

# On the Causality Relationship between Demographic Changes, Economic Growth and Domestic Savings in Vietnam

*(Hubungan Arah Sebab-Menyebabkan antara Perubahan Demografi, Pertumbuhan Ekonomi dan Tabungan Domestik di Vietnam)*

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## ABSTRACT

*The study aims to investigate the short run and long run relationships between demographic factors (population growth and the age dependency ratio), economic growth (GDP per capita growth) and domestic savings in Vietnam for the period of 1986 to 2016 using the cointegration and Wald tests. The findings revealed that there is a cointegration relationship between domestic savings and demographic and economic variables, while Wald test shows a unique causality trend running from population growth to domestic savings in Vietnam. The policy implications from this study suggest that the Vietnam government should focus on boosting economic growth (GDP per capita growth) through mobilizing its resources, managing fertility level between urban and rural areas and population growth in relation with growth rate of the economy. Moreover, the Vietnam government should take advantage of the golden population structure and limit the effects of the dependency ratio through offering attractive beneficial programs for the elderly and provide opportunities to increase their productivity, and thus spur savings in Vietnam.*

*Keywords: Dependency ratio; domestic saving; economic growth; population growth; Johansen cointegration test; causality test.*

## ABSTRAK

*Kertas ini mengkaji hubungan jangka panjang dan jangka pendek antara faktor-faktor demografi (pertumbuhan penduduk dan nisbah ketergantungan umur), pertumbuhan ekonomi (pertumbuhan KDNK per kapita) dan tabungan domestik di Vietnam untuk tempoh 1986 hingga 2016 dengan menggunakan ujian kointegrasi Johansen dan arah sebab-menyebab Granger. Penemuan utama kajian ini menunjukkan kewujudan hubungan kointegrasi antara tabungan domestik, pemboleh ubah demografi dan pertumbuhan ekonomi, manakala keputusan ujian Granger pula menunjukkan arah-sebab menyebabkan yang sehalu daripada pertumbuhan populasi kepada tabungan domestik di Vietnam. Implikasi dasar daripada kajian ini menunjukkan bahawa penggubal dasar di Vietnam perlu memberi tumpuan kepada meningkatkan pertumbuhan ekonomi (pertumbuhan KDNK per kapita) melalui menggerakkan sumber, mengawal tahap kesuburan antara kawasan bandar dan luar bandar dan pertumbuhan penduduk yang berhubung dengan kadar pertumbuhan ekonomi. Di samping itu, penggubal dasar boleh mengambil kelebihan daripada struktur penduduk warga emas dan menghadkan kesan nisbah pergantungan orang tua melalui menawarkan program menarik yang bermanfaat untuk mereka serta menyediakan peluang untuk meningkatkan produktiviti justeru meningkatkan tabungan domestik di Vietnam.*

*Katakunci: Nisbah pergantungan; tabungan domestik; pertumbuhan ekonomi; pertumbuhan penduduk; ujian kointegrasi Johansen; ujian sebab-menyebab.*

## INTRODUCTION

Both the developing and developed countries are facing demographic changes in terms of population size and dependency ratio. The huge population resulting from a rapid increase in the fertility rate over time creates both advantages and disadvantages to the economy. If the working age population (active population) is high and there are more younger than elderly population, the demographic structure is more beneficial to the growth

of the economy with increase in savings due to a smaller burden of the dependency population. Conversely, a high ratio of dependents in the population will cause a big burden to economic growth, thus depressing both household and domestic savings (Bloom et al. 1999; McNicoll 2006; Fent et al. 2008).

According to the Life Cycle Hypothesis of Modigliani (1970), individuals attempt to smooth consumption over their lifetime. People tend to save more when they are young and their incomes are high, and spend when they



are old and retired. Their savings are highest during their working life, and will gradually reduce during their retirement and old age in order to maintain their normal standard of living. The higher dependency ratio, which is the proportion of young dependents (those less than 15 years) and the elderly (those older than 60 years) to the working age population (people aged 15-60), indicates the possibility of more expenditure relative to their income, and thus comparatively less personal and domestic savings.

Indeed, economic growth requires investment that can be financed through domestic savings or from foreign capital inflows. Domestic savings is the fundamental component to boost sustainable economic growth of a country. In the long run, economic recovery and growth relies mainly on investment through domestic savings and capital accumulation (Bisat et al. 1997; Sinha & Sinha 2008). With regards to the relationship between demographic factors, economic growth and domestic savings, there are a large number of empirical studies conducted in the context of developed and developing countries. Most studies indicated that there is a significant linkage between dependency ratio, economic growth and domestic savings. Furthermore, population growth and dependency ratio have an impact on domestic savings, and economic growth proceeds and leads to an increase in savings. There is a specifically positive connection between economic growth and domestic savings. The higher the rate of economic growth, the higher is the rate of domestic savings that accrued from the higher lifetime wealth of the young savers in relation to the old spenders in the country (Wilson 2000).

Although there exists a significant connection between demographic variables, economic growth and domestic savings, and the causality often running from population growth and dependency ratio to domestic savings, the direction of the causality between economic growth and domestic savings has continued to generate numerous debates among researchers. Most studies stated that savings is driven by economic growth, while several researchers (e.g., Adebisi 2005; Alguacil et al. 2002; Katircioglu & Naraliyeva 2006; Sinha 1999) supported the idea that savings is causal to economic growth. Indeed, studies have found a bilateral causality between the two variables, but only a few studies showed that there is ambiguous or no relationship between them (Anderson 1999; Mohan 2006; Sinha 1996). Furthermore, most of the studies employed cross-country data for estimation, but the limitation of cross-country regression analysis is that it relies on assumptions of homogeneity of the nature and quality of data, and thus the validity of the result is suspect. There is therefore a need to undertake econometric analysis on saving behavior using the time series data of individual country and employing the well-developed techniques for handling non-stationary time series data within an integrated theoretical framework (Deaton 2005).

Vietnam is a developing country situated in South East Asia and has experienced dramatic demographic changes with a slower speed of population growth and a decline in the ratio of young dependents to the working age population due to a rapid decrease in fertility rate, an increase in the pre-retirement working population, and coincident with a remarkable growth in the sovereign economy. Specifically, the population size of Vietnam increased from 64.37 million in 1986 to 76.32 million in 1999, and 93.42 million in 2016. During this period, the elderly population, aged 60 and above, also increased two times from 4.64 to 9.34 million, which was equivalent to the slight increase in the proportion of the elderly in the working age population from 9.9% in 1986 to 10.20% in 1999 and 10.34% in 2016. By contrast, the proportion of child dependents to the working age population in Vietnam dropped from 81.48% in 1986 to 53.18% in 1999 and 31.9% in 2016, about a 2.5-fold decrease during this period. The decreasing ratio of child dependents was due to a dramatic decline in the fertility rate by a half from 4.60 to 2.33 births per woman due to implementation of the national family planning policy in the period 1986-1999, and to approximately 2.1 births per woman during the period 2000-2016 (General Statistic Office of Vietnam 2017). Conversely, Vietnam experienced a remarkable economic growth that earned her the moniker of a new economic dragon in Southeast Asia (Collins & Zhu 2005). The achievement was made possible through the comprehensive economic reform known as *Doi Moi* (renovation program) since 1986 aimed at transforming the country "from a centrally planned economy to a market-oriented economy". However, whether the coincident development of demography and economy are interrelated is a moot question?

The author acknowledged the advantage of the cointegration techniques, for handling non-stationary time series data, and were thus adopted in studying the relationship between demographic changes, economic growth and domestic savings. More importantly, there is no robust consensus on the associations of demographic changes and economic growth with domestic savings reported in previous researches, and to date there is no empirical study conducted on this relationship in Vietnam. Thus, there is clear merit in conducting empirical research in this area by employing the cointegration techniques. The approach is suitable for analyzing time series data from Vietnam and for investigating the short run and long run impacts of demographic changes and economic growth on domestic savings within the Life Cycle Hypothesis framework.

The main purpose of this research is to investigate the short run and long run relationship between demographic factors (population growth and age dependency ratio), economic growth, and domestic savings in Vietnam within the Life Cycle Hypothesis framework. Specifically, this study aims to determine whether the short run and the long run associations of demographic

changes (population growth and age dependency ratio) and economic growth with domestic savings exist in Vietnam or otherwise. And if affirmative, what is the direction of causality between these variables. In addition, some policy recommendations are suggested to boost domestic savings as well as the economic growth in Vietnam.

## LITERATURE REVIEW

The Life Cycle Hypothesis, which was developed by Modigliani (1970), was the most important theoretical framework used to examine the relationship between population age structure, economic growth and savings. According to this hypothesis, people tend to save more when they are young and working, whereas they tend to spend more relatively when they are old and retired. Modigliani (1970) also indicates that children do not have income and only contribute to consumption. As such if youth dependency ratio increases, then household savings will tend to decrease, leading subsequently to depletion in domestic savings. Similarly for retirees, their income decreases following retirement and they are subsequently forced to use a part of their accumulated savings, earned during their working life, in order to spend on their basic needs. In consequence, retirees recorded a negative saving rate which depends on the size of their age group in the population. Specifically, the higher the proportion of the working population will lead to higher domestic savings, while conversely the higher the ratio of children and elderly in the population, the lower are the savings.

Assume that individuals start working at age  $D$ , work for  $W$  years and retire for  $R$  years, and die at  $L$  years old; that income and consumption are independent of age; that no productivity growth and no bequest or other intergenerational transfers exist in the model; and that the interest rate is zero. The saving rate in Modigliani's model (1970) is presented below (Thornton 2001):

$$SR = \frac{(D + R)}{L} - \frac{W}{L} * DEP \quad (1)$$

Where DEP, the age dependency ratio, is the ratio of dependents to the working age population. Equation (1) shows that the saving rate is a declining function of the proportion of dependents (DEP), and the coefficient of DEP is the negative of the proportion of working life to total life span.

In general, the Life Cycle Hypothesis posits that an increase in savings results from earnings by a proportionally higher percentage of working adults together with those from a smaller percentage of youth and the elderly in the population. The hypothesis also confirms that demographic factors such as population growth, dependency ratio, life expectancy, and the income level are likely to be determinants of domestic savings (Yasin 2008). Furthermore, savings also depends mainly

on the level of economic growth and other variables, such as population growth and age groups in the population (Mankiw 2000). As such, the underlying implication of Life Cycle Hypothesis is the linkage between demographic changes (represented by population growth and dependency ratio), economic growth and savings.

Past empirical studies have extensively examined the relationship between demographic transition, economic growth and domestic savings. Demographic transition is caused by an increase in the proportion of working age population and a corresponding decrease in the proportion of children. This has implications in decreasing the amount of expenditure for fulfilling their demands, and thus increasing domestic savings. On the other hand, the advantage of a smaller proportion of child dependents can be adapted to accelerate economic growth (Bloom et al. 2003; Bloom & Williamson 2007; Fent et al. 2008; Mason 2005; McNicoll 2006;). Bloom et al. (2003) similarly stated that domestic savings and economic growth are closely related to demographic factors. Specifically, the potential for domestic savings is in the working age population and in the amount of accrued domestic savings that can be converted to resources for investment into the economic growth of the country.

Apergis and Christou (2012) employed the cointegration and causality tests to investigate the relationship between dependency ratio, domestic savings rate (as the share of GDP) and real per capita income (GDP per capita) in sixteen African developing countries. The empirical results provided the evidence of the cointegration (long run) relationship between dependency ratio, domestic savings rate, and GDP per capita. Additionally, this analysis also indicated a negative causal connection between dependency ratio and domestic savings rate, meaning that as the dependency ratio decreased, the domestic savings rate increased. In general, the size of dependent population in these countries was one of the most important factors determining the long run savings behavior, while the size of working age population make a positive contribution to a higher domestic savings rate. Indeed, economic growth is a powerful factor determining domestic savings rate in the long run. However, Apergis and Christou (2012) doubted the possibility of increasing domestic savings rate of the African countries since they were at an earlier stage of demographic transition due to a lower fertility rate, whereas the youth and elderly dependency ratios remained high as compared to other Asian countries.

Keho (2012) also used a time series data from sixteen African developing countries and applied the cointegration and causality tests to examine the relationship between domestic savings as a share of GDP, dependency ratio and real GDP per capita. The results of the cointegration test confirmed the long run relationship between domestic savings, dependency ratio and real GDP per capita in these countries. Nevertheless, the Granger causality test gave different results between countries.

The low dependency ratio in Cameroon and Sierra Leone for example elicited a positive impact on its domestic savings rate, whereas for nine other African countries (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Kenya, Mauritania, Nigeria, Zambia and Zimbabwe) it produced a negative influence. Indeed, the remaining five countries showed no evidence of the causality relationship between the two factors.

Salman (2012) investigated the linkage between demographic variables (dependency ratio and fertility rate), investment, and the national saving in Pakistan in the period 1980-2009 using the Vector Error Correction Model (VECM). The VECM findings revealed that there are negative relationships between dependency ratio and national saving, and between fertility rate and national saving, in both the short and long run. The national saving of Pakistan is however positively related to its investment. Similarly, Xu (2012) employed the VECM and found the long run steady-state relationship between the population age structure, household savings and GDP per capita in China during the period 1963-2006. Moreover, the short run relationship between these variables also exists. In particular, the age dependency ratio in China has a significant negative effect, while the growth rate of GDP per capita has a positive effect on household savings.

Other studies also confirmed the significant association between demographic transition and domestic savings. Bloom et al. (2000) found that the high level of domestic savings in the East Asian countries was caused by a significant decrease in the dependency ratio resulting from a rapid decline in fertility rate in these countries. In a later study, Bloom and Williamson (2007) found that demographic transition played a crucial role in the East Asian economic miracle boosting by two-fifths domestic savings. Lee et al. (2001) earlier revealed that a decrease in the age dependency ratio generated a remarkable increase in domestic savings in the Taiwan economy. Similarly, Kögel (2005) confirmed that the high proportion of young dependents led to a decrease in aggregate saving which reduced the growth of economic productivity in a country. Horioka (1997) in an earlier study discovered the significant negative effect of the dependency ratio on Japanese household savings in both the short and long run. Kelley and Schmidt (1995) recorded negative relationship between dependency ratio and domestic savings rate in 89 countries in three growth periods (1960-1970, 1970-1980, and 1980-1990).

In another study, Li et al. (2007) used the data from more than two hundred countries sourced from the World Bank to test the impacts of population growth and dependency ratio on domestic savings, investment and the growth rate of GDP per capita. They confirmed that population growth and the dependency ratio are important factors contributing to economic growth in these countries. Moreover, the age dependency ratio has a negative effect on domestic savings, investment and economic growth, while population growth has a

positive effect on domestic savings, investment and the economic growth.

The previous studies in the literature clearly indicate a significant association between demographic changes (population growth and the dependency ratio) and domestic savings. Despite the extensive reporting, causality trend between economic growth and domestic savings remains indistinct. Some however recorded a positive nexus between the two variables. They included DeGregorio (1992), who employed the OLS method (with domestic savings rate as a share of GDP); Dekle (1993) using the Granger causality test worked on a group of fast developing countries; Carroll and Weil (1994) on OECD member countries; and Edwards (1995) who worked on a panel of 36 countries and also discovered that the economic growth Granger causes domestic savings. Similarly, Carroll et al. (2000) found that an increase in domestic savings is caused by an increase in GDP growth rate in the East Asian countries. In addition, Sinha and Sinha (1998) reported on work from Mexico, Sinha (2000) from the Philippines and Sinha and Sinha (2008) from India. They all confirmed that economic growth leads to growth in domestic savings.

In contrast, Alguacil et al. (2002) examined the saving-growth nexus and discovered that higher domestic savings precede and lead to faster economic growth. Likewise, Katircioglu and Naraliyeva (2006) applied the cointegration and Granger causality tests and found one-way and positive effect of domestic savings on economic growth in Kazakhstan for the period 1993 - 2002. Similarly, Sinha (1999) found that high domestic savings cause faster economic growth in Asian countries. Indeed, Anoruo and Ahmadi (2001) employed Granger causality methodology for testing the cross-sectional data of seven African countries and recorded the causal relationship between domestic savings and economic growth. Specifically, economic growth and domestic savings are cointegrated in all the African countries except for Nigeria, and that economic growth leads to growth of domestic savings in all countries except for the Congo.

Waithima (2008) found a positive relationship between GDP growth rate and domestic savings for Kenya using the Hendry Model two-step method to identify the function of savings. The Granger causality test also showed unidirectional causality running from GDP per capita growth to domestic savings. In a similar study, Sajid and Sarfraz (2008) applied the cointegration and VECM tests and disclosed the significant long run relationship and the unidirectional short run relationship, from output (GDP and GNP) to household savings in Pakistan. Olajide (2009) and Nurudeen (2010) employed the cointegration and Granger causality tests and discovered that economic growth in Nigeria has a positive effect on domestic savings and that a unidirectional causality proceeded from economic growth to domestic savings. They subsequently proposed that the Nigerian

government should establish policies that could boost its economic growth so as to raise its domestic savings. In contrast, Adebisi (2005) in an earlier study used the Granger causality test for analyzing quarterly Nigerian data spanning from 1970 to 1998 and affirmed that economic growth is sensitive and has negative influence on domestic savings.

Piotr (2010) applied both the cointegration and Granger causality tests and discovered one-way causality running from domestic savings to GDP in both emerging developing countries and developed countries. The same result was recorded by Ramesh (2011) that there is such long run relationship and that the high domestic savings trigger high economic growth in India during the period 1950-51 to 2007-08. A similarly trend was also discovered by Aswini and Mohit (2012) for India in the period 1950-2011.

Several studies confirmed a bilateral causality direction between economic growth and domestic savings (e.g. Abu Al-Foul 2010; Jappelli & Pagano 1994; Lee & Mason 2007; Sajid & Sarfraz 2008; Tang & Zhang 2007). The economic growth leads to higher domestic savings rate, which in turn elevates domestic savings rate and increases capital accumulation which finally loops back to escalate economic growth of the country. On the contrary however, some studies (Anderson 1999; Sinha 1996; Mohan 2006) did not find any relationship between the economic growth and domestic savings nexus.

In general, it could be concluded that there was robust consensus of researches who focused on the relationship between demographic changes (population growth and the age dependency ratio) and domestic savings. It was clear that the dependency ratio has a negative influence on domestic savings, while the impact of population growth on the parameter is negative or positive depending on population age structure of the country. In addition to the economic growth-domestic savings nexus, its linkage with the direction of the causality is still debated among researchers. Nevertheless, empirical studies on the causality relationship between the economic growth-domestic savings nexus remained sparse due mainly to the scarcity of sufficiently long time series data from most of the developing countries.

## METHODOLOGY

### DATA SOURCES FOR ECONOMETRIC ANALYSIS

This study uses the time-series data from Vietnam, for the period 1986-2016, which was sourced from the World Development Indicators, the World Bank and General Statistics Office of Vietnam. For this research, domestic savings (% of GDP) is the dependent variable. The important factors in determining domestic savings are considered as explanatory variables, which include the growth rate of population, age dependency

ratio, and Gross Domestic Product (GDP) per capita growth rate.

Data for population growth and dependency ratio were sourced from the World Bank. The dependency ratio is referred to as the total dependency ratio, which is the ratio of dependents (individuals aged below 15 and above 64) to the working age population (those aged 15-64). The annual growth rate of GDP per capita and the ratio of gross domestic savings to GDP were sourced from the General Statistics Office of Vietnam.

### MODEL SPECIFICATION

Based on the original model of Life Cycle Hypothesis and previous empirical studies, the relationship between demographic changes, economic growth and domestic savings can be modeled as follows:

$$Savings_t = \beta_0 + \beta_1 \cdot pop_t + \beta_2 \cdot age_t + \beta_3 \cdot gdp_t + u_t \quad (2)$$

Where,

$\beta_0$  = Constant

$t$  = Time period

$Savings_t$  = Gross domestic savings (% of GDP)

$pop_t$  = The growth rate of population

$age_t$  = The age dependency ratio

$gdp_t$  = Gross Domestic Product (GDP) per capita growth rate

$\beta_1, \beta_2, \beta_3$  = The coefficients of  $pop_t$ ,  $age_t$ , and  $gdp_t$ , respectively

$u$  = The error term

*Empirical Methodology* The unit root test, cointegration analysis and Error-Correction Model (ECM) are utilized in this study. The unit root test is employed to detect the stationarity of the variables. The test is undertaken for two reasons. Firstly, the test helps avoid the spurious regression problem. Secondly, a basic assumption underlying the application of causality test is that the time series should be stationary. Hence, in order to detect the stationarity of the variables, we employ the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller 1981). Each of the time series may not be stationary, but there may be cases of linear combination among them. This means that non-stationary demographic and economic time series may produce stationary relationships if they are cointegrated. This is the reason why we subjected the four variables individually to unit root analysis. If the time series are integrated in the same order,  $I(d)$  for  $d = 0, 1, 2, \dots$ , then the four series are said to be cointegrated and the regression on the same levels of the four variables is meaningful.

Having established the order of integration, the cointegration test is conducted to establish the existence of a long run equilibrium relationship and the short run dynamics amongst the variables. The cointegration technique pioneered by Granger (1986), Engle and Granger (1987) allows long-run components of variables

to obey long-run equilibrium relationships with the short-run components having a flexible dynamic specification. In determining the number of cointegrating vectors, the study applied the Trace and Maximum Eigenvalue tests. If there is no cointegration, the vector autoregressive (VAR) model is estimated. By contrast, if there contains one or more cointegration vectors, the VECM is conducted to identify the long run equilibrium relationship and short run dynamics between the considered variables. The simple Error Correction Model (ECM) is as follows:

$$\Delta y_t = \alpha ECT_{t-1} + \gamma \Delta x_t + u_t \quad (3)$$

Where  $u_t$  is independently and identically distributed (i.i.d.).  $\Delta y_t$  and  $\Delta x_t$  are the first difference of  $y_t$  and  $x_t$ , respectively.  $ECT_{t-1}$  is one period lagged value of the residuals from the estimation of equilibrium error term. The coefficient ( $\alpha$ ) of the error correction term (ECT) in the VECM presents the speed of adjustment toward the long run equilibrium and a cointegration relationship exists as the expected sign of coefficient of the VECM is significantly different from zero. Indeed, the error correction term (ECT) in the VECM is reasonable, if the coefficient of ECT is in negative number and is not lower than -2 (Loayza & Ranciere 2005).

The simple ECM (3) above can be applied in the multivariate system. In this research, four variables related to the relationship between demographic changes (population growth,  $pop_t$  and the age dependency ratio,  $age_t$ ), economic growth (GDP per capita growth rate,  $gdp_t$ ) and domestic savings ( $Savings_t$ ) are considered as endogenous variables, while the constant term is considered as exogenous variable. The ECM can be developed in the following equations:

$$\begin{aligned} \Delta Savings_t &= \beta_0 + \beta_1 \Delta Savings_{t-1} + \beta_2 \Delta pop_{t-1} + \beta_3 \Delta age_{t-1} \\ &\quad + \beta_4 \Delta gdp_{t-1} + \beta_5 ECT_{t-1} + u_{1t} \\ \Delta pop_t &= \sigma_0 + \sigma_1 \Delta Savings_{t-1} + \sigma_2 \Delta pop_{t-1} + \sigma_3 \Delta age_{t-1} + \\ &\quad \sigma_4 \Delta gdp_{t-1} + \sigma_5 ECT_{t-1} + u_{2t} \\ \Delta age_t &= \delta_0 + \delta_1 \Delta Savings_{t-1} + \delta_2 \Delta pop_{t-1} + \delta_3 \Delta age_{t-1} + \\ &\quad \delta_4 \Delta gdp_{t-1} + \delta_5 ECT_{t-1} + u_{3t} \\ \Delta gdp_t &= \tau_0 + \tau_1 \Delta Savings_{t-1} + \tau_2 \Delta pop_{t-1} + \tau_3 \Delta age_{t-1} + \\ &\quad \tau_4 \Delta gdp_{t-1} + \tau_5 ECT_{t-1} + u_{4t} \end{aligned}$$

Where  $ECT_{t-1}$  is the lagged error correction term, which is derived from the long run cointegration relationship between these variables.

$$ECT_{t-1} = Saving_{(-1)} - \Omega_1(pop_{(-1)}) - \Omega_2(age_{(-1)}) - \Omega_3(gdp_{(-1)}) \quad (4)$$

In the above  $ECT_{t-1}$  model, the coefficient ( $\Omega$ ) estimates the long run effects of any independent variables representing demographic changes and economic growth on domestic savings as the independent variable increases a unit or one percent. Besides, all coefficients in the overall VECM measure the short run impact of any independent variables on domestic savings as this variable increases a unit. In other words, the VECM is considered as an alternative way to determine the strength obtained from long run relationship. Indeed, the VECM helps correct any disequilibrium in the short run by estimating the speed of adjustment at which the dependent variable will return to the equilibrium as a response to a change in the independent variables. Specifically, if the coefficient of ECT, which is known as the coefficient of speed of adjustment between the short run dynamics and the long run relationship, is negative, it indicates that an adjustment mechanism exists in the short run. By contrast, the positive coefficient of ECT indicates that any disequilibrium in the variable continues to grow, but it also expresses incomplete specifications in the model (Banerjee et al. 2011).

## EMPIRICAL RESULTS

### UNIT ROOT TEST

This study employs the ADF statistics to investigate the stationarity in variables by testing unit root. The meaning of the ADF statistics is that if the data of corresponding variable have unit roots, the variable is thus not stationary and vice versa.

The ADF tests statistic value of each of the variables, in absolute value. If this is smaller than its corresponding critical value at level form, we cannot reject the presence of unit root for all the variables at their level form. In other words, all the variables are not stationary at their

TABLE 1. The results of the Augmented Dickey-Fuller unit root test

Variables	ADF value in level form	Critical value	ADF value in first difference	Critical value	Level of integration
Savings	-2.310311	-3.574244	-5.300989	-3.595026*	I(1)*
pop	-1.008382	-3.574244	-6.342953	-3.595026*	I(1)*
age	-2.889392	-3.580623	-2.860897	-2.635542**	I(1)**
gdp	-2.909134	-3.574244	-4.961397	-3.580623*	I(1)*

Source: The results are calculated by using EViews 8.

Note: \* and \*\* denote the rejection of the null hypothesis of unit root at the 5% and the 1% significance levels, respectively. The corresponding critical values for the ADF unit root test is collected from MacKinnon (1996) one-sided values.

level form. However, when checking the stationarity in first difference for the data series at the 5% and 1% significance levels, and the null hypothesis of non-stationarity is rejected, it is thus indicative that in the first difference level, the time series is stationary. Overall, the series are non-stationary at their level form, but become stationary in first difference. This means that all the variables are integrated in the same order of one (I(1)) at the 1% significance level, implying that the Johansen cointegration approach can be applied in the following part.

COINTEGRATION TEST

The first important step in the Johansen cointegration test is to determine the optimal lag length since it is necessary to formulate the appropriate error term and produce valid estimation. A wrong choice may lead to inconsistent estimates of a VAR model. Due to a small data sample, we could only estimate an unrestricted VAR model with all variables from lag 1 to lag 4 in order to select the optimal length based on minimized values of both Akaike information criterion (AIC) and Schwarz criterion (SC). If we have contradicting results of AIC and SC, we will use SC in determining the optimal lag length because this criterion penalizes more and will provide the correct model with few lags as compared to one with many lags that the AIC would offer (Gutierrez et al. 2007).

Table 2 indicates that the optimal lag length for unrestricted VAR model is four, as determined by both the minimized values of AIC and SC criteria. In the next step, the Trace and Maximum Eigenvalue statistics are conducted with an intercept and with no trend model at the 5% significance level, to determine the number of cointegrating vectors.

TABLE 2. AIC and SC for the optimal lag length in the unrestricted VAR model

Lag Length	1	2	3	4
Akaike AIC	8.010236	5.460528	5.638371	2.185475
Schwarz SC	8.953199	7.173362	8.134057	5.475882

Source: The results are calculated by using EViews 8.

If the computed value of the test statistic is greater than its corresponding critical value, with the null hypothesis of at most r cointegrating vectors are rejected. The results in Table 3 shows that the computed values of both Trace and Maximum Eigenvalue tests are greater than their critical values at the 5% significance level when the hypothesized number of cointegration equation(s) equal to none, at most 1 and at most 2. However, we cannot reject the null hypothesis of at most 3 cointegration

TABLE 3. The results of the Trace and Maximum Eigen Value Tests

Hypothesized No. of CE(s)	Trace statistic	5% critical value	Max-Eigen statistic	5% critical value
None	171.2213*	47.85613	108.0159*	27.58434
At most 1	63.20547*	29.79707	35.93444*	21.13162
At most 2	27.27103*	15.49471	20.48461*	14.26460
At most 3	6.786414	8.841466	6.786414	8.841466

Source: The results are calculated by using EViews 8.

Notes: \* denotes rejection of the null hypothesis of Trace test and Maximum Eigenvalue test at the 5% significance level

vectors because the computed values of Trace and Maximum Eigenvalue tests at  $r = 3$  are 6.786 and 6.786 which are less than its critical value (8.841) at the 5% significance level. This also confirms the existence of three cointegration vectors among these I(1) variables. In this case, the spurious and inconsistent regression problems, which usually occurred with the regression of non-stationary data series, can be avoided. Indeed, the existence of cointegrating relationships among the four I(1) variables confirm that the VECM can be applied to disaggregate the short run and long run relationships between demographic changes, economic growth and domestic savings in Vietnam.

VECTOR ERROR CORRECTION MODEL (VECM)

The long run relationship (the cointegration vectors)

Since the Johansen cointegration test results indicated that the cointegration vectors exist among the stationary variables (I(1)), we thus estimate the long run regression model. The first normalized equation below provides the long run linkage between the dependent variable (domestic savings, *savings*) and three explanatory variables (population growth (*pop*), the age dependency ratio (*age*) and economic growth (*gdp*)).

The first normalized equation given in Table 4 can be rewritten in the regression model as follows:

$$Savings = 51.52*pop - 0.73*age + 0.30*gdp - 52.29$$

The value and sign of the coefficients show how the explanatory variables affect the dependent variable (whether significant or insignificant, positive or negative effect). The common rule regarding the degree of significance of relationship is that when the value of coefficient of the variable is double than its standard error value, the relationship is significant. Hence, the results in Table 4 indicate one significant positive long run association of population growth (*pop*) with domestic savings (*savings*); one positive, but insignificant association of GDP per capita growth rate (*gdp*) with domestic savings; and one significant

TABLE 4. The first normalized equation

Variable	Coefficient	Standard error	t-statistic
Constant	52.28825	-	-
Savings	1.000000	-	-
pop	51.52359	2.00808	25.6581
age	-0.725689	0.06532	-11.1094
gdp	0.303582	0.20834	1.45714

Source: The results are calculated by using EViews 8.

negative relationship between age dependency ratio (age) and domestic savings in Vietnam. Additionally, the highest positive coefficient for pop of 51.52 signifies a strong positive effect of population growth on domestic savings in Vietnam, whereby a 1% increase in population growth rate will lead to a significant increase in domestic savings by 51.52%. The high coefficient of population growth can be explained in that this study was conducted with the inclusion of control variables and as compared to other considerate variables, the population size of Vietnam has increased dramatically under her remarkable growth rate during the period 1986-2016. The significant population growth coefficient, with its expected sign, also implies that population growth is a determinant of domestic savings in Vietnam. Furthermore, the significant positive linkage between population growth and domestic savings confirms the underlying motivation for precautionary savings among the Vietnamese. As consistent with the role of “family relationship” in most Asian cultures, adult Vietnamese tend to save more for the bequest of their young

generations mainly as buffer against risks faced in life. As the population grows, the Vietnamese will save more for their young, thus leading to a significant increase in both household and domestic savings.

GDP per capita growth rate (gdp) has correspondingly a positive effect on domestic savings. A 1% increase in GDP per capita growth in the long run, for example, will cause a rise in domestic savings by 0.3%. By contrast, the coefficient of age dependency ratio (age) is negative (-0.73), meaning that in the long run the effect of age dependency ratio on domestic savings is negative and modest. This finding is consistent with the Life Cycle Hypothesis of Modigliani (1970) whose simplified model expressly indicated that the coefficient of age dependency ratio will be negative. This was due to the tendency by the elderly to consume relatively more than their reduced retirement income. As such, the higher their consumption rate is the less would be their personal savings. Conversely for the minors (those aged below 15) who do not have income and are dependents, their consumption depends entirely on the income of the working age adults in the household. As such, a high consumption rate by them will also reduce household savings. In general, the higher the age dependency ratio is, the lower the household savings, and a subsequently lower domestic savings.

*Short Run Analysis* The VEMC not only identify the cointegration (long run) relationship, it also helps to detect the short run dynamics between these variables. It also indicates whether the latter dynamics are affected by the estimated long run relationship. Table 5 below presents results of the dynamic error-correction model.

TABLE 5. The results of the short run VECM

	Coefficient	Std. Error	t-Statistic	Prob.
ECT	-0.200943	0.243224	-0.826164	0.0128
D(Savings(-1))	-0.295266	0.275776	-1.070671	0.3291
D(Savings(-2))	-0.309566	0.261572	-1.183484	0.5742
D(Savings(-3))	-0.505783	0.276443	-1.829611	0.7583
D(pop(-1))	-6.121190	9.111305	-0.671824	0.0479
D(pop(-2))	3.659294	9.543100	0.383449	0.0530
D(pop(-3))	-2.975161	11.04656	-0.269329	0.0417
D(age(-1))	-4.320596	3.788733	-1.140380	0.0391
D(age(-2))	5.119261	6.314452	0.810721	0.0659
D(age(-3))	1.398589	4.190853	0.333724	0.0632
D(gdp(-1))	0.169142	0.827099	0.204500	0.0414
D(gdp(-2))	-0.027378	0.705761	-0.038792	0.0697
D(gdp(-3))	0.105848	0.720661	0.146877	0.0857
Constant (C)	4.997373	2.821420	1.771226	
R-squared	0.474313		Adjusted R-squared	0.139862
F-statistic	1.469744		Durbin-Watson stat	2.031877

Source: The results are calculated by using EViews 8.0

Based on the above results of VECM estimates, the domestic savings equation is rewrite as follows:

$$\begin{aligned}
 D(\text{Savings}) = & -0.20*[Savings(-1) - 51.52*pop(-1) \\
 & + 0.73*age(-1) - 0.30*gdp(-1) + 52.29] \\
 & + C(2)*D(\text{Savings}(-1)) + C(3)*D(\text{Savings}(-2)) \\
 & + C(4)*D(\text{Savings}(-3)) + C(5)*D(pop(-1)) \\
 & + C(6)*D(pop(-2)) + C(7)*D(pop(-3)) + \\
 & C(8)*D(age(-1)) + C(9)*D(age(-2)) \\
 & + C(10)*D(age(-3)) + C(11)*D(gdp(-1)) \\
 & + C(12)*D(gdp(-2)) + C(13)*D(gdp(-3)) + 4.99 + \epsilon_t
 \end{aligned}$$

Where:

$$\begin{aligned}
 ECT = & Savings(-1) - 51.52*pop(-1) + 0.73*age(-1) \\
 & - 0.30*gdp(-1) + 52.29
 \end{aligned}$$

The ECT in a VECM presents the speed and the tendency of adjustment at which the dependent variable adjusts to changes in the independent variables in moving towards the long run equilibrium. The coefficient value of ECT in the study is negative (-0.201) and significant because its p-value is 0.013 which is less than the 0.05 significance level, which implies that the annual speed of adjustment of domestic savings from its disequilibrium is about 20.1% per year.

The lagged coefficients of explanatory variables capture the short term influences on the dependent variable ( $D(\text{savings})$ ). The results in Table 5 indicate the short run negative coefficient values of three lagged explanatory variables of population growth  $D(\text{pop})$ , the age dependency ratio  $D(\text{age})$  and GDP per capita growth  $D(\text{gdp})$ . They have different estimated values and signs, indicating that population growth, the age dependency ratio and GDP per capita growth have significant short run impacts on and can explain the changes in domestic savings. The first and third lags of population growth ( $D(\text{pop}(-1))$  and  $D(\text{pop}(-3))$ ) have statistically significant and negative short run effects on domestic savings with the coefficient values of -6.12 and -2.97 respectively at the 5% significance level. This suggests that in the short term, a 1% increase in population growth causes a decline in domestic savings in Vietnam by 6.12% and 2.98%, respectively. Similarly, domestic savings respond to changes in the age dependency ratio in the short run in Vietnam. The first lag of dependency ratio ( $D(\text{age}(-1))$ ) negatively affects domestic savings with the coefficient value of -4.32. A 1% increase in the age dependency ratio leads to a decrease in domestic savings by 4.32% in the short run. By contrast, the first lag of GDP per capita growth ( $D(\text{gdp}(-1))$ ) has a positive short run effect on domestic savings in the country whereby a 1% increase in GDP per capita growth brings a higher domestic savings rate by 0.17% in the following year.

The statistical values of F statistic and R squared identify the overall significance of the model. Specifically, R-squared of 0.4743 means that 47.43% of variation in domestic savings in Vietnam can be explained by variation

in three explanatory variables: population growth, age dependency ratio and GDP per capita growth. The estimated F-statistic of 1.4697 at  $p = 0.0128$  suggests that the variables can jointly explain the changes in domestic savings. Furthermore, the Durbin-Watson value clearly indicates that there is no serial correlation in the model. The study has 31 observations (from 1986 to 2016) and  $k = 3$  (number of explanatory variables), thus the lower level and the upper level for Durbin-Watson d-statistic is 1.21 and 1.65, respectively. The Durbin-Watson value is 2.03 greater than the upper level, meaning that there is no auto-correlation in this VECM model.

*Wald Test For Testing The Short Run Causality* In order to confirm the short run relationship between domestic savings and the explanatory variables involved in the VECM, Wald test is then applied to examine the short run causality from explanatory variable to domestic savings. Firstly, we test whether or not domestic savings (savings) and population growth (pop) have the short run causality. The Null hypothesis is  $C(5) = C(6) = C(7) = 0$ , meaning that there is no short run causality running from population growth to domestic savings. Secondly, we test whether or not domestic savings (savings) and the age dependency ratio (age) have the short run causality. The Null hypothesis is  $C(8) = C(9) = C(10) = 0$ . Lastly, we test whether or not domestic savings (savings) and GDP per capita growth (gdp) have the short run causality. The Null hypothesis is  $C(11) = C(12) = C(13) = 0$ .

TABLE 6. Wald Test

	Test Statistic	Value	df	Prob.
$C(5) = C(6) = C(7) = 0$	Chi-square	0.595532	3	0.0350
$C(8) = C(9) = C(10) = 0$	Chi-square	2.971056	3	0.3961
$C(11) = C(12) = C(13) = 0$	Chi-square	0.055656	3	0.9966

Source: The results are calculated by using Eviews 8.

Since the p-value of population growth (pop) is less than 5%, we can reject the null hypothesis, meaning that  $C(5)$ ,  $C(6)$ ,  $C(7)$  are zero. This means that there is the short run causality running from population growth to domestic savings in Vietnam. However, I could not find the short run causality running from the two remaining explanatory variables to domestic savings. This is most probably due to the small sample size and to the fact that only annual observations are available. The Wald test results are consistent with the VECM results vis-à-vis the significant short run relationship between population growth and domestic savings.

## CONCLUSION AND POLICY RECOMMENDATIONS

The main objective of this study is to examine the short run and long run relationships between demographic changes (population growth and the age dependency ratio), economic growth (GDP per capita growth rate) and domestic savings in Vietnam. The cointegration techniques were applied using the annual time series data in Vietnam from 1986 to 2016. The main finding is that there exists a significant long run linkage between population growth, the age dependency ratio, GDP per capita growth, and domestic savings in the country. Specifically, in the long run, population growth and GDP per capita growth have significant positive impacts, while the age dependency ratio has a negative influence on domestic savings. In addition, population growth is a determinant contributing to the growth of domestic savings. Besides, with regards to the short run relationship, the VECM results indicate the significant short run influences of the lags of population growth, the age dependency ratio and GDP per capita growth on domestic savings with different estimated values and signs. These results also confirm that all three explanatory variables can explain the changes in domestic savings in Vietnam. Unlike the VECM dynamic findings, the Wald test found a single trend in unidirectional causality which specifically runs from population growth to domestic savings.

The important contribution of this study is in the policy implications which aspire to drive the level of domestic savings in Vietnam. The government can rely on the indicators: population growth, the dependency ratio and GDP per capita growth to affect the level of domestic savings. Specifically, the Vietnam government should firstly, concentrate on boosting economic growth (GDP per capita growth) to generate a higher rate of domestic savings. In the long run, the government should mobilize its resources, for instance, in opening opportunities of production or investment for the institutions in the market through liberalizing the rules in order stimulate economic growth. This would lead to increased GDP per capita (per capita income) and elevate domestic savings.

The age dependency ratio has a significant negative effect on domestic savings in Vietnam in the long run. The population structure of the country has changed over the previous decades with a significant increase in the elderly population and a still high children dependency ratio. The government should therefore take advantage of the “golden population structure”, control the fertility rate and limit the impact of elderly dependency ratio through offering attractively beneficial programs for the aged. They should be provided opportunities to increase their productivity and thus contribute to economic growth as consistent with the increasing income per capita. With increased income, the individual citizen will be empowered to

higher saving, thus contribute to rising personal and domestic savings.

Population growth has a significant positive effect on domestic savings. Recognizing this, the Vietnam government should formulate a population policy that not only control the growth of population, but also manage rising population ageing so as to create harmonious development between ageing and economic growth. The current huge population in Vietnam inflicts a heavy burden to economic development but at the same time this apparent setback presents an opportunity for a “gold labor market” that can potentially boost her economic growth.

Accordingly, the Vietnam government has to carefully implement the existing population policy and control population growth in relation to economic growth that can be further elevated to subsequently increase domestic savings. This is especially so when the national income is presently low due to high population growth and savings rate greatly depressed. Under the current situation where urban fertility rate in the country is rapidly declining as opposed to rising rural fertility, an appropriate population control policy should thus encourage urban couples to be limited to two children and rural fertility rate simultaneously reduced. Such policy should effectively manage population growth, sustain fertility rate to realistic level, and hence decelerate population ageing and its consequent dependency rate in order to boost economic growth.

## ACKNOWLEDGEMENT

The authors specially thanks to Professor Kőrösi Gábor in Faculty of Business and Economics, University of Pécs for his helpful comments.

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