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AGE DISTRIBUTION AND THE HOUSEHOLD SAVING RATE: EVIDENCE FROM EU COUNTRIES

Bachelor's thesis
Programme Applied Economics, specialisation Economic Analysis

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Tallinn 2020

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The document length is 8239 words from the introduction to the end of the conclusion.

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ABSTRACT

Understanding the nature of household saving behavior and factors that impact it is crucial in designing policies and forecasting economic growth. The main basis of this thesis is the life-cycle hypothesis of Franco Modigliani and Alberto Ando and the permanent income hypothesis of Milton Friedman. This thesis examines the impact of the age structure of the population represented by the young and old dependency ratios on the household saving rate. The thesis also aims to examine the impact of other additional variables on the household saving rate such as employment in agriculture, the annual growth rate of GDP per capita, unemployment rate, inflation of consumer prices, the annual growth rate of the urban population, and life expectancy at birth. The results of the performed analysis indicate a negative impact of the young dependency ratio on the household saving rate in 21 countries of the European Union and the United Kingdom over 2000-2018. An impact of the old dependency ratio on the household saving rate is ambiguous.

Keywords: Life-cycle hypothesis, permanent income hypothesis, household saving, the young dependency ratio, the old dependency ratio

INTRODUCTION

Understanding the nature of household saving behavior is crucial in designing policies and forecasting economic growth. The age structure of the population is among the most important determinants of saving behavior (Loayza *et al.* 2000).

Two main theories, which link saving and consumption behavior with age are the life-cycle hypothesis (LCH) of Franco Modigliani and Alberto Ando (1963) and the permanent income hypothesis (PIH) of Milton Friedman (1957).

The life-cycle hypothesis (Ando & Modigliani 1963) postulates that the saving and the lifetime consumption of individuals are associated with their lifetime income. The permanent income hypothesis (Friedman 1957) suggests that households' consumption will respond to changes in permanent income but will be nearly irresponsive to transitory income shocks. The LHC and the PIH played a central role in theoretical and empirical work about saving and consumption since they were elaborated, however many recent empirical studies fail to support these theories.

This thesis examines the impact of the age structure of the population represented by the young and old dependency ratios on the household saving in 21 countries of the European Union and the United Kingdom over 2000-2018. The focus of the thesis is on the household saving rate. The household saving is defined as the disposable income of a household less household spending. This is the most common approach because of its simplicity and availability of data.

This thesis also aims to examine the impact of other explanatory variables on the household saving rate such as employment in agriculture, the annual growth rate of GDP per capita, unemployment rate, inflation of consumer prices, the annual growth rate of the urban population, and life expectancy at birth.

The main research questions are:

- How does the age structure of the population impact the household saving rate?

- Which variables have the most significant impact on the household saving rate?

The main hypotheses of the thesis are:

- An increase in the younger population has a negative impact on the household saving rate.
- An increase in the older population has a negative impact on the household saving rate.

Two fixed-effect models are used in this thesis. The first is the baseline model and the second one is estimated with years 2007-2009 removed from the original dataset to eliminate the effects of the financial crisis of 2008.

The results show that the young-age dependency ratio has a negative impact on the household saving rate. According to the estimates of the baseline model, an increase in the young dependency ratio by 1 percentage point results in a decline of the household saving rate by 1.178 percentage points. According to the baseline model, the impact of the old dependency ratio remains unclear due to the high standard error. The estimated coefficient of the old dependency ratio is 0.172 and the standard error is 0.495. The variable is not statistically significant.

The thesis consists of an abstract, introduction, four main sections, and a conclusion. In the first section, I review previous research papers on age as a determinant of household saving. The second section handles other determinants of household saving. In the third section, I review data and the methodology and in the fourth section, I perform the analysis and review the empirical results.

1. AGE AS A DETERMINANT OF HOUSEHOLD SAVING

This section discusses age and the age distribution of the population as determinants of household saving. This section also discusses previous empirical researches on the life-cycle hypothesis of Franco Modigliani and Alberto Ando (1963) as well as the permanent income hypothesis of Milton Friedman (1957).

There are two main hypotheses regarding age impact on households' saving and consumption behavior: the life-cycle hypothesis of Franco Modigliani and Alberto Ando (1963) and the permanent income hypothesis of Milton Friedman (1957).

The life-cycle hypothesis (LCH) of Franco Modigliani and Alberto Ando (1963) says that the savings and the lifetime consumption of individuals are associated with their lifetime income. In terms of individual savings, the increased dependent population will have a negative impact on the household saving, while an increase in the active working population will affect household saving positively (Ando & Modigliani 1963; Doker *et al.* 2016). Three main conclusions can be made from the hypothesis: national savings behavior is linked with the growth rate of the economy, pension plan and the level of wealth in the economy are the determinants of national savings and the demographic structure of the population is another important factor that determines the national economy (Doker *et al.* 2016).

According to the permanent income hypothesis (PIH), household consumption is responsive to a one-to-one basis to permanent income shocks but is nearly irresponsive to transitory income shocks. Households save the transitory component of the income and consume entirely the permanent one (Friedman 1957; Pistaferri 2001). Ozcan et al. (2003) explain that households, who seek to smooth out consumption over their lifetime, save when they expect future income to be low and dissave when they anticipate it to be high.

The life-cycle hypothesis has played a central role in theoretical and empirical work about consumption since it was proposed, however many recent empirical studies fail to support this

hypothesis (Hurd 1987). White (1978) employed simulation analysis in his paper to test the life-cycle hypothesis. The results demonstrate that the model is lacking as an explanation of aggregate household saving in the United States. White (1978) concludes that saving for future consumption does not account for the totality of observed aggregate personal saving. For a wide range of parametric values, the simulated values of aggregate saving fall significantly short of the observed levels. In the research paper of Horioka and Wan (2007) on Chinese data, age structure related variables have the expected impact on the household saving rate in one out of four samples. These results provide mixed support for the life-cycle hypothesis as well as and the permanent income hypothesis.

Niculescu-Aron and Mihăescu (2012) suggest that the financial behavior of the youth and the elderly differs from the financial behavior of the mature population. The young individuals who did not reach employment age yet diminish the savings rate, because their parents spend a big part of their incomes to support their children's needs. Similarly, the increase in the average life span promotes the increase of the saving rate during the active life with the view to maintaining the level of consumption during the active life. Therefore, the increase in the proportion of the older population is equivalent to diminishing the population savings, since this group of individuals is dissaving or is saving at a very reduced pace. Lindh (1999) suggests that young cohorts (15–29) should borrow, prime (30–49), and middle-aged (50–64) save and amortize, while the elderly (65+) spend savings.

Niculescu-Aron and Mihăescu (2012) emphasize the importance of the life expectancy and demographic aging process as determinants of household savings because people are aware that they will live longer and, thus, they adapt their saving behavior according to this perception.

Previous researches demonstrate that the age distribution of the population has pervasive effects on the economy. Lindh (1999) has demonstrated in his research on OECD data that age effects on saving do not arise through a direct life cycle mechanism but that changes are rather cumulative and reinforced with a delay by growth mechanisms. Lindh (1999) indicates some difficulties in estimating age structure models. First, changes in the age distribution are comparatively slow-moving and difficult to discriminate from other potential trends in the data. Second, different age groups correlate both within and between countries leading to multicollinearity.

Economists debate regarding the relationship between the age structure of the population and household savings. Yasin (2008) points out that research based on microeconomic data fails to detect a robust link between the age structure of the population and national saving, while macroeconomic studies support a stronger connection between the two variables.

Yasin (2008) demonstrates a positive relationship between the share of the working population and the national saving rate in 13 out of 14 emerging markets in the Middle East and North African region. These findings agree with the implication of the life cycle hypothesis that the national saving rate rises with a larger percentage of the working population. Also, the empirical results of Yasin (2008) support a negative relationship between the share of children in the population and household savings. Yasin (2008) suggests that prospective demographic structures contain valuable information for predicting future trends in national saving.

According to Loayza *et al.* (2000), the young and old dependency ratios have a significant negative impact on the household saving rate. The old-age dependency ratio is the ratio of the number of elderly individuals at an age when they are generally economically inactive (i.e. aged 65 and over), compared to the number of individuals of working age (i.e. 15-64 years old). On the other hand, the young-age dependency ratio is the ratio of the number of young individuals at an age when they are generally economically inactive, (i.e. under 15 years of age), compared to the number of individuals of working age (i.e. 15-64). Jongwanich (2010) demonstrates in the empirical research on Thailand data that a 1% increase in young dependency leads to a reduction in household savings of 0.53% in the short-run and 0.88% in the long-run. A 1% increase in the old dependency ratio results in a long-run reduction in household savings of 3.30%.

Empirical results of Hondroyiannis (2004) demonstrate that in societies with a high proportion of the population in the working-age exists a high rate of household saving as individuals save for their retirement. Yasin (2008) also mentions that according to the LCH the working part of the population saves for retirement and thus their saving rates tend to be higher. On the other hand, the very young and the elderly save very little due to their low or falling income, respectively. Therefore, household saving rises with a higher percentage of the working population and falls with a higher percentage of the youth and elderly. However, the empirical results of Yasin (2008) do not support such a contention.

2. OTHER DETERMINANTS OF HOUSEHOLD SAVING

This section discusses the main determents of household saving, both economical and demographical. Numerous theoretical and empirical researches on savings have outlined the main determinants of household saving. These factors can be grouped under the headings of government policy variables, financial variables, income and growth variables, demographic variables, uncertainty measures, and external variables (Ozcan *et al.* 2003).

2.1. Income and income growth

The effect of income and its growth on household saving has been well studied in previous theoretical as well as empirical researches. When these two variables increase, household saving also tends to increase. Results of empirical research on the determinants of household saving behavior in Turkey reveals a statistically significant connection between income and household saving (Ozcan *et al.* 2003). The analyzed regression indicates that a 1% increase in per capita real gross household disposable income (GPDI) will have a 5 to 6% increase in the household saving rate. However, income growth was not proved to be statistically significant, which means that this variable does not affect the household saving rates in the case of Turkey (Ozcan *et al*. 2003).

Although income growth was not statistically significant in the model on Turkey's data analyzed by Ozcan *et al.* (2003), income growth was statistically significant in some OECD countries. Empirical research performed by Sarantis and Stewart (2001) on OECD countries indicates a positive impact of income growth rate in 12 OECD countries.

Per capita income, as well as income growth, proved to be important determinants of the household saving rate in a developing economy such as India. Athukorala and Sen (2004) showed in the results of their research on determinants of household saving in India that per capita income and income growth are positively associated with saving rates. An increase in the income growth rate by one percentage point leads to a long-run increase in the household saving rate by 0.15 percentage points and a 1% increase in per capita income brings about a 0.09 percentage point

increase in the household saving rate. The results support the argument that, for countries in the initial stages of development such as India, the level of income is an important determinant of the capacity to save.

Loayza *et al.* (2000) demonstrate that both the level and the growth rate of real per capita household disposable income have a positive and significant effect on the household saving rate. The results show that an increase in income by 10% raises the household saving rate by 0.47 percentage points. The estimated growth coefficient indicates that an increase in the income growth rate by one percentage point leads to a household saving rate increase of 0.45 percentage points in the short run.

2.2. Financial variables

Another set of factors that determines household saving can be grouped under a category of financial variables. According to Ozcan *et al.* (2003), these determinants are expected to be especially relevant for developing countries.

One of the most important factors for economics is the real interest rate, however previous empirical and theoretical researches showed ambiguous results regarding this variable. An increase in the real interest rates reduces the present value of future income flows and due to income effect has a negative impact on savings, but at the same time, it increases the net return on savings and makes savings more attractive today (Matur *et al.* 2012).

Hondroyiannis (2004) also mentions in his research paper that the effect of interest rates on household saving is ambiguous due to the wealth, intertemporal substitution effects, and user cost of durable goods. However, his results on Greek data demonstrate a statistically significant positive effect on the household saving rate. The result suggests that an increase of real interest rate by one percentage point leads to a household saving rate increase of 0.003 percentage points. On the other hand, De Serres and Pelgrin (2003) demonstrated a negative effect of the real interest rate on household saving in OECD countries.

Balassa (1993) and Ogaki *et al.* (1995) show a positive impact of an increase in the real interest rate on household saving for developing countries. However, the results of the empirical research

performed by Loayza *et al.* (2000) indicated a negative impact on the household saving rate, suggesting that its income effect outweighs the sum of its substitution and human-wealth effects. Loayza *et al.* (2000) determined that an increase of one percentage point in the real interest rate produces a short-term decline of 0.25 percentage points in the household saving rate.

Financial market development also referred as "financial depth" of an economy is considered as a determinant of the household saving. Financial depth is determined by M_2/GNP ratio, where M_2 represents money plus quasi-money (Ozcan *et al.* 2003). Some empirical research papers have found a statistically significant connection between financial depth and economic growth, through which financial depth has an indirect positive impact on household saving (Odhiambo 2008). But other research papers did not prove any statistically significant impact of financial depth on the household saving rate (Loayza *et al.* 2000).

The third variable is financial liberalization or the borrowing constraint. Ozcan *et al.* (2003) suggest if the borrowing constraint is tight, households would rather save money for real estate, cars, and other goods than borrow money. That would produce a positive impact on household saving. According to Ozcan *et al.* (2003), there is another channel through which financial liberalization may affect the household saving, which is the impact of the more efficient financial system on economic growth. This connection can be considered as indirect, rather than the one described previously. Findings of other researchers like Loayza *et al.* (2000) do not indicate any positive, direct effect of financial liberalization on the household saving rates.

2.3. Uncertainty variables

Ozcan *et al.* (2003) describe uncertainty variables as variables that capture the effects of uncertainty about the future bear on saving rates primarily via their impact on precautionary savings. Ozcan *et al*. label these variables as macroeconomic stability and political stability.

Ozcan *et al.* (2003) and Loayza *et al.* (2000) suggest that macroeconomic uncertainty could be proxied by the inflation rate. Both researchers report a statistically significant positive impact of the inflation rate on household saving, as households in case of high inflation would try to hedge risk by saving a larger fraction of their income. Hondroyiannis (2004) in the research on Greek data demonstrate that an increase in inflation rate by 1 percentage point leads to a household saving

rate increase by 0.79 percentage points. Political instability is expected to act similarly to macroeconomic instability and produce a positive impact on household saving (Ozcan *et al.* 2003).

Bande and Riveiro (2013) in their research on Spanish regional data suggest the unemployment rate as a measure of uncertainty. The econometric results of their research demonstrated a highly significant connection between the unemployment rate and household saving. An increase in the unemployment rate increases households' uncertainty about future income which makes them save more. Bande and Riveiro (2013) also state that due to increased uncertainty consumption of savings is postponed. Increased savings today will not cause increased consumption in the future and will not trigger investment and the creation of employment through an increased demand (Bande & Riveiro 2013b). This condition can further increase unemployment and uncertainty which leads to increased savings.

Chamon *et al.* (2013) in the research on Chinese data demonstrated that uncertainty affects the savings of both younger and older groups of individuals. The results show that the increase in saving rates is particularly pronounced for households with young household heads (those in their twenties and early thirties) and older household heads (aged in the mid-fifties and up). According to Chamon *et al.* (2013), the younger group is mostly affected by the uncertainty about future income, and the key determinant for the older group are changes in pension policies.

2.4. Government policies

Government policies are another determinant of household saving. Government policies may directly affect the incomes of households as well as their level of uncertainty, which determines households' saving behavior. Fiscal policy has been demonstrated to impact household savings. According to Loayza *et al.* (2000), a rise in public savings leads to a decrease in household saving. The private sector reduces its saving rate by 0.29 percentage points for each percentage point increase in the public saving rate within the same year the policy change occurs. Over the long term, the offset coefficient rises to 0.69.

2.5. Demographic variables

Demographic factors can affect the saving behavior of consumers. Traditionally saving models that account for demographic variables focus on the fact that individuals at different ages save at different rates. So aggregate savings are affected mostly through changes in the age structure of the population (Bloom *et al.* 2007).

Bloom *et al.* (2007) suggest considering another fundamental variable that may affect the behavior of the household saving: the length of life. Bloom *et al.* (2007) suggest that life expectancy determines household savings in conjunction with the countries' social security system. As it is shown theoretically, with no social security and perfect capital markets, the optimal response to a prolonged life expectancy is lengthened working life, with no (or possibly a negative) effect on savings rates. However, in countries where social security provisions create strong incentives to retire, the retirement age may be fixed, so that longer life spans lead to longer periods of retirement and greater pre-retirement savings. Empirical results of Bloom *et al.* (2007) show that higher life expectancy does not increase savings rates in the absence of universal coverage and retirement incentives. However, a longer life expectancy is associated with higher savings rates in countries with universal coverage and retirement incentives, but this effect disappears in systems with pay-as-you-go pension finance and high replacement rates. A replacement rate refers to the percentage of an individual's annual employment income that is replaced by retirement income when they retire. In pension systems where workers get substantially different payouts due to their differing incomes, the replacement rate can be used to determine the effectiveness of the pension system.

According to Bloom *et al.* (2003), improvements in health and longevity have a large impact on life-cycle behavior as individuals look forward to living longer. Increases in longevity alone tend to increase the relative length of retirement, therefore raises the need for retirement income and generating higher savings rates among the young. Improvements in health lead to a more ambiguous effect on saving because they can give rise to longer working lives and postponed retirement. Empirical results of Bloom *et al.* (2003) demonstrate that increased life expectancy positively affects the household saving rate.

Urbanization ratio may be considered as another demographic variable which may affect the household saving. Empirical results of Ozcan *et al.* (2003) and Loayza *et al.* (2000) demonstrate a statistically significant negative impact of the urbanization rate on the household saving rates.

Ozcan *et al.* (2003) explain that increased urbanization reduces the need for precautionary saving, which is high in rural societies which tend to have greater volatility in income.

3. DATA AND METHODOLOGY

3.1. Data description

The paper uses a panel covering 21 EU countries and the United Kingdom over the period 2000–2018. The annual data used is aggregate national-level data. The data about young and old dependency ratios and explanatory variables are obtained from the World Development Indicators published by the World Bank (2019) and the data about the household saving rates are obtained from the OECD Database (2019). The sample covers Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom. Bulgaria, Croatia, Cyprus, Czech Republic, Malta, Romania – are not included in the sample due to lack of data. Selected countries are members of the OECD and the European Union which makes the sample more homogeneous.

The main benefits of analysis of panel data are: it allows for the highlighting of the individual particularities of the countries, increased efficiency and consistency of the econometric estimation because the analysis of panel data brings extra information, reduces multicollinearity between the variables, and increases the degrees of freedom (Baltagi, 2008).

For each country, the variables of interest are the young dependency ratio (% of working-age population), old dependency ratio (% of working-age population), and household saving rate (% of disposable income).

Following the literature, additional control variables are employment in agriculture (% of total employment), GDP per capita growth (annual %), unemployment rate (% of the total labor force), Inflation of consumer prices (annual %), the growth rate of urban population (annual %) and life expectancy at birth (years). Fiscal policy is excluded from the list of control variables due to a lack of consistent data.

The household saving rate is a dependent variable defined as gross household saving divided by gross disposable income. The variable is presented in percentage points. Due to the presence of unit root, the first difference of the household saving rate is used as a dependent variable in the estimated models.

Young and old dependency ratios are the main demographic variables used as determinants of household saving in previous empirical research papers. The old dependency ratio is the ratio of the number of elderly individuals at an age when they are generally economically inactive (aged 65 and over), compared to the number of individuals of working age (15–64 years old). The young dependency ratio is the ratio of the number of young individuals at an age when they are generally economically inactive (under 15 years of age), compared to the number of individuals of working age (15–64 years old). Dependency ratios are commonly used to represent the age structure of the population. Based on previous research papers (Doker et al. 2016; Jongwanich 2010) both dependency ratios are expected to have a negative impact on the household saving rate.

Employment in agriculture is a share of individuals employed in the agricultural sector compared to total employment. The agriculture sector consists of activities in agriculture, hunting, forestry, and fishing (The World Bank 2019). Used data are in percentage points. This variable is expected to positively correlate with the household saving rate as those employed in agriculture tend to have greater volatility in their income, therefore additional savings might be needed.

GDP per capita growth represents the economic growth of the countries. The effect of this variable on the household saving rate is ambiguous. Economic growth is associated with income growth and households could potentially save a greater part of their disposable income. On the other hand, if the target wealth level is already achieved, households can increase their spending and leave the amount of regular saving unchanged, therefore its share from disposable income will decline (Jappelli *et al.* 2008).

The unemployment rate represents labor income uncertainty. This variable has an ambiguous impact on the household saving rate. It may have a positive impact on the household saving rate because households will increase precautionary saving. On the other hand, it may have a negative impact on the household saving rate, because the ability of households to save decreases when unemployment increases.

Annual inflation of consumer prices was chosen as a representation of macroeconomic uncertainty. This variable has an ambiguous impact on household saving. Households can increase their precautionary savings when macroeconomic uncertainty increases. However, if consumer prices rise and households' real income decreases, households may be forced to dissave to maintain their regular lifestyle.

The annual growth rate of the urban population is expected to have a negative impact on household saving. The urban population refers to people living in urban areas as defined by national statistical offices (The World Bank 2019). The growth rate is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects. According to Ozcan *et al.* (2003), urban residents tend to have less volatile income compared to the rural population, thus less precautionary saving is needed.

Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life (The World Bank 2019). This variable is expected to have a positive impact on the household saving rate. As individuals are looking forward to longer lives, thus raises the need for retirement income and generating higher savings rates among the young, because of the relative length of retirement increases (Bloom *et al.* 2003).

Table 3.1. presents summary statistics of used variables. See the correlation matrix of the variables in Appendix 1.

Table 3.1. Summary statistics of used variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
ΔH_Savin	392	-0.024	2.278	-13.840	14.148
ΔAge_Dep_Young	396	-0.112	0.354	-1.237	0.893
ΔAge_Dep_Old	396	0.410	0.300	-0.254	1.317
EmpAgr	418	5.648	4.182	1.026	19.632
GDPpercap_Growth	418	2.058	3.654	-14.269	23.986
Unemp	418	8.835	4.519	1.805	27.466
ΔInfl	396	-0.121	1.846	-11.868	5.455
ΔUrb_Pop_Growth	396	0.006	0.267	-1.703	1.803
ΔLife_Exp	396	0.240	0.304	-0.707	1.620

Source: The World Bank database (2019), OECD database (2019), author's calculations

Levin-Lin-Chu test (Levin *et al.* 2002) is used to test unit root in the panel data. The panel framework provides improvements in test power compared to performing a separate unit root test for each individual time series. The use of panel unit root tests proves to be particularly useful in analyzing industry-level and cross-country data (Levin *et al.* 2002). The null hypothesis of the Levin-Lin-Chu test is that each unit in the panel has integrated time series and the alternative hypothesis is that all individual time series are stationary. It is worth mentioning that even if the null hypothesis is rejected, some individual time series may remain non-stationary.

Table 3.2. presents the results of the Levin-Lin-Chu test of a unit root in panel data.

Table 3.2. Results of Levin-Lin-Chu test

Variable	Code	P-value	Conclusion
Household saving rate (% of disposable income)	H_Savin	0.193	Non-stationary
The first difference of Household saving	ΔH_Saving	0.000	Stationary
Age dependency ratio, young	Age_Dep_Young	0.102	Non-stationary
The first difference of Age dependency ratio, young	ΔAge_Dep_Young	0.027	Stationary
Age dependency ratio, old	Age_Dep_Old	1.000	Non-stationary
The first difference of Age dependency ratio, old	ΔAge_Dep_Old	0.000	Stationary
Employment in agriculture	EmpAgr	0.000	Stationary
GDP per capita growth (annual %)	GDPpercap_Growth	0.000	Stationary
Unemployment, total	Unemp	0.000	Stationary
Inflation, consumer prices (annual %)	Infl	0.000	Stationary
Urban population growth (annual %)	Urb_Pop_Growth	0.000	Stationary
Life expectancy at birth (years)	Live_Exp	0.010	Stationary

Source: The World Bank database (2019), OECD database (2019), author's calculations

3.2. The model

Following the approach of Niculescu-Aron and Mihăescu (2012) the model with fixed effects was chosen. The model with fixed effects is recommended in case of the analysis of a specific set of variables for "N" countries in "T" moments of time intervals. In this case N=22 and T=19.

The reduced form saving rate model is:

$$\Delta H\_Saving_{it} = constant_i + \beta_{YD}\Delta Age\_Dep\_Young_{it} + \beta_{OD}\Delta Age\_Dep\_Old_{it} + \beta_X X_{it} + \varepsilon_{it} (1)$$

Where:

- ΔH_Saving_{it} – the first difference of the household saving rate as a share of disposable income;
- $\Delta Age\_Dep\_Young_{it}$ – the first difference of the young dependency ratio;
- $\Delta Age\_Dep\_Old_{it}$ – the first difference of the old dependency ratio;
- X_{it} – a matrix of control variables, which includes employment in agriculture EmpAgr, the annual growth rate of GDP per capita GDPpercap_Growth, the unemployment rate Unemp, the first difference of inflation of consumer prices ΔInfl, the first difference of annual growth rate of urban population ΔUrb_Pop_Growth and first difference of life expectancy at birth ΔLife_Exp.

The coefficients β_{YD} and β_{OD} are to be estimated, β_X is a vector of coefficients of the control variables. ε_{it} is an error term. The subscript *t* refers to the time period and *i* is the country.

4. RESULTS

Table 4.1. presents estimates of the baseline model. The model is a fixed-effects model using 392 observations. The dependent variable is ΔH_Saving.

Table 4.1. Baseline model

	Coefficient	Std. error	P-value	Stat. significance
Constant	2.815	0.623	0.000	***
ΔAge_Dep_Young	-1.178	0.593	0.060	*
ΔAge_Dep_Old	0.172	0.495	0.732	
EmpAgr	-0.285	0.069	0.001	***
GDPpercap_Growth	-0.139	0.079	0.092	*
Unemp	-0.161	0.068	0.028	**
ΔInfl	-0.167	0.109	0.145	
ΔUrb_Pop_Growth	-0.570	0.415	0.184	
ΔLife_Exp	0.713	0.458	0.135	

Source: Author's calculations
Notes: The dependent variable is the first difference of the household saving rate. The period is 2000-2018. ***, **, * indicate levels of statistical significance at 1, 5, and 10 percent respectively.

The p-value of the joint test on named regressors is $1.727 \cdot 10^{-9}$ which indicates that the model is statistically significant. The test for different group intercepts suggests preferring the fixed-effects model over the pooled OLS model (test p-value=0.444). The R-squared of the model is relatively low (R^2=0.139). The Wooldridge test for autocorrelation in panel data (Wooldridge 2010) indicates the absence of first-order autocorrelation (p-value=0.389). Belsley-Kuh-Welsch collinearity diagnostics (Belsley *et al.* 2005) indicates the absence of multicollinearity. The test for normality of residual indicates that residuals are not normally distributed (p-value= $6.061 \cdot 10^{-56}$). According to the results of the distribution-free Wald test, there is heteroscedasticity in the dataset (p-value=0.000), therefore the presented model uses robust standard errors. Pesaran test for cross-sectional dependence (Pesaran 2004) indicates absence of cross-sectional dependence at 5% (p-value=0.096).

Table 4.2. presents estimates of the baseline model using random effects. The model uses 392 observations. The dependent variable is ΔH_Saving.

Table 4.2. Estimated baseline model using random effects

	Coefficient	Std. error	P-value	Stat. significance
Constant	0.831	0.302	0.006	***
ΔAge_Dep_Young	-0.172	0.378	0.649	
ΔAge_Dep_Old	0.040	0.415	0.923	
EmpAgr	-0.029	0.033	0.371	
GDPpercap_Growth	-0.085	0.035	0.016	**
Unemp	-0.093	0.028	0.001	***
ΔInfl	-0.179	0.067	0.007	***
ΔUrb_Pop_Growth	-0.465	0.418	0.267	
ΔLife_Exp	0.932	0.368	0.011	**

Source: Author's calculations
Notes: The dependent variable is the first difference of the household saving rate. The period is 2000-2018. ***, **, * indicate levels of statistical significance at 1, 5, and 10 percent respectively.

The model with random effects is statistically significant, it is indicated by the joint test on named regressors (p-value=$2.612 \cdot 10^{-7}$). However, according to the Hausman test (Hausman 1978), the random-effects model cannot be used (p-value=0.007) and the fixed-effects model should be chosen. Results of the Breusch-Pagan test (Breusch & Pagan 1979) also indicate that the model with random effects is not suitable (p-value=0.837).

As the Great Recession of 2008 had a great negative impact on the economy, table 4.3. presents the baseline model with years 2007–2009 removed from the original dataset.

The model is statistically significant. The p-value of the joint test on named regressors is 0.002. The test for different group intercepts indicates that the fixed-effects model is better than the pooled OLS model (test p-value=0.888). The R-squared of the model is 0.156. The Wooldridge test for autocorrelation in panel data (Wooldridge 2010) indicates the absence of first-order autocorrelation (p-value=0.947). Belsley-Kuh-Welsch collinearity diagnostics (Belsley et al. 2005) indicates the absence of multicollinearity. According to the results of the test for normality of residual residuals are not normally distributed (p-value= $5.785 \cdot 10^{-30}$). The presented model uses robust standard errors because according to the results of the distribution-free Wald test there is heteroscedasticity

in the dataset (p-value=0.000). Pesaran test for cross-sectional dependence (Pesaran 2004) indicates absence of cross-sectional dependence (p-value=0.131).

Table 4.3. A model with removed years of the Great Recession of 2008

	Coefficient	Std. error	P-value	Stat. significance
Constant	1.640	0.712	0.032	***
ΔAge_Dep_Young	-0.513	0.561	0.371	
ΔAge_Dep_Old	0.009	0.379	0.981	
EmpAgr	-0.263	0.078	0.003	***
GDPpercap_Growth	0.010	0.099	0.924	
Unemp	-0.078	0.050	0.137	
ΔInfl	-0.431	0.160	0.014	**
ΔUrb_Pop_Growth	-0.464	0.522	0.385	
ΔLife_Exp	1.074	0.627	0.102	

Source: Author's calculations
Notes: The dependent variable is the first difference of the household saving rate. The period is 2000-2018 (excluding 2007–2009). ***, **, * indicate levels of statistical significance at 1, 5, and 10 percent respectively.

Table 4.4. presents estimates of the model with removed years of the Great recession of 2008 using random effects. The model uses 392 observations. The dependent variable is ΔH_Saving.

Table 4.4. An estimated model with removed years of the Great Recession of 2008 using random effects

	Coefficient	Std. error	P-value	Stat. significance
Constant	0.281	0.307	0.360	
ΔAge_Dep_Young	-0.035	0.290	0.903	
ΔAge_Dep_Old	0.154	0.307	0.615	
EmpAgr	-0.083	0.035	0.016	**
GDPpercap_Growth	0.051	0.043	0.235	
Unemp	-0.050	0.029	0.079	*
ΔInfl	-0.419	0.086	0.000	***
ΔUrb_Pop_Growth	-0.358	0.391	0.360	
ΔLife_Exp	1.163	0.301	0.000	***

Source: Author's calculations
Notes: The dependent variable is the first difference of the household saving rate. The period is 2000-2018 (excluding 2007–2009). ***, **, * indicate levels of statistical significance at 1, 5, and 10 percent respectively.

According to the result of the joint test on named regressors (p-value=$5.301 \cdot 10^{-10}$) the model with random effects is statistically significant. However, according to the Hausman test (Hausman 1978), the preferred model is the model with fixed effects (p-value=0.005). Results of the Breusch-Pagan test (Breusch & Pagan 1979) indicate that the model with random effects is not suitable (p-value=0.791).

In both models with fixed effects, the young-age dependency ratio has a negative impact on the household saving rate, which agrees with literature. But only in the baseline model, this variable is statistically significant at 10 percent. According to the estimate of the baseline model, an increase by 1 percentage point (pp) in the young-age dependency ratio will result in a decrease in the household saving rate by 1.178 pp. The estimates of the model with years of the financial crisis of 2008 removed indicate a decrease of the household saving rate by 0.513 pp if the young-age dependency ratio increases by 1 pp.

Horioka and Wan (2007) got similar results in their research on the Chinese data over 1995-2004. According to the estimates of Horioka and Wan (2007), old and young dependency ratios have positive coefficients in the sample of urban households and the sample of rural households but are not statistically significant. In the sample of all households, both variables have positive coefficients and the young dependency ratio is statistically significant at 5%.

The estimates of both models with fixed effects indicate a positive correlation between the old-age dependency ratio and the household saving rate, however, coefficients in both models are not statistically significant. Also, it is worth pointing out that standard errors of estimated coefficients are very high so that it is not possible to estimate whether the household saving rate will increase or decrease if the old dependency ratio changes. In the baseline model, the estimated coefficient of the first difference of the old dependency ratio is 0.172 and the standard error is 0.495. In the model with years of the Great Recession removed the estimated coefficient of the first difference of the old dependency ratio is 0.009 and the standard error is 0.379. According to both models, it is unclear how the old dependency ratio impacts the household saving rate.

Employment in agriculture is statistically significant at 1 percent in both models with fixed effects. However, its negative correlation contradicts the literature and initial expectation. The baseline model and the model with crisis years removed show that an increase by 1 pp in employment in agriculture will decrease the household saving rate by 0.285 pp and 0.263 pp respectively. One of

the possible explanations for the results can be the technological development of the agricultural sector. New technologies are the key factor for growth in agriculture, which alleviates poverty. Due to the growth of the technology income of agricultural employees increased and became less volatile, therefore less precautionary saving is needed (Coxhead & Warr 1995).

The annual growth rate of GDP per capita is statistically significant only in the baseline model at 10 percent. The variable has a negative impact on the household saving rate, according to the estimates of the baseline model. An increase of 1 pp in the annual growth rate of GDP per capita results in a decrease in the household saving rate by 0.139 pp. However, the estimated impact of the annual growth rate of GDP per capita is unclear in the model with removed years of the Great Recession of 2008 due to high standard errors. The estimated coefficient is 0.010 and the standard error is 0.099.

The unemployment rate is statistically significant in the baseline models at 5 percent. However, its negative impact contradicts the literature (Aron & Muellbauer 2000; Levenko 2020) and initial expectations. According to the estimates of the baseline model, an increase of 1 pp in the unemployment rate will decrease the household saving rate by 0.161 pp. The second model estimates a marginal change in the household saving rate. An increase of 1 pp in the unemployment rate decreases the household saving rate by 0.078 pp.

The inflation of consumer prices is statistically significant at 5 percent only in the model with years of the financial crisis removed. Both models with fixed effects indicate a negative impact which contradicts with the literature (Howard 1978). The baseline model estimates a decrease by 0.167 pp and the model without crisis years estimates a decrease by 0.431 pp in the household saving rate if inflation of consumer prices increases by 1 pp.

The growth rate of the urban population is statistically insignificant in both models with fixed effects. However, its negative impact on the household saving rate agrees with the literature and initial expectations. The baseline model indicates that an increase in the growth rate of the urban population by 1 pp will result in a decrease in the household saving rate by 0.570 pp, but the impact is unclear in the model with removed years of the financial crisis of 2008 due to high standard error. The estimated coefficient is -0.464 and the standard error is 0.522.

Life expectancy at birth has a positive impact on the household saving rate. However, the variable is not statistically significant in the baseline model as well as in the model with removed years of the Great Recession of 2008. According to the estimates of the baseline model, an increase of life expectancy at birth by 1 year results in an increase in the household saving rate by 0.713 pp and according to the model with removed years of the Great Recession of 2008, an increase of life expectancy at birth by 1 year results in an increase in the household saving rate by 1.074 pp.

CONCLUSION

This thesis aims to examine the impact of the age structure of the population on the household saving rate in 21 countries of the European Union and the United Kingdom over 2000–2018 using panel data sourced from the World Development Indicators published by the World Bank (2019) and the OECD Database (2019). Bulgaria, Croatia, Cyprus, Czech Republic, Malta, Romania – are excluded from the sample due to lack of data.

The main basis of this thesis is the life-cycle hypothesis (LCH) of Franco Modigliani and Alberto Ando (1963) and the permanent income hypothesis (PIH) of Milton Friedman (1957). Two models with fixed effects are developed and analyzed: the baseline model and the model with years 2007–2009 removed from the original dataset due to the Great Recession in 2008. According to the performed analysis, the exclusion of years of the Great Recession does not impact estimated results significantly. The models contain the household saving rate as a dependent variable, the main independent variables which represent the age structure of the population are young and old dependency ratios. The models also contain additional variables such as employment in agriculture, the annual growth rate of GDP per capita, unemployment rate, inflation of consumer prices, the annual growth rate of the urban population, and life expectancy at birth. Two models with random effects are also developed: the baseline model using random effects and the model without years of the Great recession using random effects. However, according to the results of the Hausman test (Hausman 1978) and the Breusch-Pagan test (Breusch & Pagan 1979), both models with random effects are not suitable.

The young dependency ratio is statistically significant only in the baseline model. This variable has a negative impact on the household saving rate, which agrees with the life-cycle hypothesis (Ando & Modigliani 1963) and the permanent income hypothesis (Friedman 1957) as well as previous empirical research papers. According to the estimates of the baseline model, an increase in the young dependency ratio by 1 percentage point results in a decrease in the household saving rate by 1.178 percentage points.

The old dependency ratio is not statistically significant in both estimated models with fixed effects. Although both models demonstrate a positive correlation between the old dependency ratio and the household saving rate, the impact of the old dependency ratio remains unclear because of the high standard error.

The main research questions of this thesis are:

- How does the age structure of the population impact the household saving rate?
- Which variables have the most significant impact on the household saving rate?

The hypothesis "An increase of the younger population has a negative impact on the household saving rate" is accepted. Estimates of both analyzed models with fixed effects indicate a negative impact on the household saving rate. This result agrees with the life-cycle hypothesis (Ando & Modigliani 1963) and the permanent income hypothesis (Friedman 1957).

The hypothesis "An increase of the older population has a negative impact on the household saving rate" is not accepted nor rejected due to ambiguous results of the performed analysis.

KOKKUVÕTE

VANUSELINE JAOTUS JA MAJAPIDAMISTE SÄÄSTUMÄÄR: TÕENDID EL-i RIIKIDEST

Roman Kruus

Antud lõputöö eesmärgiks on analüüsida ühiskonna vanuselise jaotuse mõju majapidamiste säästumäärale ajavahemikus 2000-2018 valitud Euroopa Liidu riikide näitel. Analüüsiks kasutatakse paneelandmeid, mis pärinevad Maailma Panga ja OECD andmebaasidest. Valim hõlmab järgmisi riike: Austria, Belgia, Taani, Eesti, Soome, Prantsusmaa, Saksamaa, Kreeka, Ungari, Iirimaa, Itaalia, Läti, Leedu, Luksemburg, Holland, Poola, Portugal, Slovaki Vabariik, Sloveenia, Hispaania, Rootsi, Ühendkuningriik. Bulgaaria, Horvaatia, Küpros, Tšehhi Vabariik, Malta, Rumeenia valimisse ei kaasatud andmete puuduse tõttu. Veel valitud riigid on nii Euroopa Liidu kui ka OECD liikmed, mis teeb valimi homogeensemaks.

Töö kõigepealt baseerub elutsükli hüpoteesil, mille autoriteks on Franco Modigliani ja Alberto Ando ning püsiva sissetuleku hüpoteesil, mille autoriks on Milton Friedman. Lõputöö koosneb sissejuhatusest, neljast peatükist ja kokkuvõttest. Esimeses peatükis vaadeldakse vanust kui majapidamiste säästumäära mõjurit. Teises peatükis vaadeldakse muid faktoreid mis mõjutavad majapidamiste säästmist. Kolmandas peatükis kirjeldatakse kasutatavaid andmeid ja metodoloogiat. Neljandas peatükis läbi viiakse analüüsi ja arutletakse empiirilisi tulemusi.

Lõputöö peamised uurimisküsimused on järgmised:

- Kuidas rahvastiku vanuseliene struktuur mõjutab majapidamiste säästumäära?
- Millised faktorid avaldavad kõige tugevama mõju majapidamiste säästumäärale?

Autor püstitab kaks hüpoteesi:

- Rahvastiku noorema osa suurenemine negatiivselt mõjutab majapidamiste säästumäära.
- Rahvastiku vanema osa suurenemine negatiivselt mõjutab majapidamiste säästumäära.

Töö käigus on arendatud ja analüüsitud kaks mudelit fikseeritud efektidega. Esimene mudel on baasmudel ja teises mudelis on eemaldatud aastate 2007-2009 andmed 2008. aasta finantskriisi mõju elimineerimiseks. Samuti olid ka arendatud juhuslike efektidega mudelid, kuid Hausmani ja Breusch-Pagani testide tulemused näitavad, et mõlemal juhul juhuslike efektidega mudelid ei sobi ja tuleb valida fikseeritud efektidega mudelit. Sõltuvaks muutujaks on majapidamiste säästumäära esimene difirents. Peamisteks sõltumatuteks muutujateks on noorte ja vanemaealiste ülalpeetvate määrade esimesed difirentsid. Mudelites on ka lisamuutujad: tööhõive põllumajanduses, SKP *per capita* aastane kasvumäär, töötuse määr, tarbijahindade inflatsioonimäära esimene diferents, linnaelanike kasvumäära esimene difirents ja oodatava eluea esimene diferents.

Analüüsi tulemused näitavad, et noorte ülalpeetvate määr negatiivselt mõjutab majapidamiste säästumäära. Baasmudeli hinnangute järgi, kui noorte ülalpeetvate määr suureneb ühe protesdipunkti võrra majapidamiste säästumäär kahaneb 1.178 protsendipunkti võrra (olulisuse tõenäosus 0.060). Saadud tulemus on kooskõlas töö teoreetiilise baasiga.

Vanemaealiste ülalpeetvate määr ei ole statistiliselt oluline mitte ükskis mudelis. Baasmudeli hinnangud näitavad koefitsienti 0.172 ja standardvea 0.495 (olulisuse tõenäosus 0.732), seega ei saa öelda, kas antud muutuja mõjutab majapidamiste säästumäära negatiivselt või positiivselt.

Läbi viidud analüüsi tulemusena hüpotees „Rahvastiku noorema osa suurenemine negatiivselt mõjutab majapidamiste säästumäära“ on vastu võetud. Hüpotees „Rahvastiku vanema osa suurenemine negatiivselt mõjutab majapidamiste säästumäära“ ei ole vastu võetud ega tagasi lükatud, kuna saadud tulemus on ebaselge.

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APPENDICES

Appendix 1. Correlation matrix

5% critical value (two-tailed) = 0.0986

Table 1. Correlation matrix

	ΔLife_Exp	ΔUrb_Pop_Growth	ΔInfl
ΔH_Saving	0.006	-0.052	-0.171
ΔAge_Dep_Young	-0.017	-0.032	0.051
ΔAge_Dep_Old	-0.093	-0.064	0.044
EmpAgr	0.015	0.112	0.391
GDPpercap_growth	-0.131	0.112	0.391
Unemp	0.01	-0.133	-0.19
ΔInfl	-0.041	0.055	1
ΔUrb_Pop_Growth	0.032	1	–
ΔLife_Exp	1	–	–

Source: The World Bank database (2019), OECD database (2019), author's calculations

Table 2. Correlation matrix

	Unemp	GDPpercap_growth	EmpAgr
ΔH_Saving	-0.153	-0.206	-0.13
ΔAge_Dep_Young	-0.107	-0.235	-0.313
ΔAge_Dep_Old	0.156	0.051	0.134
EmpAgr	0.419	0.243	1
GDPpercap_growth	-0.051	1	–
Unemp	1	–	–

Source: The World Bank database (2019), OECD database (2019), author's calculations

Table 3. Correlation matrix

	ΔAge_Dep_Old	ΔAge_Dep_Young	ΔH_Savings
ΔH_Saving	-0.059	0.02	1
ΔAge_Dep_Young	0.353	1	–
ΔAge_Dep_Old	1	–	–

Source: The World Bank database (2019), OECD database (2019), author's calculations

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