indonesia, 2025 and 2050

| Year | The Change in Age Distribution | Demographic Effects (Compare to 2013-2017) |
|------|--------------------------------|-------------------------------------------|
|      | Young Dependency (0-14 years old) | Working age (15-64 years old) | Old Dependency (≥65 years old) | Savings | Investment | CAB |
| 2025 | -3.17%                          | 0.69%                                | 2.8%                     | -0.31%   | -1.31%     | 0.82% |
| 2050 | -8.44%                          | -2.30%                               | 13.27%                   | -2.53%   | -5.52%     | 2.36% |

Source: Author’s calculation

The aging population in Indonesia in the future causes the lowering of savings rate by 0.31 percentage point in 2025 and 2.53 percentage point in 2050, compared to the average savings rate in 2013-2017. The changing of population structure by lowering working-age and increasing old population causes a negative impact on savings. This result is relatively similar with the findings by Guest and McDonald (2004) in Malaysia and the Philippines. They found that in the early stage of the aging population, countries face decreasing of dependency ratio and increasing old dependency ratio, which leads to lowering of the savings rate. However, this paper finds different results with Higgins (1998) where he predicts that the demographic transition has a positive impact on savings in 2010 and 2025. The demographic changing in Higgins (1998) is through decreasing young dependency ratio, increasing working-age ratio, and small increase on old dependency ratio. The more up to date data used by this paper and Guest and McDonald (2004) may cause this different finding.

Figure 3 The Demographic Effect in The Past and Future (The Average of 1973-2017 as baseline)

Source: Author’s calculation
5. Discussion

The projection of future population, as well as the estimated level of savings, investment and current account, provides essential information for public policy in Indonesia. Indonesia will face the aging population, which means the old population increase, while the young and working-age population decrease. Two important things that must be taken in to account regarding this trend are the pension plan and the investment level.

First, given an anticipated aging population in Indonesia, Indonesia needs the policy to support the longer retirement time. The pension system is better than a social welfare benefit scheme to encourage working and investing in preparing for retirement. As argued by Lee and Mason (2010), the private and public transfer lowers wealth accumulation. Curtis at al. (2017) claim that the older the pension age, the lower the saving rate to support the needs on retirement age. Besides, the replacement rate is essential to encourage saving behaviours. Curtis et al. (2017) find that the lower the replacement rate, then the higher the savings rate.

Second, the trend of decreasing estimated investment rate will potentially lower the national output since investment is one factor that determined GDP. In 2021, Indonesia will potentially reach the largest proportion of working-age population before this reduces in the future. As estimated, the high proportion of the population in working age is related to a high level of saving and investment. This period is the best time to push investment which can have an impact on boost economic performance (Romer, 2012).

6. Conclusion

The transition of demographic structure, which is influenced by a decrease in young dependency and an increase in old dependency, has an impact on savings, investment, and current account balance. The first objective of this paper is to investigate the relationship between age distribution and all dependent variables by using data from 104 countries between 1973 to 2017. This paper finds that the high dependency ratio, both young and old, lowers the rate of savings, and creates the hump shape relationship between the share of age groups and savings. Meanwhile, only the old dependency ratio has a negative relationship to investment demand, the young dependency and the working-age have a favorable demand for investment. The gap between savings and investment determines the current account. For the young age population, the current account is in deficit, but it goes up over the years and then ends up with a surplus for the old age population.

The second objective of this paper is to examine demographic transition's effect in all dependent variables in Indonesia from 1973 to 2017 and in the future. Indonesia is on its way to an aging population, in which the share of young dependency keeps decreasing, while the old age group moves in the opposite direction. This transition causes a change in the level of savings, investment, and current account balance. In the period 1973 to 2017, the savings and investment increase because of demographic transition, that the change in savings is greater than the change in investment. In this period, the current account balance also increases overtime. In the future, the savings rate and investment rate would be decreasing, but the change on savings is much lower than the change on investment which results in a surplus in the current account. The government must take in to account this condition in policy formulation, such as through reforming pension policy and pushing investment. This policy will help to anticipate the impact of the aging population in economy and to boost the economic performance.

7. Limitation

This model uses two control variables which are labour productivity and relative price of investment as control variables. One implication of this model is that the number of R-squared is small or the model only explains the little variance of savings, investment, and current account balance. Putting more good control variables may end with better results for the coefficient of all age groups. It can impact the relationship of the proportion of age groups with savings, investment, and capital flows. Moreover, the future impact of demographic transition on those dependent variables may also change.

References

Bosworth, B.P., & Keys, B. (2004). Increased Life Expectancy: A Global Perspective. in H.J. Aaron & W.B. Schwartz (eds), Coping with Methuselah- The Impact of Molecular and Biology on Medicine and Society. 247-283. Washington, D.C.: Brookings Institution Press.

Cavallo, E., Sánchez, G., & Valenzuela, P. (2018). Gone with The Wind: Demographic Transitions and Domestic Saving. Review of Development Economics, 22(4), 1744–1764.

Curtis, C. C., Lugauer, S., & Mark, N. C. (2015). Demographic Patterns and Household Saving in China. American Economic Journal: Macroeconomics, 7(2), 58–94.

Curtis et al. (2017). Demographics and Aggregate Household Saving in Japan, China, and India. Journal of Macroeconomics, 51, 175–191.

Doker, A.C., Turkmen, A., & Emsen, O. S. (2016). What are The Demographic Determinants of Savings?
An Analysis on Transition Economies (1993-2013). *Procedia Economics and Finance, 39*, 275–283.

Guest, R. S., & McDonald, I. M. (2004). Demographic Transition and Optimal Saving in Four Asian Countries. *Economic Analysis and Policy, 34*(1), 1–13.

Higgins, M. (1998). Demography, National Savings, and International Capital Flows. *International Economic Review, 39*(2), 343-369.

Lee, R., & Mason, A. (2010). Some Macroeconomic Aspects of Global Population Aging. *Demography, 47*(1), 151-172.

Mankiw, G. (2009). *Macroeconomics*. New York: Worth Publishers.

Modigliani, F. (1986). Life Cycle, Individual Thrift, and the Wealth of Nations. *Science, 234*(4777), 704–712.

Nicholson, W. (2008). *Microeconomic Theory: Basic Principles and Extensions*. Mason: Thomson Higher Education.

Romer, D. (2012). *Advanced Macroeconomics*. New York: McGraw-Hill.

Schmitt-Grohé, S & Uribe, M. (2014). *International Macroeconomics*. Columbia University. Available at http://www.columbia.edu/~mu2166/UIM/notes.pdf. [Viewed 23 July 2019]

Taylor, A. M. (1995). Debt, Dependence and The Demographic Transition: Latin America in to The Next Century. *World Development, 23*(5), 869–879.

Wooldridge, J. M. (2016). *Introductory Econometrics: A Modern Approach*. Boston: Cengage Learning.