THE EFFECTS OF AGEING ON HOUSEHOLD CONSUMPTION IN CENTRAL AND EASTERN EUROPE

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Abstract

Recent shortcomings in consumption-oriented stimulus measures in the EU point to demographic trends as a possible explanation of lacklustre growth. The author studies changes in the age composition of CEE countries over time and their effects on household consumption using a force-fitted polynomial model. A strong negative link is found between the proportion of the population aged 65+ and the level of household consumption. The paper's findings are expected to help augment current macroeconomic analysis techniques used by researchers and public institutions with a demographic component.

Key words: *consumption, demographics, economy*

1. INTRODUCTION

The prolonged period of weak pan-European economic development has become a contentious topic of discussion. With remedial measures taken by governments and increasingly accommodative monetary policy from the ECB falling short of their goal, we face heightened uncertainty. Consistent downward revisions of real GDP expansion, unfavourable economic projections and volatility in financial markets raise the possibility of a Japanese-style lost decade.

Although a confluence of factors compounds the challenge of finding a solution to return to robust growth, the public focus on reviving the economy through consumption is notable. Considering the status quo's persistence, there is utility in bringing the discussion to potential determinants of consumption such as demographic trends in order to address the demonstrated policy shortcomings in the region.

Analysing demographic shifts in order to determine their role in consumption as an integral part of GDP may provide insight for policymakers to better address the ongoing issue of economic growth. Empirical studies in the Central and Eastern European theatre are fragmented and scarce in comparison to the body of work dedicated to studying the effects of demographics on the economy in the USA, India or Japan. As such, there is no consensus over a theoretical approach to the topic, which manifests itself in competing methodologies. This paper adds to the discussion by building upon the newest publications dedicated to the topic to address a concern pending in the region.

An ageing population presents a transformative challenge to the economy that appears all but inevitable in our society. Hence, making an effort to enhance our understanding of the underlying macroeconomic processes is a step towards preparing the grounds for definitive action. The much publicised refugee crisis and the reluctance exhibited in parts of Central and Eastern Europe add to the resolve of providing suggestions based on hard data.

Consumption expenditures of households in Central and Eastern Europe are the main concern of this research. They are analysed based on the evolution of the population's age composition in each country. The author hypothesises the presence of a statistically significant effect of demographic variables on household consumption. In addition, it is hypothesised that this effect is heterogeneous across Central and Eastern Europe as well as feasible to be represented by a non-linear function.

The purpose of this work is to deliver a quantitative analysis of consumption expenditures of households, focusing on the effects of demographic variables. To achieve this goal, the following objectives are formulated: 1) provide a comprehensive review of relevant empirical studies and chief interpretations; 2) build a model stemming from the literature review to analyse relationship outlined in the goal and

test the hypotheses; 3) interpret research results obtained via the model, provide conclusions and recommendations for further study.

The literature review embodies a comparative summary with several focal points analysed with regard to different points of view. Citations of key statements from authoritative sources define key statements, supplemented by a model derived from the described empirical studies and their practical conclusions. The empirical part deliberates on these findings with the help of an econometric model obtained via panel regression of secondary time series data, checked for robustness via a range of statistical tests, ANOVA.

The work's structure consists of three parts. The first section is divided in such a way that tracks developments in empirical studies before presenting the methodological framework to be implemented in empirical analysis. The second section features research results and a discussion of their scientific significance as well as practical utility. The paper is concluded with a list of conclusions and suggestions derived from the first two sections.

This work is largely based on third-party empirical literature without giving precedence to a particular school of thought or methodology. Sources are rigorously cross-referenced by juxtaposing them topically and geographically. Guidance on the economic implications of ageing is taken from IMF's Bloom & Canning (2006), UBS's Magnus (2009, 2010, 2013) and Lee & Mason (2006, 2010a, 2010b, 2011) while research design is based on suggestions by Arnott & Chaves (2012), Macunovich (2010) and McKinsey Global Institute (2004), among others.

Difficulties and Limitations experienced in this paper are factored by the modern nature of associating demographic data with macroeconomics, specifically, household consumption expenditures. Country-level data is coarse and limited in scope to the period between 1996 and 2013. The Central and Eastern Europe perspective provides an additional challenge of having to rely mostly on foreign studies in a field currently defined by geographical and cultural heterogeneity.

2. MODERN APPROACHES TO THE EFFECTS OF DEMOGRAPHICS ON CONSUMPTION

In this section, the body of available empirical work dedicated to the analysis of demographic trends and their effect on consumption in the macroeconomic sense is reviewed. The sources presented below are selected based on their contribution to the discussion, focusing on new research. The first subsection encompasses a range of third-party studies while the second subsection builds on their methodological guidance to develop a model to be utilised in the next section.

2.1. The Relationship of Demographics and Consumption in Literature

A number of research papers has been published on the topic of demographics and how they influence economic variables. Empirical studies traditionally focused on topics such as pension systems and GDP growth (Arnott, 2012). Their effect on consumption reflects a more recent turn, mimicking the proliferation of consumption-oriented tools to stimulate the economy. Considering the data-dependent nature of this phenomenon, this subsection contains a review of empirical studies aimed to identify the structural elements for regression analysis. Previous studies are collated for methodological guidance, including variable identification, prevalent analysis techniques and consensus in the conclusions obtained.

The mention of demographics in research papers is not homogenous. While certain characteristics like age and gender may be considered intuitive, these are not necessarily included when a paper deems its regressors *demographic*. Studies vary in scope, ranging from one variable to a system of variables, which leads to an equally broad range of conclusions. This is not unexpected, taking in mind the geographic fragmentation and data challenges for researchers in the field. In parts of the developing world, the papers in this review are the first of their kind, with a subset of countries having no publications on the topic. As such, there are difficulties in verifying persistence of third-party claims in time, compounded by the susceptibility of changes in demographic makeup in the long run due to exogenous shocks.

Stacking predictable short-run changes in demographic makeup raises the question of the current framework's longevity, considering retirement benefits, consumption and economic development as a whole. Bloch (2011) argues all of the above will undergo a meltdown with cuts to reduce the amount of distributable welfare on every level.

Dizard (2013) seems to agree with the Bloch's sentiment, as far as pointing out the sectors to be affected by demographic changes. Dizard further contributes to the discussion with the addition of non-healthcare elder goods and services, providers of which are to manage altering their economic activity in a timely manner to reap benefits from changes in demand. He predicts that due to life expectancy continuing to the increase, demographic transformations will reduce demand of youth-oriented consumer products and put pressure on producers. Moreover, he expects gains of medical and care service providers to be modest due to restrictive government legislation and an increasing strain of public finances caused by the need to deliver the assumed amount of funding. Dizard introduces care homes as an example of a service in high demand that is not profitable enough for the private sector to fully satisfy the demand.

A Romanian study by Nadelea & State (2008) contributes to the discussion by pointing out the costs of demographic transformations incurred by the consumer goods market whilst a Norwegian sectoral study by Gustavsen (2014) aims to assess these costs for producers of select goods. Jalal & Khan (2014) point out the wealth prerequisite for a country to be able to address the transformation costs. These costs, as determined by Nankervis (2015), may need to be spread over a considerable period of time with government support.

Stampe et al (2013) present a log-linear approach to modelling the empirical connection between demographics and consumption based on Brazilian figures. Their findings suggest significant differences in sectoral consumption, which appears to be in line with the Life-Cycle Hypothesis. The authors stress changes in consumption levels post-retirement. Results of a more recent study by Tracey & Fels (2016) with US demographic data show this is also relevant in different regions.

Volatility in consumption levels is addressed by Gorbachev (2011) in a US case study. Her input contrasts the overall rise in income and lower volatility in US GDP dynamics during the 35-year period ending in 2004 with more volatile consumption trends. A number of demographic variables, including age, sex and education are considered significant to this change.

The question of consumption volatility in the US is further covered by Twum-Barima (2015), who also references the Life-Cycle Hypothesis. Their input focuses on the way children affect household consumption, pointing out a negative correlation between the proportion of children in the US society and consumption. Conversely, consumption volatility decreases and becomes positive after reaching adulthood.

Pope (2009) connects the notion of consumption volatility in the US with uncertainty under the permanent income hypothesis. Demographics, according to his paper, play a role in consumption and can be depicted with a U-shaped lifetime uncertainty curve. Since the opposite can be applied to consumption, it connects the notion made by Stampe et al (2013) regarding retirement and Twum-Barima (2015) with reference to children.

Magnus (2009, 2010, 2013), Jensen (2013) and Kim (2010) offer a consensual valuation of the state of affairs, but their views on the ageing-driven downturn are muted. Magnus argues that regions experiencing the transition to low birth rates and low infant mortality rates such as Europe or Japan are home to global businesses able to provide stability thanks to income generated in emerging markets. Such enterprises are not expected to fall under the trend. Nonetheless, both authors admit a doubling old age dependency ratio is a problem the effects of which are largely unknown. As Magnus (2010, p. 1) puts it: "We actually have no template about what to expect because 21st century population aging is unique." Kim (2010) stresses the presence of coping mechanisms stemming from demographics as a means to smooth consumption in a period of perceived economic hardship. Japan's experience may be even more unique for cultural reasons, but the implications of a lost generation happening in the EU deserve more attention than they currently get, Jensen concludes. Magnus' Japanese case study pointed to a temporary effect in the economy that lasted for ten years, where consumption levelled off instead of falling as the population aged. This was explained with savings made on less workforce being

required along with reduced costs to equip it, leaving more funds available for consumption. This is not predicted in an earlier study conducted by Dekle (2000).

The geography of old-age dependency ratio dynamics is elaborated on by Lee & Mason (2010a, 2010b, 2011). While the US may avoid a part of the negative pressure from ageing in the medium term due to having a replacement-level birth rate, the long-run dynamics, the authors conclude, approach those of Japan and Spain at 1% annual age-adjusted aggregate consumption declines. Projections for developing countries such as Kenya and India show a more positive development until their eventual transition into low fertility, long life expectancy dynamics.

Macunovich (2010) uses examples from Latin America, Japan and the USA to explain that their economic downturns in the last 30 years were rooted in the countries' demographic makeup. In the paper, he stresses the importance of the 15-24 age group rather than an increasing old age dependency ratio. He discovered that growing economic activity and GDP per capita correlated with an increase in the group's relative weight while downturns occurred immediately after the period of the cohort's peak size. This effect manifested itself in many countries across Europe, including Belgium, Sweden and Russia. Macunovich suggests examining the age structure as a polynomial to avoid omitting meaningful data, going as far as suggesting overestimating the number of degrees in the polynomial to begin with unbiased, if inefficient, estimates. However, he warns against combining countries with different types of age structures, as they indicate a different economic effect in the 65 and over age group due to the presence or absence of government aid schemes. This is also true, Yusuf, Brooks (2009) find, for large countries with regional heterogeneity, as determined in a study of consumption patterns in major Chinese urban centres.

McKinsey Global Institute, the research arm of the McKinsey & Company consultancy, proposes a standardised approach towards polynomials as a representation of ageing effects in a publicised discussion on the upcoming *demographic deficit*. In their case study on Germany, Italy and the UK, among non-EU countries, they have used fifth-degree estimates of life cycle effects.

The Institute details in the technical notes section: "In this type of synthetic panel specification, all trends in the data are captured by lifecycle and cohort effects. Linear time trends cannot be separately identified since age, time and cohort are linearly related. Any time effects are implicitly assumed to be orthogonal to the deterministic trends represented by age and cohort effects" (McKinsey Global Institute, 2004, p. 224).

The IMF dedicated an issue of *Finance and Development* to the matter. Bloom & Canning (2006) pointed out the current state is a result of more than 100 years of deviation from a historic trend, in which populations and age structures changed very little. The "upheaval", according to the authors, caused a wave of "booms, busts, and echoes" referring to baby boomers, the subsequent decline in fertility as they reach maturity and echo effects, maintaining that a generation's influence manifests itself in waves.

Regardless of the looped effect and overall population increases, the IMF's contributors point out the total fertility rate dropped from 5 in 1950 to approximately 2.5 in 2006, projected to fall further to 2 by 2050. As such, birth rates in developing countries are not expected to remain as high as they are now. However, they also note a drop in infant mortality, down to a third of its value of 180 since 1950 in developing countries and from 59 to 7 in developed countries. This is accompanied by greater life expectancy worldwide, up by 15 years since 1950 to 65 in 2005. The increase has not been homogenous across the world, with disparity expected to rise due to AIDS hampering longevity in sub-Saharan Africa and failure to improve social infrastructure in certain Post-Soviet states (Bloom & Canning 2006).

Challenges stemming from a large cohort entering retirement, provided behaviour is constant within age and sex groups, have potentially destructive consequences, as described by Bloch (2011). Conversely, his research paper notes a change in behaviour such as more women participating in the workforce or active immigration, as confirmed by Magnus (2010), are to resist the downward pressure on real income. Lacking such structural changes, public expenditures on pensions are to increase by as much as 16 p. p. of GDP by 2050 in countries like Spain, more than twice of the projection made by the European Commission (Catalán 2007).

Magnus (2010) and Bloch (2006) support their claim with the example of Ireland, the net migration rate of which has been negative since 1960 until 1990, amounting to 1 per cent per annum on average (not dissimilar from Lithuania), but changed with the onset of economic growth fuelled by policy and demography-based factors. The increase in female labour force participation and immigrants, those returning and foreigners, dampened the negative effect predictions based purely on historic data.

A production technology model encompassing the demographic transition in China and India employed by Chamon & Kremer (2006) sheds light on the subject of challenges in utilising the benefits of demographic shifts. The log-linear model takes changes in demographic makeup and the economic transformation process as exogenous variables, meaning that certain tasks can only be done in countries deemed "developed". It results in noteworthy conclusions, one of which is a development queue, allowing a certain country to develop only after a country ahead of it in the queue attains "developed" status. The author also introduces criticality for long-term transformations, maintaining a scenario will continue indefinitely as long as external processes keep the population's demographic makeup above threshold.

Their claims are supported by multiple empirical studies conducted in the Indian theatre. Lee & Mason (2011) broaden the number of statistically significant regressors to gender, age and introduce the measure of subjective expectations. This is partially supported by Shalini (2013), whose regression and ANOVA analysis found age and marital status significant while dismissing the effect of gender in the light of other non-demographic variables acting as proxies. Charness (2012) reaches a similar conclusion, advising against far-reaching conclusions due to the possibility misspecification.

Franchi (2013) builds upon the effects of age and the economy in the US as a lagged regressor, associated with behaviours of different age groups. Franchi's findings appear in line with the Life-Cycle Hypothesis explained in detail by Bodie et al (2007). Bodie limits input to descriptive statistics, albeit over a long period of time. The non-linear effect of age on economic activity in Bodie's data pool is most pronounced during the post-retirement stages of consumption and gifting, orders of magnitude above those seen in previous stages.

Batini et al (2006) use a dynamic intertemporal general equilibrium four-country model to project the effects of demographic transformations as far as 80 years into the future. They discover the outcomes are different between regions, with Japan undergoing the most extreme changes. Developed countries are expected to boost their developing counterparts' growth over the next 10-20 years. Moreover, a rise in productivity by 0.1 p. p. per year is projected as sufficient to offset half of Japan's aggregate GDP fall attributable to demographic changes. The model inspects GDP per capita growth rates as well, concluding a decrease in industrialised nations due to ageing whilst those of developing countries are expected to increase as long as additional labour is used effectively. Lee & Mason (2010a) reach a similar conclusion in relation to productivity mitigating the negative effect of ageing while Kim (2010) points out coping mechanisms to smooth swings in consumption levels in the presence of income shocks.

With regards to policy and implementation, it is important to distinguish between cyclical and long-term structural changes. A simulation exercise run as part of the IMF Working Paper initiative underpinned capital export into developing Asia with demographic processes happening in Europe and Japan (Lueth, 2008). While there have been speculations about capital flows in 2007 stemming from loose monetary policy, the author suggests that demographic change is behind the current, "making a sudden reversal less likely" (Lueth 2008, p. 15).

Arnott (2012) presents a development in the study of demographic variables as a determinant of economic shifts. The authors use a pool of 22 countries for the main regression and increase the number of degrees of freedom by force-fitting the equation into a two-to-four-degree polynomial. While a secondary regression with 176 countries is present in their study, the authors admit that data is fragmented, allowing for more accurate estimates only in developed countries. Their study involved a two-fold set with GDP per capita being analysed in one regression and returns on securities in the other. Both sets depicted: "a strong and intuitive link between demographic transitions and both GDP growth and capital market returns" (Arnott & Chaves 2012, p. 23).

Insight taken from the works laid out in this part is used as a basis to formulate the methodology to be used in hypothesis testing.

2.2. The Methodological Framework of the Econometric Model

The model's basic premise entails the use of secondary time series data as reported in a sample of Central and Eastern European countries over a specified period. The data is panelised, labelling the demographic variables – 18 five-year age groups (0-4, 5-9, … 80-84, 85+) as the regressors and the economic variable, annual percentage changes of household consumption expenditures as the regressand in a panel least squares single-equation regression. To capture valuation and business cycle effects, the equation contains a proxy economic variable on the regressor side. This may be seen in equation (1).

$$r_t = a + \gamma X_{t-1} + b_1 s_{t,1} + b_2 s_{t,2} + \ldots + b_N s_{t,N} + \varepsilon_t \quad (1)$$

r_t – annual percentage change of household consumption expenditures at period *t*, adjusted for seasonality and working days

a – intercept term

X_{t-1}stock market index annual percentage change, used to gauge the business cycle in the period *t-1*

b_i– coefficient for five-year age group *i*, $i \in N,\ i \in [1; 18]$

$s_{t,i}$– relative population share size of five-year age group *i* at period *t*

Note that the equation contains an intercept term, a lagged term for the valuation effect and denotes age group shares for every cross-section in every period.

The main issue with equation (1) is that statistical data for most countries in a sufficiently large panel is available for a limited selection of years. As such, the number of data points is reduced, which complicates both analysis of the demographic variables' slow evolution and its effect on household consumption expenditures. In fact, estimating equation (1) directly is impossible for any country currently in the Central and Eastern Europe region because including the intended number of five-year non-overlapping age groups ($s_{t,i}$) does not leave enough degrees of freedom, as *i* spans from 1 to 18 (ages 0-4, 5-9, … 80-84, 85+), coinciding with the number of periods *t*. Excluding a particular age group, for example, ages 0 to 4 or broadening the groups is an ad hoc solution that hides a part of the information contained in the original equation.

Hence, we may include a restriction for the number of coefficients:

$$b_i = D_0 + D_1 i + D_1 i^2 + \ldots + D_k i^k \quad (2)$$

This expression suggests replacing the coefficient b_i next to every demographic share with a single polynomial of the order *k*, supposed to reduce the number of coefficients to estimate from *N* to *k*. The order of the polynomial is determined by testing it against redundancies with parsimony in mind via the Wald coefficient restriction test. This is in line with suggestions by Macunovich (2010), McKinsey Global Institute (2004) and Arnott & Chaves (2012). It is worth noting that the *i*, representing the number of the age group, spanning from 1 to N, is raised to the power from 0 to *k*.

Since age group shares have the cumulative sum of unity and the sum of their changes always equals to zero, a restriction is required on the transformed coefficients to avoid multicollinearity with the intercept term. The issue is captured by the initial term, D_0 as described in equation (3).

$$D_0 = -\frac{1}{N}\left(D_1 \sum_{i=1}^{N} i + D_2 \sum_{i=1}^{N} i^2 + \ldots + D_k \sum_{i=1}^{N} i^k \right) \quad (3)$$

Following the coefficient transformation and after the inclusion of D_0 as shown in (3), the model's regression equation intended for panel LS estimation appears as follows:

$$r_t = a + \gamma X_{t-1} + D_1 \sum_{i=1}^{N} \left[i s_t^{(i)} - \frac{i}{N} \right] + D_2 \sum_{i=1}^{N} \left[i^2 s_t^{(i)} - \frac{i^2}{N} \right] + \ldots + D_k \sum_{i=1}^{N} \left[i^k s_t^{(i)} - \frac{i^k}{N} \right] + \varepsilon_t \quad (4)$$

Note that to preserve space, the presented equation (4) does not contain fixed cross-section effects, which, after testing with the Redundant Fixed Effects test, determine the intercept term, separate for every country in the panel, supposed to capture left-over differences between countries. Equation (4) with fixed effects is used for statistical testing while equation (1) presents the end result containing implied regression coefficients of every demographic share.

The framework is put through a range of tests pertaining to the Gauss-Markov assumptions, its robustness and is subject to adaptation in case one of these assumptions is not met and the result may contribute to misleading conclusions.

As demonstrated in the first part, the variables and underlying data quality are crucial for BLUE estimation. Previously covered research limited to the USA theatre is mostly concerned with the former rather than the latter due to the relative legislative stability and availability of statistical data, allowing the researcher to focus on variable selection. The Central and Eastern European context adds complexity factored by historical and methodological divisions, which affect the quality and availability of data and its variable forms.

Institutional changes are a noteworthy example, limiting the number of data points available for study in multiple countries to a period spanning from years after the collapse of the USSR until 2013. UN Penn World Tables provide estimates for the most general demographic and macroeconomic variables as well as official statistics with their quality classified accordingly. However, this data is limited to 5-year increments or 20 data points per 100 years in addition to complementary variables necessary for hypothesis testing being absent from their repository. Hence, the European statistical authority, Eurostat (2016a; 2016b) and the ECB (2016) act as the chief sources of data, providing demographic and macroeconomic time series used in this paper.

One of the key issues concerning the execution of the model is formulating the scope of detail to describe an EU member state's demographic makeup. By referring to previous research and prior testing with draft models, it is concluded that broad age groups withheld information present in the non-overlapping five-year cohorts reported by each member state. For most Central and Eastern European countries, the series starts at 1996. A total of eleven countries traditionally attributed to the region, subject to data availability, is used in the empirical part: Austria, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

Unlike in previously cited research, the number of age groups *i* is expanded to 18. Including all of the groups would have been impossible with the degrees of freedom available in an annual series from 1996 to 2013, excluding macroeconomic variables, were it not for the model's transformation of age group shares into a polynomial.

The analysis includes the levels of age group shares in a population, as observed on January 1st of the year (*t*) in question. While short-run effects may have potential utility, the slow rate of change makes annual data the more feasible alternative.

With regard to the period selection, it features the longest time-series available for the sample of countries. Spanning over 18 years, a time long before EU ascension of most countries in the sample, to euro area membership and significant demographic, economic changes, the period encompasses the time for a generation to reach adulthood. The dynamics captured during the time are taken into consideration of the period's adequacy in allowing long-term trends to manifest.

The effect of demographic makeup shifts on consumption, discussed in detail in foreign literature, is an issue of substance as well as definition. The decision to represent the titular consumption with the annual percentage change of household consumption expenditures adjusted for seasonality and working days is factored by its intuitive connection to demographics, pertaining to households generating the consumption. The annual percentage changes make room for comparison in a single field, with a propensity to revert to the mean.

Empirical literature deliberated on in the first section suggested the inclusion of a variable to account for valuation effects and business cycles, a proxy variable for information that would otherwise be omitted (referred to as *X* in the regression equation), referencing public trading statistics as a feasible solution. The ECB provides an array of leading EU stock market indices, either taken directly from the market or synthesised via a long-lasting index such as Euro Stoxx 50. Whenever possible, this variable is supplemented with data from the member state stock market's main index used for settlements, adjusted for breaks. The measure is not taken for countries lacking such an index during the analysed period. In case of multiple markets being present, as is the case in Poland, data from the operator with the highest index capitalisation is selected. To reflect the measures taken in preparation of other variables, raw closing values of a year's first trading session are converted into annualised percentage growth rates. The timing and magnitude are to match those of the demographic shares, with the step of one year.

Dividend yields are cited as an alternative and a supplement to stock market indexes. However, these would be problematic to use as an efficient measurement instrument in markets with endemic higher volatility, compounded by the fact that dividends are generally distributed several months after the end of the year in question. It generates a time lag, the length of which differs from country to country, that the market index does not have. Furthermore, indices in parts of Central and Eastern Europe have been dividend-inclusive since as early as 1999. Adjusting pre-1999 values accordingly preserves the yield information while avoiding structural breaks.

As a proxy solution outside the financial market, the economy's production function was considered. However, such a function's estimation for every country in the sample would add complexity and reduce the number of degrees of freedom upon its inclusion in the regression.

Stationarity is often a question when dealing with demographic variables due to their susceptibility to time trends. The variables selected for analysis, i.e. the demographic shares, are held within an interval [0;1] and are taken from a sample of 11 countries experiencing different stages of the demographic transition, thus increasing the power of the tests, or, in case of economic variables, are presented in the form of annual percentage changes.

It is worth noting at this point the model's primary goal is to examine dependencies rather than make predictions while building upon previous research in the model's implementation.

Divergent interpretations of Central and Eastern Europe as a group of countries pose another challenge of analysing dependencies in an all-inclusive fashion. The list of 11 countries comprises of countries traditionally assigned to the bloc, members of EU. Countries such as Ukraine or Belarus, frequently classified as a part of the region in question, are absent from analysis due to differences in statistical reporting schedules. With regard to data availability, the model described in this part involves data from 1996 to 2013, which yields 18 periods for each of the 11 countries, a total of 198 observations.

3. ASSESSING THE DEMOGRAPHIC FACTORS OF HOUSEHOLD CONSUMPTION EXPENDITURES

In this section, the results of the empirical research are discussed, taking into account the methodology laid out in the previous section. Following a range of statistical tests for the verification of BLUE evaluation, model specification and robustness, the regression equation is estimated. Upon reverting to implied regression coefficients of each age group, estimators are juxtaposed against those obtained in prior comparable research before collating the findings to form conclusions and suggestions.

Household consumption expenditures adjusted for seasonality and working days expressed as an annual percentage change are acting as the dependent variable, noted with *r*. The basis for the model is a panel containing transformed age shares, D1, D2, D3 and D4. The annual percentage change of the respective country's main stock market index appears under the label X. In addition to this, a set of 11 dummy variables corresponding to each country in the panel handle the fixed cross-section effects. The fourth-order polynomial is assumed to be high enough as a starting point in lieu of the Life-Cycle Hypothesis as explained by Pope (2009) and Twum-Barima (2015).

After taking the steps described in the methodology subsection, namely the transition from equation (1) to equation (4), the restricted fourth-degree polynomial is tested for specification. Two of the higher order coefficients, D3 and D4 do not appear significant under the Wald coefficient restrictions test. The test values of remaining D1 and D2 call for rejection of the null hypothesis of the test regarding statistical insignificance.

The Jarque-Bera normality test shows a value of 2.477, a figure that does not exceed the critical value for the panel at a 5 per cent significance level. Eyeballing the standardised residual histogram does not contradict the test's result, which allows for the assumption of normality to be upheld.

Disturbance variance over cross-sections is addressed by employing a White cross-section covariance matrix to obtain heteroscedasticity-consistent standard errors.

A Durbin-Watson statistic of 1.89 determines no statistically significant first-order serial correlation at the same significance level. Running the Q test for higher-order serial correlation, up to 5 lags, reveals the null hypothesis regarding the absence of serial correlation also cannot be rejected.

The final model's coefficients, test values and variables presented in Table 1 consists of variables that are statistically significant at a 5 per cent significance level, with the absolute value of the t statistic ranging from 3.66 to 4.92. The value of the F-statistic is 18.65, above the critical value of the aforementioned significance level. The R-squared stands at 0.57, which is an above-average result for a model of this type. Demographics are seldom expected to capture macroeconomic movements accurately, rather than provide guidance for the general direction of change. The inclusion of X as an explanatory variable contributes to this, but the gain associated with it reads below 10 p. p.

Variable	Coefficient	Standard error	t-statistic	Probability
C	-20.96	2.21	-3.66	0.000
D1	42.19	3.53	4.38	0.000
D2	-2.64	0.37	-4.92	0.000
X	1.81	0.44	4.05	0.000

Table 1. Estimated Regression Variables, Coefficients and Test Values.
Source: Author's calculations according to data from Eurostat, ECB.

The coefficients of fixed cross-section effects, which affect the intercept for the equation in each country in the panel, are presented in Table 2. These range from -3.45 for Slovakia to 3.86 for Estonia and highlight differences between countries traditionally included in one region. The values appear to correlate for positive skew in the Baltic states and negative for Czech Republic, Slovakia and Slovenia, which allows for further drilling down in additional research.

Country	Austria	Bulgaria	Czech Republic	Estonia	Hungary	Latvia
Coefficient	-0.28	1.35	-2.29	3.86	-1.01	3.28
Country	Lithuania	Poland	Romania	Slovakia	Slovenia	
Coefficient	3.02	-1.67	-0.12	-3.45	-2.69	

Table 2. Coefficients of Country Fixed Cross-section Effects.
Source: Author's calculations according to data from Eurostat, ECB.

In order to determine the effect of each age group on household consumption expenditures, coefficients obtained via equation (4) as seen in Table 1 are transformed back to their forms described in (1), referred to as implied regression coefficients and depicted in Figure 1. The functional form, a second-degree polynomial, does not seem to contradict conclusions reached by prior research analysing consumption volatility, nor does it challenge the hypotheses raised in the introduction pertaining to the presence of a statistically effect, its heterogeneity between countries and non-linearity across age groups. It also appears to be in line with the Life-Cycle Hypothesis, crossing the axis at age groups corresponding to the entry into the workforce and retirement.

For the sake of clarity, the implied regression coefficient signifies the percentage, by which the household consumption expenditures change when the share of a particular age group in the population increases by 1 per cent.

Each group's implied regression coefficient r_i across the full period can be calculated using equation (5). The group's index, ranging from 1 to 18, is denoted as *i*.

$$r_i = -0.0264i^2 + 0.4219i - 0.9148 \quad (5)$$

The curve crosses the horizontal axis in the third (ages 10-14) and fourteenth (ages 65-69) groups, describing effects of each group. It is worth noting that both the increase of the relative share of children and retirees has a dampening effect on consumption while working-age groups make a positive contribution to the overall figure. The curve peaks at the eight group (ages 35-39), albeit the amplitude between coefficients in the 25-49 range is below 0.1, pointing to the possible explanation why demographics are considered insignificant at certain stages. The most precipitous change, of interest to this study, occurs during the transition between the third and fourth group (ages 10-14 to 15-19), the thirteenth and fourteenth (ages 60-64 to 65-69). In both cases the axis is crossed at a level difference exceeding 0.2.

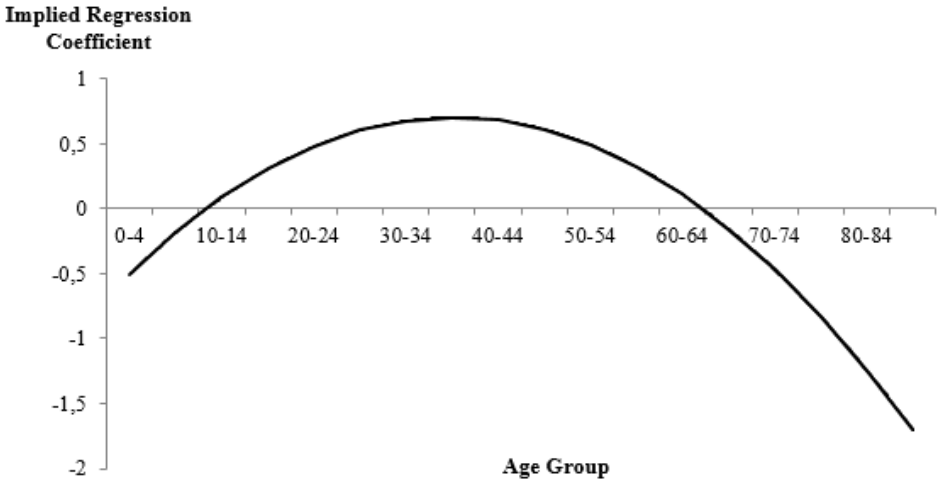

Figure 1. Implied Regression Coefficient Representation of Every Age Group.
Source: Author's calculations according to data from Eurostat, ECB.

A worrying trend can be noted on the far right of the age spectrum. The coefficients in the final two groups drop below -1, pointing to a compounding effect with the increase of the relative share of people covered by the old-age metric. These represent both the highest absolute coefficients on the implied regression curve and require significant increases in other groups, *ceteris paribus*. The increase of the relative share of these age groups by 1 per cent necessitates a 2 per cent increase in peak groups, ages

25-49. This contradicts the claim made by Macunovich (2010) regarding the role of the 15-24 age groups as a sufficient dampener to the pressure of ageing.

Considering advances in life expectancy in Central and Eastern Europe as well as unfavourable vocalisations on the topic of immigration, escaping a potential downturn may prove challenging. For countries like Lithuania, Latvia and Estonia with the median age of their respective populations peaking on the implied regression curve, this raises the risk of an accelerating downward slope. This concern has been voiced in public across the region, but the muted response seems more likely to allow the continuation of movement to the right along the curve rather than holding position at the current peak.

The potential of a nominal increase in productivity, as projected by Batini et al (2006), does not appear to manifest in the region. A demonstration based on empirics from 11 countries over 18 years puts into question the effectiveness of coping mechanisms described by Kim (2010). The exercise of halving the period for comparison yields the first-period curve with a higher peak and a 5-year earlier second crossing of the horizontal axis, corresponding to earlier retirement. Considering the transition, the partial explanation of lacklustre economic growth via demographic pressure on household consumption expenditures gains credence. Albeit this assessment is based on the analysed period and is subject to revision as new empirical data becomes available, Tracey & Fels (2016) reach a similar conclusion using US demographic data.

With the onset of demographic push towards low fertility and greater longevity, results of remedial measures taken by policymakers coming below expectations provide a sobering outlook on the tools at their disposal as well as the policymakers' willingness to employ them. The issue of migration, a net negative among groups close to the peak for most countries in the region, has thus far acted as a dampener due to the their principally unchanged contribution to consumption over the analysed period. Lacking the ability to hold the drain of those contributing the most to increases in consumption and refusing to compensate the loss by participating in European migration agreements and resettlement of individuals belonging to the same age groups is difficult to justify.

The difficulty is compounded by the institutional focus on reviving growth through consumption, having all but dismissed government expenditures in lieu of debt and deficit fixation, sufficient export growth or investment in an increasingly competitive world. Whether this can be deemed equally applicable to other parts of the EU is a question that warrants additional research, as symmetry may act as a catalyst for efficacy in a joint solution.

Sustainability of the status quo is severely questionable in Central and Eastern Europe. In the background of increasingly accommodative monetary policy from the ECB bearing many similarities with the actions taken by its Japanese counterpart, the ageing population appears as a stark common denominator. In a way, this contradicts Magnus' (2010) claims about there being no template for ongoing demographic trends. The template, as demonstrated in this analysis, is there; it is merely one of sombre realisation that the measures adopted in Central and Eastern Europe omitting demographics are likely to fall short of expectations. For consumption to prove as effective as intended, the quality and quantity of consumers is to be considered. The consumers' trait out to take precedence may be of secondary importance, keeping in mind the issue of depopulation in parts of the region. Hence, for the region as a whole, participating in refugee redistribution schemes may prove opportune.

While the model is not intended to be used as a forecasting tool and dependencies may change over time, should current conditions hold, the process of ageing does not appear to be slowing down and it is only a matter of time until the negative effects manifest with increasing weight. The challenge is compounded by the fact the Central and Eastern Europe countries have thus far been known for standing at the forefront of EU's economic development, a role that presently lacks substitutes.

4. CONCLUSIONS

The on-going debate dedicated to the relationship between demographic and economic variables produced a body of academic work during the last decade. Researchers from the USA, the EU and India spearheaded the effort by presenting a new development in the field – the analysis of the effect of demographics on consumption.

The prevalence of ageing in parts of the world creates unique socioeconomic challenges the solutions to which are still pending despite recognising the risks of experiencing a Japanese-style lost decade.

Economic transformations instilled by demographic change carry significant adjustment costs to governments and businesses alike with projected strain on public finances to cover the needs associated with increasing old-age dependency.

Empirical works dedicated to the connection of ageing and consumption point to current trend-driven downturns in the economy more often than reaching conclusions in favour of the current state's sustainability. Coping mechanisms and productivity gains are cited as potential dampeners of the process' negative effects.

Findings of previous works emphasise the need for empirical data and precise variable classification. Differences in methodology lead to analogous research reaching dissimilar conclusions. Regional fragmentation and population heterogeneity makes precise comparisons difficult to accomplish.

Demographic processes such as ageing evolve over extended periods of time, necessitating sufficient empirical data to conduct quantitative analysis and limiting the breadth of potential inferences in regions with changing jurisdictions. Force-fitting techniques are used to address the issue of limited data pools to an extent.

Previous empirical studies highlight the issue of demographic characteristics acting as proxies for other variables. This makes demographics-based models sensitive to bias and imposes care in forming far-reaching conclusions. Such models feature control variables or filters for unrelated effects.

Developments in the study of demographics as a partial determinant of consumption focus on volatility-inducing effects and conformity to the Life-Cycle Hypothesis, with young adults and retirees acting as the most frequent groups of research interest.

This paper presents an attempt to analyse the effect of demographic variables, namely, all-inclusive five-year age groups on household consumption expenditures in a panel of 11 Central and Eastern Europe countries. It is the first empirical study of this kind carried out in Lithuania.

The application of methodological guidance stemming from prior research resulted in an econometric model capable of analysing the effect of selected demographic variables on consumption with reasonably strong determination and statistical significance.

Connections established between the relative weight of an age group in a population and its effects on consumption appear intuitive, in line with economic logic, the Life-Cycle Hypothesis stipulations and do not outright contradict the results of cited comparable research. Research findings do not provide sufficient justification to reject any of the three hypotheses laid out in the introduction.

Age groups associated with entry into the labour force and retirement act as inflection points between net negative and positive effects on consumption described by a parabolic function. Peak contributors to consumption increases are found in the 25-49 age range while groups from the 80 years and above range exert pressure. The effect of the 80 years and above range is double that of the 25-49 range in absolute terms.

Demographic trends in Central and Eastern Europe form the basis of concern regarding the sustainability of the status quo. While increasing longevity should be considered a testament to the region's successful development, the challenges it entails compound over time. These challenges do not appear as having been addressed in a meaningful way during the analysed 18-year period.

This paper brings forward the case for demographics-sensitive structural reforms focused on reviving consumption, including approaches pertaining to migration, for improved results of standard stimulus measures.

Extricating the effects of demographic trends on different sectors of the economy and quantifying their adjustment costs is suggested to increase the utility of this study.

An assessment of the feasibility of a collective response, should the pending demographic shocks prove both severe and symmetrical, exemplifies the benefit of expanding this research to other parts of the EU in addition to monitoring developments in Central and Eastern Europe as new empirical data becomes available.

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