THE IMPACT OF POPULATION AGING ON REGIONAL ECONOMIC GROWTH IN UKRAINE

by

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Abstract

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The paper investigates the link between demographic factors and economic growth in a framework of conditional convergence using panel data for Ukrainian regions in 2000-2017. The first finding is that initially poor regions do not grow faster converging to the rich ones and demographic factors do not influence this result. However, there is a strong negative relationship between the dependency ratio and GRP growth rate. Young dependency ratio is found to have a large and significant negative impact on economic growth, while the old dependency ratio has almost no effect. It implies that Ukraine has benefited from the demographic transition, which led to a decrease in youth share in all regions for the analyzed period. Yet the current population ageing reduces the relative number of working-age people, which is likely to have a negative impact on future economic growth and production.

TABLE OF CONTENTS

LIST OF FIGURES

Number *Page*

LIST OF TABLES

Number *Page*

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GLOSSARY

Dependency ratio. The ratio of the number of the dependents aged below (0-14) and over the working age (64+) to the total population of the working age (15-64).

GRP. Gross Regional Product

LFPR. Labor Force Participation Ratio

TFP. Total Factor Productivity

UKRSTAT. State Statistics Service of Ukraine

UN. United Nations

C h a p t e r 1

INTRODUCTION

General demographic trends show a swift increase in the median age for the population in all developed and transition countries. Commonly, the trend is explained by the decrease in fertility and child mortality rates and the increase in the quality of the health care system. In the case of Ukraine, changes in the demographic structure are also aggravated by the growth of external migration. Thus, we can see a rise in the median age from 34.8 in 1989 to 40.8 in 2018[1].

Despite the fact that low population growth rates are common for all European countries due to the recent demographic transition, Ukraine is one of the only few countries with a negative growth rate, which makes Ukrainian population one of the most rapidly decreasing in the world[2]. In such a manner, the overall population is predicted to shrink from current 42 million to less than 36 million by the 2050 year according to the latest UN population prospects estimates.

In addition to the increase in the number of old people due to the rise in life expectancy, its share also rises because of a drop in shares of two other age cohorts. From year to year, the overall number of youngsters is predicted to decrease as population growth rate below the replacement level along with the external migration causes a reduction in population mostly from the middle age group.

These two factors in Ukraine make aging more rapid and unbalanced than in Western European countries. Figure 1 shows that up to 2015 the increase in the number of old age people was devoted both to the decrease in working age and young age cohorts. Whereas in the next 20 years, we expect straightforward

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1 http://database.ukrcensus.gov.ua/MULT/Dialog/statfile_c.asp

2 Ukraine is 169 out of 179 countries by population growth rates (-0,41%), being followed by Slovenia, Serbia, Estonia and Croatia

transition between middle-aged and old people, without notable changes in share of children.

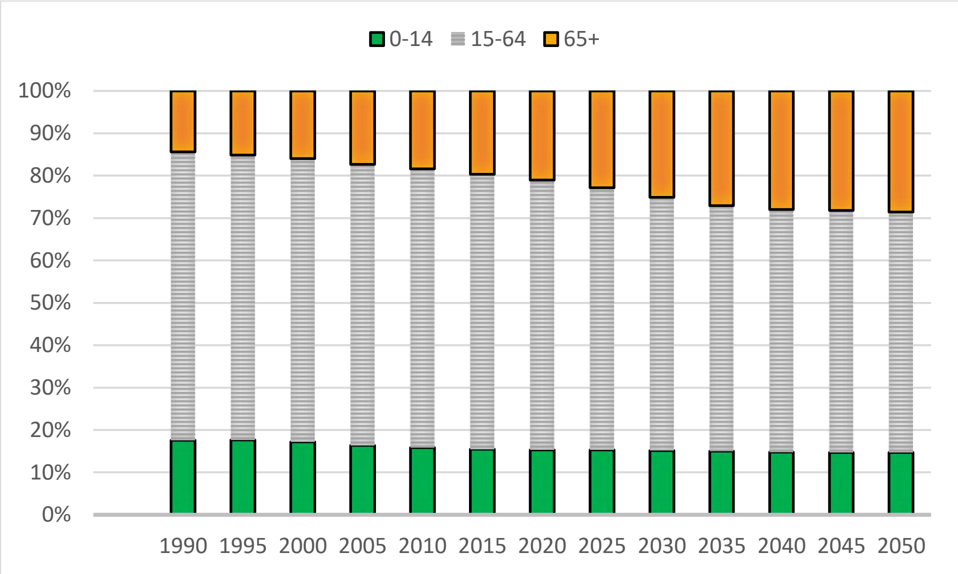

Figure 1. Trend for population age structure in Ukraine, 1990-2050.
Source: 2017 Revision of World Population Prospects

Hence, referencing to the projections and discussions, we expect population aging in Ukraine to progress. Our study aims at estimating the relations between current demographic trends and economic factors in order to determine the future economic challenges that aging may imply.

According to the literature, demographic changes and economic characteristics are linked via three main channels: labor market, financial market and shifts in fiscal policies.

To begin with, the impact of the demographic trend on labor force is straightforward – the decrease in working-age population leads to the decrease in the absolute labor force. What is more, transition also occurs inside the working-age population – trends for Ukraine show a decrease in 15-39 share in favor of 40-64, while the second group correlates with lower participation ratio (Kupets, 2016).

Moreover, there are studies providing evidence that elderly people are likely to have lower productivity (Maestas et al. 2016, Feyer and College 2008, Aiyar 2016). However, researches usually estimate the hump shape of age-productivity relationship – meaning that productivity rises up with the age to some point and drops only after reaching it. Therefore, an increase in the median age in Ukraine may be a favorable outcome for overall production if the peak has not been reached yet.

It also should be mentioned that aging is likely to have a significant effect on the demand side for healthcare and education. A body of empirical evidence shows that elderly have a higher demand for ambulatory, inpatient and chronic care, which leads to the necessity of increasing and improving the healthcare sector (World Bank, 2007). On the other hand, aging society is likely to face the oversupply of schools and colleges, as historically Ukrainian educational sector is associated with the sticky supply and slow responses to the market changes.

From the macroeconomic point of view, the age structure has a considerable effect on the economic growth through financial markets. Intuitively clear that elderly do not have any reasons for saving up money anymore, so they spend most of their income as well as previous savings. The link between age and savings is consistent with the life-cycle theory and empirical evidence show that the increase in 1 per cent of 65+ cohort is associated with a 0.6 per cent drop in private saving rate. (Loayza, Schmidt-Hebbel, and Servén, 2000). Further studies strengthened this hypothesis for East European and former Soviet countries and showed that 1 per cent rise in proportion between elderly and working-age population may result into 2.2 per cent decrease in savings rate (Chawla et al, 2007).

After all, countries with a high proportion of old people are likely to allocate more resources to take care of them. An overall increase in the number of old people tends to increase total government spending on healthcare and pensions, while a rise in relative share may lead to weighing the burden on working age population through taxes. Such allocation of resources tends to depress the pace of economic growth.

It is important to estimate the influence of demographic trends in Ukraine on overall economic performance to understand whether the current and future trends should be considered and treated as an acute problem. Given all the negative influence through discussed channels, our hypothesis states that population aging slows down the economic growth and has a significant effect on the GRP per capita growth.

In this study, we will focus on regional-level data because of the number of factors:

1. Cross-country analysis fails to account for country-specific circumstances. To be more precise, after the war in 2014 many country-level indicators are truncated. For example, population shrinks by 6 million not because of real changes, but due to annexation of the Crimea and complexity of estimating the population changes on the temporarily occupied territories.
2. There are huge differences in demographic factors and industry specifics between regions. Different regions are affected in a different manner, so overall estimates for Ukraine will not provide detailed information for accurate policy implementations.
3. We are additionally interested in finding the evidence of regional convergence for Ukraine, as the research on this topic was not conducted yet. Economic convergence is a convenient concept that may justify investing and developing certain regions or industries.

To this extent, we purpose at comparing the GRP growth between regions, find the evidence of conditional convergence and understand whether demographic changes can explain variation of the development rate in different regions. This could give us insights on the damage of future trends to the economic well-being of each particular region and general consequences for Ukraine.

The faster dependency ratio growth is expected to set up the lower steady state of GRP per worker (economic well-being), as well as regions with a higher initial level of dependency ratio are supposed to grow slower, explained by harmful effect of smaller workforce to the economic growth.

To deal with a high heterogeneity across regions we make use of the panel data specification for each of them – 24 oblast', autonomous republic Crimea and two cities: Kiev and Sevastopol for the period between 2004 and 2017[3]. The data were obtained from annual records of regional economic statistics of the State Statistics Service of Ukraine.

The structure of this paper is as follows: Chapter 2 describes the literature on the relation between the age structure and key economic variables; Chapter 3 provides the methodology and model specification; Chapter 4 presents data sources, descriptive statistics of the variables and possible issues concerning the data; Chapter 5 is devoted to empirical results and their discussion; Chapter 6 generalizes all findings and provides a brief discussion of possible implementations.

[3] There is no data available for the AR Crimea after 2014, so AR Crimea and Sevastopol have shorter observations than other regions (2000-2014)

Chapter 2

LITERATURE REVIEW

The topic of our research is not new for the modern literature. The number of articles has grown exponentially as Europe and the USA entered the last stages of the demographic transition. However, it is worth discussing how the topic was developed.

Kuznets (1960) was a starting point to the economists in this field. He was the first one to link the changes in demographic and economic performance by using data for the US in the period between 1865 and 1925. He stated that medium-term variation in output growth rate was connected with population growth rates as well as changes in the age structure explaining it by different economic behavior of age cohorts.

The postwar baby boom in the late 1940s and the 1950s imposed significant changes on the demographic structure representing unique phenomena and heating some interest in economic studies. For example, Fair and Domingues (1991) studied this question by using a low order polynomial function on the US data and detected a statistically significant influence of age distribution on consumption, housing investment and money demand.

Another American study driven by this phenomenon was done by Shoven, Topper and Wise (1994). They were concerned about the important question - economic pressure on government support programs when the generation of the baby boom retired. Using population projection given by the US, they calculated that future costs imposed mainly through health-care and pension systems on the government was going to rise by 1 trillion dollars in the next 50 years. Referring to the results, they suggested smoothing the changes by reforming health-care sector.

Bloom (2001) provided a great summary of all ideas from academic papers devoted to the link between economic growth and age structure for different world regions. Describing the trends in all countries, he showed examples that the increase in the working-age share of the population together with low fertility rates were associated with a demographic dividend to the economy while the increasing number of children or elderly required resources for their maintenance and dampen the economic growth.

The latest research on the macroeconomic effect is done by Aksoy et al. (2016), who developed his own model and estimated the impact of demographic changes on key variables, measuring the performance of 21 OECD countries over the period 1970-2007. The model captures the relationship between demographic trends and economic growth, suggesting that population aging should be associated with reducing in overall output and interest rates. More specific, the age structure has a significant influence on the output growth, savings and investment, working hours per capita, output per worker and inflation. In addition, the authors found negative economic impacts of population aging through the increase in consumptions and foregone impact of young workers on implementing innovations.

Considering other areas of impact, population aging enforces significant changes to the labor market via an actual decrease in the labor force. The mechanism is straightforward – if the share of old people increases, then the share of working-age cohort decreases and economy will experience shrinkage in human resources.

The World Bank (2007) presented a report with projections of population aging impact and due to their estimates labor force forecasted to diminish in all transitional countries in the future decades. However, they struggled to provide an overall prediction of economic consequences from the decrease in labor force only, as its strongly connected with the labor force participation, development of worker's productivity and if people out of working age retire or continue to work.

What is more, Börsch-Supan (2003) argued that the decrease could be larger than expected by The World Bank. His argument is that changes in the relative size of age groups were likely to result in growing taxes, which in its turn leads to a larger difference between gross and net wage, discouraging youth from entering the labor market.

However, population aging may not bring negative consequences to the economy if human resources are provided out of working age group or the same output can be produced using less labor. As the first solution implies using child labor or pensioners, it is not likely to be the case for developed countries. Therefore, an increase in productivity will be a crucial factor to deal with the current demographic trends, while the effect of this trend on productivity itself remains uncertain.

Malmberg, Lindh, Halvarsson (2008) presented a positive link between the plant-level productivity and share of prime-age workers using the plant-level data from Statistics Sweden covering 1985-1996 years. Their results were in line with "Horndal effect (1985)" for the US manufacturing.

Moreover, Feyrer and College (2008) explained the productivity gap between rich and poor countries mostly by using their age structures. The results of the study imply that 50-year-old workers are 60% more productive than 20-year-old workers are. So, poor countries suffering from the low life expectancy are forced to use young workforce, which is possibly undercut the productivity growth.

On the other hand, Aiyar (2016) investigated the channels of influence on productivity and identified that aging mostly related to decreasing in TFP growth. The estimated effect from projected aging for Europe was a drop by 0.2 percentage points in TFP annually over the next 20 years.

The most recent and exhaustive study on this topic belongs to Maestas, Mullen and Powell (2016), who estimated the effect of 10% increase of 60+ age cohort with the decrease of the GRP per capita growth by 5.5% only through the labor market. The effect of ageing leads to the drop in labor productivity, which accounts for the two-thirds of the overall effect, as well as slower labor force growth accounts for the remaining one third. Given their estimates, they conclude that the USA growth rate loses up to 1.2% annually due to aging.

The rate of economic growth is one of the most important variables measuring the economic performance of the country. Thus, many economists were concerned about developing the most accurate specification for this factor. For example, neoclassical model of growth implies that the initial level of income per capita has negative relationships to economic growth, thus poor regions always grow faster than rich ones. This theory was suggested by Ramsey (1928), Solow (1956) and further developed by Cass (1965), and Koopmans (1965).

However, the empirical latter studies show that this holds only if regions are similar in settings and preferences, so Barro and Sala-I-Martin (1995) introduced the model of beta-conditional convergence, where economic growth should be additionally controlled to the divergence between economies. In our study, we adopt their idea due to a high heterogeneity among regions in Ukraine – differences in economic specialization, population structure, infrastructure, investments and climate.

Following the model of conditional convergence, Aiyar and Mody (2011) estimated the economic dividend from the increase in working-age share for each of Indian states. Using initial levels and growth rates of labor participation and working-age share, they explained about 75% in variations over regional GRP growth for the period between 1970 and 2001, finding that regions benefit from the increase in the working age share. The demographic transition is responsible for about 3% of annual GRP growth of the poorest states in India.

Matytsin, Moorty and Richter (2015) tested the same approach on the Russian region-level data for the period of 1990-2011. They find the consistent with the previous study results – demographic trends has a significant impact on economic growth. Furthermore, authors showed that Russia experienced economic dividend for the given period, but population projection suggests that in the future demographic changes are likely to have a compelling negative impact and may prevent convergence, making poor regions even poorer.

Overall, almost all mentioned studies link aging with negative economic impact through different channels. Building a macro economical model that takes into account mentioned links would be an important further development of a topic. Still, we find our study a nice opening to the economic impact of demographic trends in Ukraine that uses regression analysis including the discussed variables in a conditional convergence framework.

C h a p t e r 3

METHODOLOGY

In this section, we describe a model able to capture changes in GRP per capita growth between regions using demographic factors discussed in the previous chapters.

Following Barro and Sala-I-Martin (1995), we use a conditional beta-convergence equation to estimate the differences in the economic growth:

$$g_z = \lambda \left(y^* - y_0\right) \tag{1}$$

In this equation g_z is growth in income per capita or GDP per capita, as in our case, y^* is a long run steady state level of GRP, while y_0 denotes initial level of GRP for each region. What is more, λ shows the regional speed of convergence to the steady state level.

This equation implies that initial GRP per capita determines the regional economic growth over time. What is more, regions that are more distant from their steady state will grow faster than regions that are close to it.

In other words, poor regions with low initial level of GRP are likely to be far from their steady state and expected to grow faster than rich ones if the convergence holds.

We should note that as y^* is a conditional steady state, it depends on both economic and demographic factors, which are also included in the model. Hence, we control for number of additional factors that might influence a long-run steady, but some components are time-invariant and cannot be included in a model directly.

In order to link the GRP growth with the demographic data we will use the following identity:

$$\frac{Y}{N} = \frac{Y}{L} * \frac{L}{W} * \frac{W}{N} \qquad (2)$$

Where, Y denotes GRP per capita in UAH, N – total population of a region, L – labor participation ratio and W states for working age share of a population.

According to this equation, GRP per capita is the product of GRP per worker (productivity), labor participation ratio and ratio of working age cohort to the overall population in the region.

We find the most appropriate indicator to capture demographic changes to be the dependency ratio – the ratio between young (0-15 years) or old (65+ years) and working-age (15-64) population, as it will reflect both aging and shrinking of the middle age group. What is more, it could give us an insight about how the increase in old age cohort alone affects the economic growth.

Therefore, we take one additional step to link working age and dependency ratio:

$$\frac{W}{N} = \left(\frac{(Young + Old + W)}{W}\right)^{-1} = \left(\frac{(Young + Old)}{W} + 1\right)^{-1} \qquad (3)$$

Taking logs from the described identity gives us:

$$y = y_p + y_l - y_d \qquad (4)$$

Where, y is the log of GRP per capita, y_p is the log of productivity, y_l is the log of labor force participation ratio and y_d is the log of dependency ratio.

As we cannot build our analysis on the identity, we will drop the workers productivity term out of the equation before the next step substitution.

Further, we plug-in the GRP decomposition into the convergence equation and rewriting it for all regions, time periods and control variables we obtain the following model:

$$growth_{i,t} = py_{i,0} + a_1 dependency\ ratio_{i,0} + a_2 dependency\ ratio_{i,t} + a_3 LFPR_{i,0} + a_4 d.\left(LFPR_{i,t}\right) + X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (5)$$

Where:

$growth_{i,t}$ – The difference between the current and previous level of GRP per capita measured as $y_{i,t} - y_{i,t-1}$;

$y_{i,0}$ – Initial level of GRP per capita of each region;

$Dependency\ ratio_{i,t}$ – Level of old and young dependency ratio at period t for each region;

$d.(dependency\ ratio)_{i,t}$ – Changes in dependency age ratio between period t and t-1 for each region;

$LFPR_{i,t}$ – Labor force participation rate at period t for each region;

$X_{i,t}$ – Matrix of time varying control variables (in our case they are investment, government expenditures, population density and sex ratio);

μ_i – All time invariant characteristics for regions (represented by the region dummies and few controls as area of a region and share of urban population);

τ_t – Time effects to control for changes in Ukrainian economy;

$\varepsilon_{i,t}$ – Independent and identically distributed shocks with zero mean.

As time invariant characteristics for regions (μ_i) in our model we intend geographical location, climate, natural endowment, cultural tendencies. Many of them cannot be accounted parametrically in our case, so we add regional dummies, which are expected to take away the effect of the remaining differences between the regions.

In accordance to the convergence literature, we expect the initial level of GRP to have a negative sign – imposing that poorer regions grow faster, converging to the richer. What is more, higher initial dependency ratio may dampen the growth, while higher level of labor force participation ratio can be responsible for faster growth.

Concerning our hypothesis, we expect growth in both old and young dependency ratio to have a negative effect on the dependent variable. As discussed, Ukrainian regions experienced decrease in young dependency ratio because of demographic transition, which leads to the simultaneous decrease in the number of children and increase in the working age share. Such effect is expected to be beneficial, as more people are able to work and produce GDP. Following the same logic, future increase in the old-age ratio may have the adverse effect for the same reason – less people will be able to work.

However, the nature of young and old dependency are different, so the relative strength of the effect is hard to predict – elderly are likely to burden the middle age group by demanding more economic resources for the support (pensions, social securities and healthcare), while children additionally require a lot of non-monetary resources (time and social capital).

The choice of the control variables was mostly driven by their availability for Ukraine; still the discussion about the relevance of our controls should be made.

To begin with, government spending is used to control for the demand of social benefits by the society. According to the literature, government spending usually have negative relations to the economic growth, as they are used to establish social justice and transfer the money from rich to poor groups instead of focusing on economic development.

Nonetheless, we are able to pick out the three largest components separately, namely healthcare, education and social security expenditures. Healthcare and social securities are likely to have some negative effect on growth as higher expenditures are associated with the larger share of unemployed and/or pensioners. On the other hand, high expenditures on education can be identified as an investment in future generations and may be favorable in the long run. What is more, current regional spending on education is highly correlated with the previous levels, so regions with higher spending may be already advanced with the more skillful workforce.

The investment effect is likely to be straightforward – higher investment in the current period is associated with the faster growth through increasing in real production and demand for the workforce on freshly created positions from the investment.

To deal with the high level of heterogeneity among Ukrainian regions with only a limited number of control variables we will be using the panel data specification. The most appropriate method to deal with μ_i would be using fixed effects, but working in the frame of conditional convergence, this approach will eliminate both unobserved individual effect and initial values of explanatory variables.

As a possible solution, we introduce an additional assumption that the regional steady state should be considered as dynamic and idiosyncratic. For example, if a certain macroeconomic shock in period *t* had different influence on agricultural and industrial sector, these regions would have benefited / struggled more than others and long run steady states would affected in a different manner. In addition, a dynamic steady state may be caused by changes in region policies, improvement of institutions or influence of cultural trends

Under this assumption, our previous equation takes form:

$$d.(y_{i,t}) = py_{t-1,0} + a_1 dependency\ ratio_{t-1,0} + a_3 LFPR_{t-1,0} + a_2 d.(dependency\ ratio_{i,t}) + a_4 d.(LFPR_{i,t}) + X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (6)$$

It implies that the growth of GRP per capita depends not on *initial* wealth and *initial* demographic characteristics, but on factors *at the start of each period*. Still, convergence holds if regions with lower GRP in period t-1 experienced larger growth during this period.

Given model allows us to use fixed effects estimations, which are likely to provide more consistent results than random effects. In addition, the relevance of using random effects over fixed for the equation 6 and fixed over random for the equation 5 was tested and proved.

Chapter 4

DATA DESCRIPTION

The research is based on the data gathered from annual reports of regional statistics provided by the State Statistics Service of Ukraine. It is a regional-level annual data, containing different demographic and economic characteristics for Ukraine. In addition, it was merged with regional government spending taken from annual budget reports.

The data are available for 27 administrative units of Ukraine – 24 oblast', AR Crimea and 2 cities – Kyiv and Sevastopol. The time period of our analysis is from 2000 to 2017, but the data for AR Crimea are not available for the 2014 – 2017, while Donetsk and Luhansk regions experienced a huge drop in all factors in the same period. Still, the information from these regions and data for 2014-2017 from all other regions are important for us, so we are going to work with unbalanced panel data. (Number of total observations is 443).

We aim at the analysis of demographic determinants of economic growth measured as the difference in levels of GRP per capita between two years.

The average annual GRP growth varies from 2.5% (Zakarpatska oblas't) to 8.8% (Sevastopol). Kyiv and Sevastopol are likely to experience relatively huge growth because of the differences in administrative structures between cities and regions. Thus, variation cannot be explained by demographic factors we are interested in. To keep the results consistent we will use only the data for 24 oblast' in the main part of our analysis.

The three leaders for the average growth are AR Crimea, Kirovograd and Donets'k Regions, while three most slowly developing regions are Zakarpattya, Sumy and Zaporizhzhya Regions. (Figure 2)

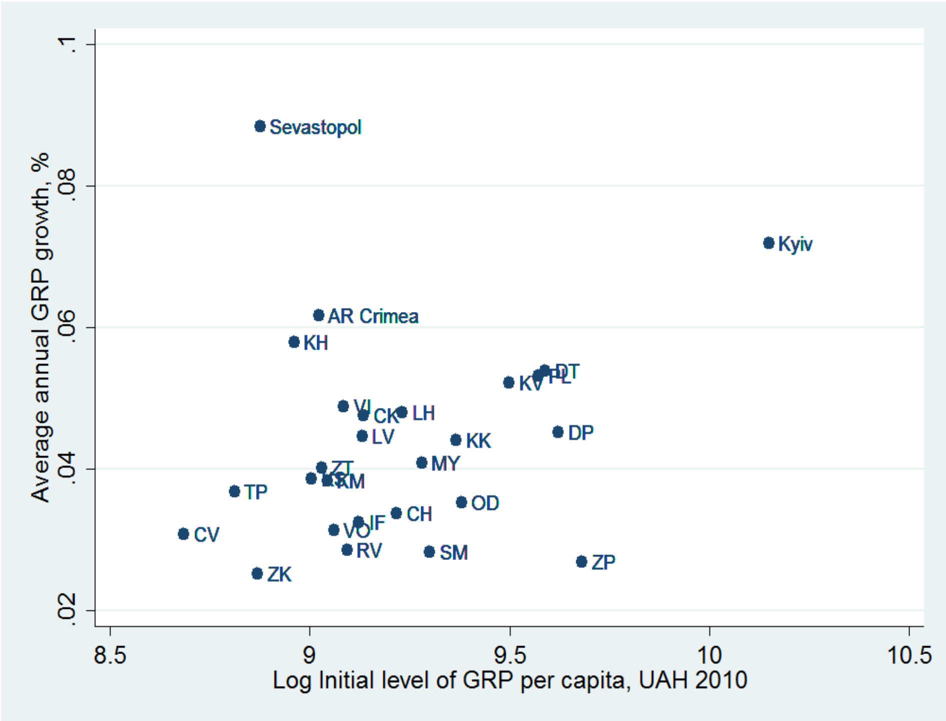

Figure 2. Regional annual average growth, 2000-2017 vs initial level of GRP, 2000.

Source: State Statistics Service Reports, 2000-2018.

In addition, we can see that there is no clear dependence between the initial level of GRP and annual growth for Ukrainian regions.

Another effect to be estimated is the impact of the dependency ratio on regional growth. We define dependency ratio as a proportion of people below and above the working age relatively to the working age cohort:

$$Dependency\ ratio = \left(\frac{total\ number\ of\ 0{-}14}{total\ number\ of\ 15{-}64}\right) + \left(\frac{total\ number\ of\ 65+}{total\ number\ of\ 15{-}64}\right)$$

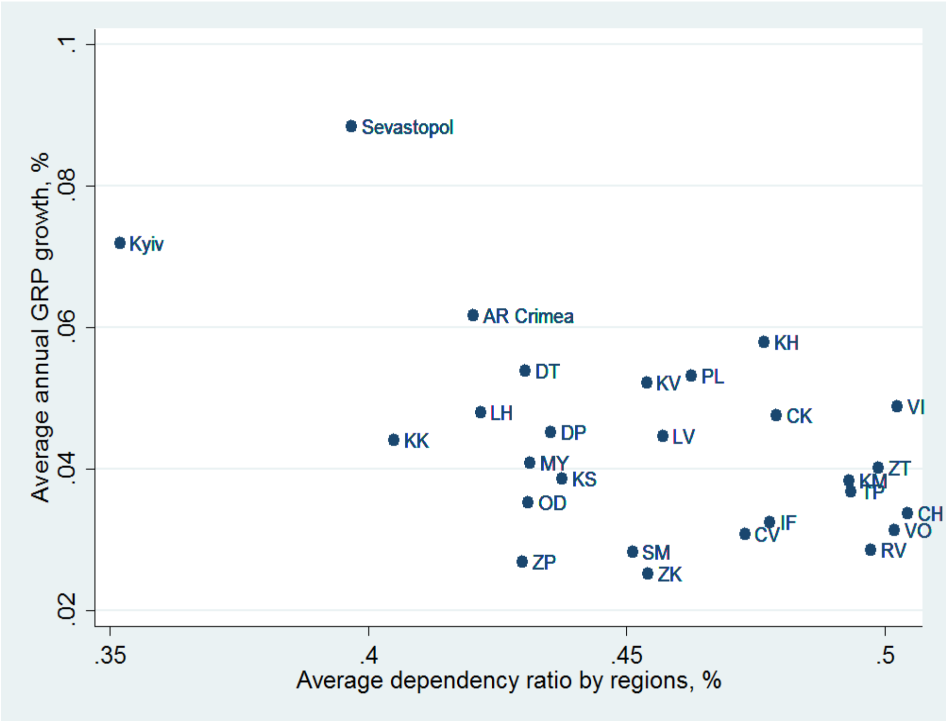

Figure 3. Regional annual average growth vs Average dependency ratio for the all regions, 2000-2017.

Source: State Statistics Service Reports, 2000-2018.

The relations between the dependency ratio and economic growth looks "clearer", as we can see regions with a high dependency experience lower growth in comparison to others. Still, the causality of the effect is investigated in the next chapters.

As a next step, we divide regions into two groups: poor and rich, based on the median level of initial GRP per capita (GRP in 2000). At this step, we drop the city of Kyiv and Sevastopol and finish up with 12 poor and 13 rich regions.[4]

Figure 4 shows that there is no evidence of unconditional convergence for the Ukrainian data. Regions with lower initial level of GRP have the same or even smaller growth over the last 17 years than rich regions.

[4] Below the median (poor) are: Cherkasy, Chernivtsi, Ivano-Frankivs'k, Kherson, Khmelnytsky, Kirovograd, Lviv, Rivne, Ternopil, Vinnytsya, Volyn, Zakarpattya and Zhytomyr regions; Above or on the median (rich) are all other regions.

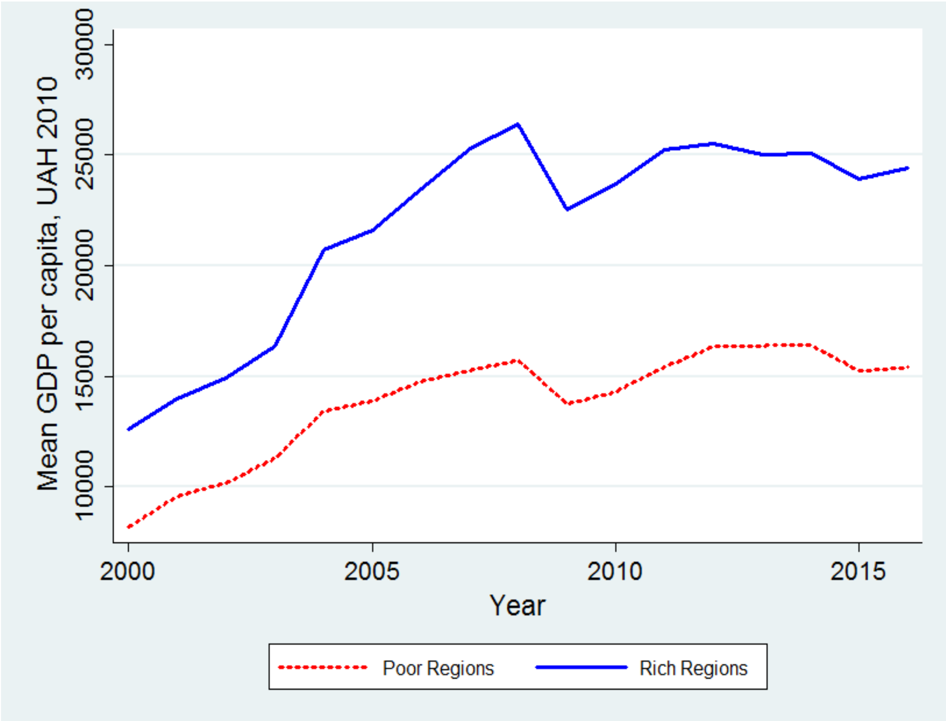

Figure 4. Mean GRP per capita for poor and rich regions, 2000-2017.
Source: Own estimations.

On the other hand, the evolution of dependency ratio and other variables can give us insights about whether the concept of conditional convergence holds for Ukrainian regions.

It can be seen from Figure 5, that the level of young dependency ratio was initially lower in rich regions and across time it moved simultaneously for both poor and rich. Old dependency ratio follows the opposite pattern being initially at the same level in poor and rich regions but growing faster for rich ones. One of the possible explanation is the preferences of middle age cohort to move to the richer regions and stay there for retirement.

It is also interesting to note, that initially rich regions ended up having an increase of 3% in old dependency ratio, while poor regions are the same level as they were in 2000. In contrast, young dependency ratio dropped by more than 5% for both poor and rich regions with the larger decrease for rich regions.

On the country, we expect regions with a higher growth to have an increase in young age cohort as favorable economic environment usually increases the birth rates. Opposite pattern means that higher regional economic growth is likely to be partially explained by the shift in the young age cohort in favor of middle age group.

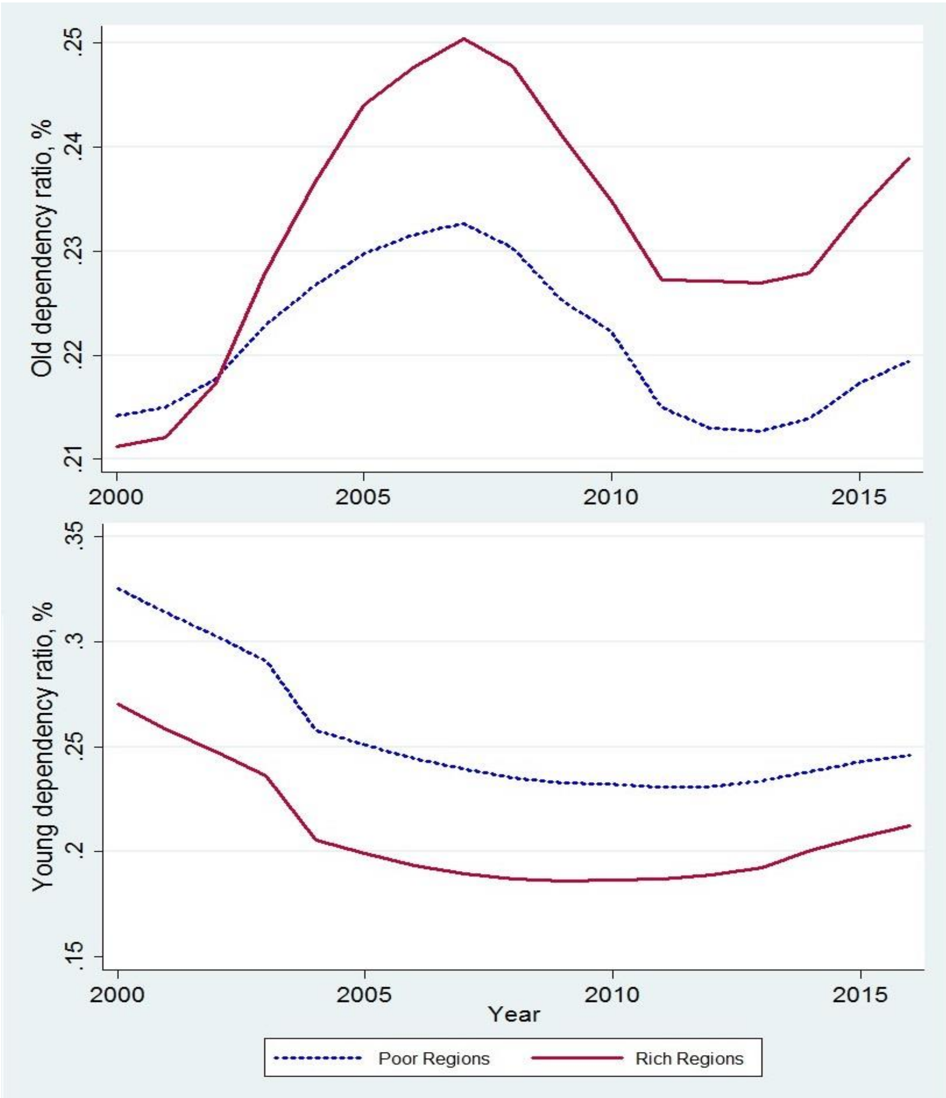

Figure 5. Evolution of mean dependency ratio in rich and poor regions, 2000-2017.

Source: Own estimations.

Table 1 provides descriptive statistics for our important control variables such as government spending on health, education and social securities UAH per capita, capital investment in regions and labor force participation rate of people aged 15-64.

It is interesting to note that mean investment are almost twice higher in initially poor regions than rich, meaning that there was policy attempts to fasten the development of lagging regions and contribute to the equality and convergence.

Descriptive statistics for all other variables is provided in Annex A.

Table 1. Descriptive statistics of main control variables between rich and poor regions, 2000-2017

		Health	Education	Social secuties	Investment	LFPR
Unit of measurement		UAH per capita, constant 2010 UAH				%
Poor	**mean**	651.4	875.4	635.1	4637.4	64.86
	min	304.5	283.4	134.4	961.7	56.0
	max	1313	1355.3	1515.2	23643.8	72.7
Rich	**mean**	610.5	962.7	697.7	2507.0	62.3
	min	249.6	317.6	128.8	634.9	50.1
	max	1313.5	1491.0	1500.1	7620.1	72.2
Total	**mean**	632.0	916.8	664.8	3613.0	63.63
	min	249.6	283.4	128.8	634.9	50.1
	max	1313.5	1491.0	1515.2	23643.8	72.7

C h a p t e r 5

ESTIMATION RESULTS

In this section, we discuss chosen model specifications and how they contribute to provide unbiased estimations for the impact of demographic changes. As considered in methodology section, we have two similar models: conditional beta-convergence equation and its weaker version with dynamic demographic inputs.

5.1. Static Steady State

The first model (equation 5) was estimated using random effects GLS regression in order to keep initial values along with tackling the heterogeneity between regions. Results are presented in Table 2.

Despite the fact that the initial level of GRP per capita has an expected sign, it is not statistically significant likewise other initial values of demographic factors, so estimation results suggest that conditional convergence does not hold.

Our initial hypothesis is confirmed as we found a strong negative link between GRP growth and the dependency ratio. Control variables also have an expected effect on the economic growth – positive influence of investment and increase in labor force participation ratio and negative effect of government spending.

The elasticity of the total dependency ratio seems to be very high – for 1% increase in dependency ratio GRP growth would decrease by 3.97%. Still, 1% decrease in working age cohort will decrease dependency ratio by less than 1%, so the results needed to be interpreted cautiously by the reader.

We can see from Column (2) that the increase in young dependency ratio has more negative economic effect than the increase in old dependency ratio. Given results imply that regions with lower share of youth have higher growth of GRP per capita, while share of old people doesn't influence economic growth.

There are few possible explanations on the relative size of the dependency ratio coefficients. The most intuitive concerns differences in nature of load that children and elderly imposes for the economy.

Childbirth in a family often compels mother to be off the work up to 3 years on a paid basis and after the end of maternal leave there is a probability of exiting the workforce to be a full day stay-at-home parent. Therefore, the increase in young age cohort will also drag a decrease in workforce participation, which has a negative impact on the economic growth. What it more, there is a proven link between good sleep and productivity, while newborn babies in family are likely to be the reason of a bad sleep for both of parents.

What is more, the actual contribution to the economy from old-aged and young-aged people are different. We do not have a data on how many of 64+-age cohort continue working, but we may assume that healthcare system is improving considerably in Ukraine and the rise in life expectancy leads to additional years with high quality health, so old-age people do not quit labor force and continue to produce output.

In addition, there is less the optimistic issue of low pensions below the sustainable level that force pensioners to continue working. It still results in an increase of GDP, while child labor is highly unpopular in Ukraine and thus the young age group is likely not to contribute to the economic growth at all.

Table 2. Estimation results using model 1 (equation 5)

Dependent variable: Annual GRP per capita growth		
	(1)	(2)
Log of initial level of GRP per capita (2000)	-0.00401	-0.00185
	(0.0262)	(0.0262)
Log of initial participation ratio	0.0654	0.0736
	(0.0691)	(0.0652)
Log of initial young dependency ratio		-0.0607
		(0.167)
Log of initial old dependency ratio		-0.0505
		(0.132)
Log of initial overall dependency ratio	-0.151	
	(0.126)	
Growth of total dependency ratio	**-3.973*** **	
	(0.572)	
Growth of young dependency ratio		**-1.434*** **
		(0.145)
Growth of old dependency ratio		**0.175**
		(0.208)
LFPR growth	0.00625***	0.00586***
	(0.00177)	(0.00166)
Population density	-0.000275**	-0.0003***
	(0.000145)	(0.000121)
Investment per capita (thnd. UAH)	0.000937	-0.00250
	(0.00294)	(0.00282)
Government spending on -Education per capita (thnd UAH)	-0.102*** (0.0344)	-0.0584* (0.0341)
-Health per capita (thnd UAH)	-0.0739	-0.0166
	(0.0569)	(0.0571)
-Social securities per capita (thnd UAH)	0.0383	0.0465*
	(0.0254)	(0.0240)
Constant	-0.0205	-0.207
	(0.298)	(0.297)
Observations	373	373
Number of Regions	24	24
R-squared	0.61	0.733

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, Estimations are provided for 24 regions, 2000-2017

5.2. Dynamic Steady State

The second model weakens the restriction of unconditional beta convergence and implies that region grow faster if it was poorer at the start of the period (not initial point of time).

We can see from the Table 3 that coefficients on the past levels of GRP per capita are significant, as well as the previous levels of old and young dependency ratio. Results imply that if the region has a 1% lower GRP per capita in the current period it is likely to outperform the economic growth of more developed regions in the next period by almost 0.5%, which is in line with the convergence theory.

In addition, we can see from a Column (2) that a lower proportion of an young aged group at the start of a period boost the GRP growth, while overall dependency doesn't matter much as young and old dependency have adverse effect which cancels out in total.

The impact of the total dependency ratio growth is more or less the same as in the previous model - 1% increase in overall dependency leads to 2.67% decrease in the annual GRP growth. Even though both old and young dependency growth is significant with the following specification, the magnitude of young dependency is twice higher and likely to absorb the positive effects associated with the old age group.

Overall, the model with random effects and decomposed demographic variables as well as the model with fixed effects can explain about 60-70% of the variation in annual GRP growth between regions.

Table 3. Estimation results using model with dynamic steady state (equation 6)

Dependent variable: Annual GRP per capita growth		
	(1)	(2)
Log of GRP per capita in period t-1	-0.363***	-0.477***
	(0.0328)	(0.0421)
Young dependency ratio in period t-1		-0.279***
		(0.0961)
Old dependency ratio in period t-1		0.226***
		(0.0804)
LFPR in period t-1	-0.150	0.0737
	(0.110)	(0.107)
Overall dependency ratio in period t-1	0.0775	
	(0.137)	
Growth of overall dependency ratio	**-2.671*** **	
	(0.510)	
Growth of old dependency ratio		**0.573*** **
		(0.206)
Growth of young dependency		**-1.102*** **
		(0.134)
Population density	-0.00122***	-0.000407
	(0.000379)	(0.000375)
Investment per capita (thnd UAH)	0.0175***	0.00841**
	(0.00357)	(0.00358)
Government spending on -Education per capita (thnd UAH)	0.0401	0.0500
	(0.0429)	(0.0406)
-Health per capita (thnd UAH)	0.0866	0.0715
	(0.0649)	(0.0621)
-Social securities per capita (thnd UAH)	0.0819***	0.0911***
	(0.0238)	(0.0225)
Constant	4.242***	4.160***
	(0.485)	(0.568)
Observations	373	373
R-squared	0.563	0.619
Number of Regions	24	24
Country FE	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, Estimations are provided for 24 regions, 2000-2017

5.3. Robustness check

To be confident that our findings are stable, we conducted robustness check. Several modifications are available to test:

1) Change the working age group definition. We attribute people below 15 to the young age group and people above 65 to the old age group, while usually children start working only after 17 (their graduation for the 11th grade in school or college) and retirement age was 60 for the 2000-2016 in the Ukraine. Hence, the new definition implies that young age cohort is 0-17, working age is 18-59 and old age group is 60+. In this manner, we expand the dependent groups both from the bottom and from the top, so we expect the coefficient become smaller in a magnitude, but have the direction of the effect.

2) Working with the perfect balanced data. We know the nature of reasons why certain regions[5] in our panel lacking the data and we believe that they can be treated as 'random'. Still, unbalanced panel implies using GLS, where all the coefficients are weighted in order to minimize possible biased depending on their variance. This approach possibly may lead to biases in the results, so we see a point in checking if the results will differ.

3) Working with the full available data. At the step of describing the statistics, we have found that two cities – Kyiv and Sevastopol as well as AR Crimea experienced much faster growth than any other region in Ukraine. Our assumption is that the reasons of such swift growth is institutional and infrastructural, but not socio-demographical. Therefore, for the sake of our analysis, we treated them as outliers and these observations were not used for the final specifications. If the results are stable, bringing such observations back will not influence the results much.

For the first case, results are presented in the Table 4. From it we can see that the elasticities of the young and old dependency ratio varies much depending

[5] Donets'k, Luhansk and AR Crimea for 2014-2017

on a chosen set of controls, but all significance levels and the directions of the effects are sustained. Even if we define old-age group as 60+, the increase in the proportion of this group relatively to the middle-aged group is not associated with the large losses.

Specification in column (4), which uses no controls at all, predicts the highest positive impact from growth in old dependency but in the same time it predicts largest loses from the changes in young dependency. As both of these changes appear simultaneously we may predict that the effect of the increase in young dependency ratio is stronger which will dampen the economic growth.

Overall, we may state such results as an evidence of robustness of our findings. What is more, this specification also highlights that higher initial levels of the dependency ratio and labor force participation ratio in initial period do not influence the economic growth, which implies the absence of conditional convergence in demographic framework.

For second and third cases, we have found that the econometric results didn't change at all. The elasticity of the growth of dependency ratio have almost the same values at the same levels of significance.

Table 4. Robustness check using model 1 (equation 5) for alternative age cohort definition

Dependent Variable: Annual GRP growth per capita				
	(1)	(2)	(3)	(4)
Log of initial level of GRP per capita (2000)	-0.00806 (0.0205)	-0.0181 (0.0211)	-0.0121 (0.0312)	0.0181 (0.0128)
Log of initial participation ratio	0.0799*** (0.0279)	0.0897*** (0.0343)	0.0756** (0.0331)	0.0560** (0.0239)
Log of initial young dependency ratio	-0.0556 (0.0759)	-0.0411 (0.0855)	0.104 (0.162)	0.178* (0.104)
Log of initial old dependency ratio	-0.0304 (0.0542)	-0.0474 (0.0519)	0.0306 (0.0556)	0.0426 (0.0506)
Growth of young dependency ratio	**-1.172*** (0.372)**	**-1.190*** (0.355)**	**-1.034** (0.480)**	**-2.590*** (0.374)**
Growth of old dependency ratio	**-0.158 (0.325)**	**-0.153 (0.316)**	**0.132 (0.478)**	**0.981** (0.440)**
LFPR growth	0.00649*** (0.00141)	0.00632*** (0.00141)	0.00557*** (0.00144)	0.00428*** (0.00148)
-Health per capita (thnd UAH)	-0.0628 (0.0600)			
-Social securities (thnd UAH)	0.0392* (0.0209)	0.0358* (0.0202)		
-Education (thnd UAH)	-0.104*** (0.0292)	-0.131*** (0.0184)	-0.118*** (0.0163)	
-Investment (thnd UAH)	0.00383*** (0.000878)	-0.00258 (0.00340)	0.00401** (0.00160)	
Population density	-0.0004*** (0.000109)	-0.000394*** (9.28e-05)		
Constant	-0.0906 (0.203)	-0.0510 (0.224)	-0.139 (0.325)	-0.498*** (0.171)
Observations	373	373	373	373
Number of Rid	24	24	24	24
R-squared	0.305	0.303	0.285	0.236

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, Estimations are provided for 24 regions, 2000-2017

C h a p t e r 6

CONCLUSTIONS AND POLICY RECOMENDATIONS

Using the panel for the Ukrainian regions, we investigated the link between demographic variables and economic growth in a conditional convergence framework. However, we fail to find evidence that the initial values of GRP or demographic variables influence the economic growth, the regions with a lower level of GRP per capita at the start of the period are likely to experience higher growth during this period.

Considering the second part of our results, we can say that Ukraine benefited from the demographic transition when the young and total dependency ratio was falling because of decreasing number of children and their shift to the middle age group. The recent years of the decrease in the working age cohort were connected with the decelerating rate of economic growth. The future demographic trends are likely to aggravate the current situation and slow down economic growth even more.

Still, we have found that an increase in the old-age cohort by itself does not bring negative economic consequences. A growing number of elderly is currently compensated by the benefits they continue to produce to the economy.

Nonetheless, future trends are associated with a large decrease in the working-age cohort, which will be much more of a problem, as the shrinking cohort is pressured by the responsibility towards both young and old. Following the experience of Europe, steps should be made to produce the same level of GDP using smaller and older workforce.

Otherwise, the pressure on the middle-aged group and adverse economic atmosphere may decrease the birth rate even more, causing the snowballing effect of the demographic crisis for the future generations.

Our study shows that increase in a young dependency has a substantial negative impact on the economic growth, however, we cannot target a decrease in young age cohort as it carries a decrease in working age group in 15 years. Therefore, one of the possible solutions is to reduce the negative influence of young dependency ratio.

As discussed, the impact is so large because children require a lot of time and social resources, which usually discourages mothers from participation in the labor force after childbirth. This issue can be partially resolved by establishing more nurseries, where children can spend time during the day and after the end of the working day return to the family. In such a manner, families will be less discouraged from having a baby and birth rates may be restored back to the replacement level.

Another option is to improve the health care sector and promote a healthy lifestyle. This will lead to an increase in quality-adjusted years of life so the elderly will be able to retire later or to replace young parents with childcare. It induces both a decrease in economic resources that older people require and an increase in their contribution to the economy.

Still, the working age group is predicted to outnumber the other two groups despite the swift rates of ageing. Thus, sufficient policy takes into consideration the working age cohort as well.

For example, additional years of schooling or training make people more skillful and productive and thus can compensate for the decrease in the number of workers. What is more, better education increases lifetime earnings and likely to prevent a person from working on harmful or dangerous for health jobs. Therefore, higher and easier payoff will reduce the incentives to retire at an early age.

The number of employed can also be enhanced by better education that gives flexible or deficient skills for the labor market. Overall, the rise in productivity is vital for sustainable economic growth, so the government should focus on providing young people with skills demanded by labor market to diminish unemployment and educational mismatch. In addition, the accumulation of human capital via training or educational courses while people are in work also may boost their productivity and should be promoted by the key policy.

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APPENDIX A.
DESCRIPTIVE STATISTICS

Table 5. Descriptive statistics of main variables, 2000-2017

	Obs.	Mean **(total)**	Mean **(poor)**	Mean **(rich)**	SD	Min	Max
Labor force participation ratio, %	416	59.95	59.43	60.61	3.521	50.10	72.20
GRP per capita, 2010 UAH	416	17,268	13,838	21,720	6,356	5,913	39,701
Annual GRP growth, %	391	0.04	0.04	0.04	0.086	-0.241	0.328
Old dependency ratio	416	0.226	0.221	0.232	0.030	0.156	0.320
Young dependency ratio	416	0.235	0.256	0.209	0.044	0.166	0.373
Total dependency ratio	416	0.461	0.477	0.441	0.042	0.376	0.587

APPENDIX B.

GEOGRAPHIC DIVISION OF UKRAINE

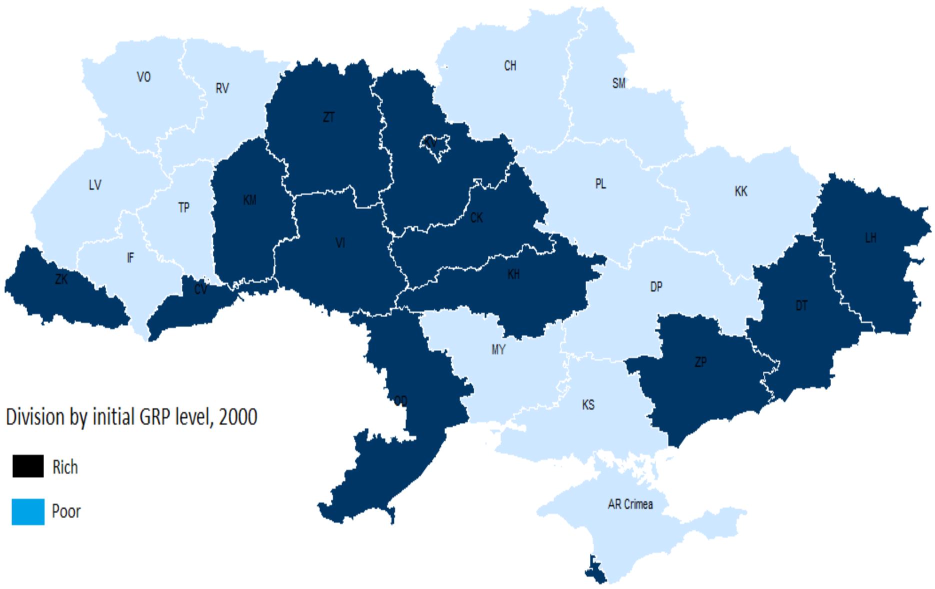

Figure 6. The division of Ukraine into poor and rich regions by level of initial GRP per capita, 2000.

Source: Own estimations.