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**ESTIMATING THE RELATIONSHIP
BETWEEN HEALTH AND
EMPLOYMENT
OF RUSSIAN PEOPLE IN
PENSIONABLE AGE**

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**ESTIMATING THE RELATIONSHIP
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OF RUSSIAN PEOPLE IN PENSIONABLE AGE²**

This paper provides an analysis of the labor supply of Russian people in pensionable age. It aims to answer two questions: (1) whether bad health is an important limitation for labor activity and (2) whether a greater pension benefit could be a stimulus for delayed retirement. This is an empirical work based on data of the Russia Longitudinal Monitoring Survey - Higher School of Economics (RLMS-HSE) from 2000-2010. Findings suggest that the most important factor of labor supply is income, and it is more significant for people with higher education. Bad health contributes to leaving the labor force, but the effect is smaller than income'. Some policy implications are also suggested based on the empirical results of the study.

JEL Classification: C2, J1, J2.

Keywords: labor supply, health, pensionable age, postponement of retirement, Russia, RLMS-HSE.

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1. Introduction

In many developed countries the population is ageing and in recent years this problem has affected developing countries, too. Russia is not an exception. According to official statistical data, in 2013 the share of population in above working age³ is 23.09%⁴ and it will increase to 28.8% in 2031⁵. This corresponds to high level of demographic aging. The consequences of this fact include increased pressure on the social security system, especially pension system.

One of the ways of solving the problem is to involve older people in the labor market. The importance of this is emphasized in the Organisation for Economic Co-operation and Development (OECD) report “Live Longer, Work Longer” (2006). The ongoing pension reform in Russia aims to create incentives for older people to delay their retirement. If retired after the official retirement age, a person will acquire additional ‘pension points’, so her pension benefit will increase in the future. But the effectiveness of this measure is questionable. One of the main issues is whether older people’s health status allows continuing work and whether the planned increase of payments is sufficient for delaying retirement.

To answer these questions it is necessary to reveal factors which make older people work, their relative importance and the influence of different restrictions. Recent Russian research on this topic show that the financial position of non-working retirees is much worse than those who work (Presnyakova 2006; Lezhnina 2008) and the majority of the population believe that the pension payment amount will be insufficient to maintain a good living standard (Kuzina 2012), so financial factors are rather important for the retirement decision. Also, a higher level of education increases the probability of being employed in older age (Merkuryeva 2004; Kuzina 2012; Lyashok, Roshchin 2012). Poor health is considered to be a significant limitation for the labor supply (Lyashok, Roshchin 2012). But the relative importance of these factors has not been determined. Thus in this paper attention will be paid to the marginal effects of different variables and their changes as a person ages.

³In Russia the official retirement age is 55 for women and 60 for men.

⁴ Rosstat (2013a). Demograficheskiy ezhegodnik Rossii. (The Demographic Yearbook of Russia) [http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1137674209312]

⁵ Rosstat (2013b). Predpolozhitel'naya chislennost' naseleniya Rossiyskoy Federatsii do 2030 goda - statisticheskiy byulleten' (Estimated Population of Russian Federation up to 2030 - Statistical Bulletin). [http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1140095525812]

The rest of the paper is organized as follows. Section 2 provides a review of relevant literature. Section 3 presents the hypothesis and data description. Descriptive statistics are presented in Section 4. Section 5 contains information about methods and results are discussed in Section 6. The paper ends with a conclusion.

2. Literature review

As the aim of this paper is to study factors of labor supply of older people, and especially the impact of health status, we are interested in the literature of several areas. First, we will examine papers devoted to the analysis of labor supply factors in general; second, literature focusing on the estimation of health impact.

Literature on labor supply is quite extensive. One of the first empirical studies dates back to 1934 (Douglas, 1934), wherein the elasticity of the labor supply (share of employment) by real wages in 38 cities was investigated. Factors investigated were gender, age and racial composition of the population. Later, the need to consider the variables of income – permanent income and current income deviations from this level – was shown using the example of the labor supply of married women (Mincer, 1962). Married women were chosen because for them, especially for women with small children, family factors are more important for the decision to enter the labor market. It should also be noted that in this paper micro-data were used.

In the late 1960s and 1970s the amount of available data at the micro level significantly increased because of the emergence of regularly distributed population surveys, (e.g. in the USA, Current Population Survey – a study conducted in 1940, Panel Study of Income Dynamics – since 1968, National Longitudinal Surveys – several studies after the late 1960s). As a consequence, there were a large number of papers devoted to the analysis of labor supply based on these data. The labor supply of different groups – men and women separately and households as a whole – was investigated. A large number of comprehensive reviews of such articles has already been written: Heckman and MacCurdy (1981); Heckman, Killingsworth and MacCurdy (1981); Keeley (1981); Killingsworth (1981, 1983). Therefore we will not dwell on these papers.

At the same time appeared articles on retirement decisions. The interest was due to the fact that in these years many people stopped work and left the labor market at an earlier age. In all articles, large unearned income, both personal and household, reduce working hours, while the impact of other factors was different.

The simplest model of retirement is a one-period model of choice between work and leisure. The main assumption is that a person retires if she chooses a ‘corner solution’ with zero hours of work. The disadvantage of this approach is that in the next period a person may decide to enter the labor market again and the model does not take into account such a possibility. Thus, it is simply a model of labor force participation, without any specifics related to pension solutions. This model was used for the analysis of the impact of social policy reforms on the retirement decision: Munnell (1974), Feldstein (1974), Boskin (1977), Pellechio (1978), Boskin and Hurd (1978), and Burtless and Hausman (1980). The same model, but a little more complicated, taking into account the influence of many different factors, was also used in articles by Butbidge and Robb (1980), Gustman and Steinmeier (1986a), Burtless (1986) and Hurd (1990).

More complex models are dynamic models in which a retirement decision is made based on maximizing utility present value, taking into account the dynamic budget constraint (Gustman and Steinmeier, 1986b). There are also models in which an individual compares the utility of retirement present value at the current moment and all subsequent. When the benefits of delaying retirement become negative, the individual decides to withdraw from the labor market (Stock and Wise, 1990; Rust 1994). The extension of this concept is the model where an individual can choose not only between the options “continue working” and “stop working”, but also “choose part-time work” (Berkovec and Stern, 1991).

Both one-period and dynamic models analyze the optimal retirement age. Although they are useful in terms of econometric methods for analyzing qualitative and panel data, the practical application of them on available Russian data is limited. This is due to the fact that retired people did not have the opportunity to officially choose the age of retirement, but they could continue their work after the official retirement age. Theoretically, one could consider retirement as an age when the individual completely ceases work activities. However, to find out definitively whether the individual left the labor market permanently or just temporarily stopped working is not possible with the available data.

We should also mention the articles which talk about the impact of health factors on a work decision. Currie, Madrian (1999) argue that the main indicators of health are:

- self-rated health;
- constraints to work;
- constraints to perform daily activities;
- chronic and acute diseases;

- use of health services;
- mental health, alcoholism;
- height, weight, body mass index.

The first two indicators have the greatest effect on labor supply. However, using a self-rated health indicator can lead to biased estimates because measurement errors may be non-random due to the fact that individuals can report worse health to justify reducing working hours. In addition, self-reported health may depend on an individual's characteristics: education, income or employment. For example, richer people have greater opportunities to monitor their health, so they are better informed about their illnesses and tend to think their health is worse compared to poorer individuals having the same health, but not fully aware of it (Currie, 1995; Strauss and Thomas, 1998).

It is also argued that lagged variables of health or changes in health status should be taken into account while using panel data. The rationale for this recommendation is the fact that consistently poor health may not have a significant effect on the labor supply of workers, while the sharp deterioration from good to average may lead to a decision to withdraw from the labor force (Bound, Schoenbaum, 1998; Disney, Emmerson, Wakefield 2006; Haan, Myck 2009).

There are several Russian articles devoted to senior citizens and the retirement and pension system. One can mention articles written by Presnyakova (2006), Lezhnina (2008) and Kuzina (2012). They analyze the state of Russian older people from different angles.

The first article uses data from various surveys of 2004-2005. Several factors – material, social, physiological and psychological – are compared between “young” and “old”. It is argued that the main difference is the financial situation, which worsens sharply at older age. Health and psychological state also deteriorate with age, but not as fast.

The article by Lezhnina is based on Russia Longitudinal Monitoring Survey - Higher School of Economics (RLMS-HSE) data of 2005. The obtained results are broadly consistent with the previous work considered. It also noted that the financial factor is the most important one – older people continue their work for the improvement of their financial situation. Another factor, contributing to retiree's economic activity is a higher level of education.

Kuzina's article analyzes whether people are planning to use additional income sources after retirement. These plans are compared with the behavior of today's pensioners. The main source of additional income is work – 43% of future retirees plan to work and 30%

among current retirees work now. Greater economic activity is observed among people with higher education. Age is also an important factor – only 18% of respondents work after 66 years old.

There are a number of econometric studies analyzing economic activity of older people. Merkureva (2004) analyzes the impact of the 1998 reform when an alternative method of pension benefit calculation was introduced. She uses probit for modelling economic activity and tobit for labour supply. Financial factors also play an important role: greater wages increase the probability of being economically active and receiving unearned income decreases it. Other factors increasing the probability of economic activity are good health, younger age group, higher education and longer working experience.

Roschin (2003) conducted an analysis of labour supply factors using RLMS data from 1994-2000. He estimates the regression for all respondents and for different age groups, including the older group – people older than 55 years old for women and 60 years old for men. In addition to previous results, he finds out that the employment of a spouse has a significant positive impact on the probability of economic activity. The unemployment rate and average wage in the region also have a positive influence, while living in cities and villages in comparison with regional centers has a negative effect.

Gurvich and Sonina (2012) analyze the probability of work continuation. The dependent variable was the share of the working period after the official retirement. They found that a respondent's wage has a positive impact on the probability of work continuation for men. Restrictions are problems with health before the retirement and number of children for women. At the same time, heart diseases after the retirement age influence the duration of working period positively. In my opinion, this can be the result of endogeneity of health variable and work.

Lyashok, Roshchin (2012) focus on the health impact. They admit that it can be an endogenous variable, so they use lagged variable of health, fixed effect regressions and instrumented variables. They argued that health is a great limitation for the probability of work and number of working hours. Furthermore, change in health has a smaller impact than bad health for a long period. For women, current health is more important than health in previous periods. Their work can be considered as the most accurate one from an econometric point of view, but they pay no attention to the comparative impact of different factors. And

from previous works reviewed, it can be seen that financial factors are usually considered more important than health status.

In this study, in contrast to previous studies, special attention will be paid to the analysis of marginal effects of various variables, including how they change with the age of an individual. In addition, the suggested system of simultaneous equations solves the problem of endogeneity of self-estimated health and employment.

3. Hypotheses and data

The following hypotheses based on the literature review were put forward in this paper:

- I. There is interdependence between self-reported health and economic activity.
- II. Bad health is a great limitation on economic activity.
- III. Greater unearned income decreases the probability of being economically active.
- IV. Level of education determines the extent to which other factors influence economic activity.

To carry out the empirical calculations we used micro-data of the Russian Longitudinal Monitoring Survey (RLMS-HSE), conducted by the Higher School of Economics and ZAO “Demoscope” together with the Carolina Population Center, University of North Carolina at Chapel Hill, and the Institute of Sociology at the Russian Academy of Sciences (National Research University Higher School of Economics [HSE], 2013). These data have a number of significant advantages. First, the sample is nationally representative. Second, data was collected yearly from 1992, therefore the number of observations is sufficient for the construction of high-quality econometric models. Third, the information is available not only on the employment of individuals, including self-employment, but also on many other socio-demographic characteristics such as financial position and so on. In addition, the panel structure of the data allows us to investigate the dynamic effects of different factors.

We used data from 2000-2010, i.e. waves 9 to 19. Previous years in which the survey was conducted are not included due to a change of methodology in 1994 and the impact of the 1998 crisis. Since the objective of the study is to analyze the labor supply of seniors of pensionable age, the sample included women over 55 and men over 60 years old. As a result, the total sample amounted to 32,274 observations, After excluding observations with missing

values we were left with 27,666 observations. The sample size varies greatly from year to year. In 2000, data are available for 2,342 respondents, whereas in 2010 there is data for 4,579 respondents. There are 745 individuals in the sample, for whom data are available for each wave. On average, an individual was observed over three years. Males constitute 27% of the sample due to their lower life expectancy. The average age of women in the sample is approximately equal to that of males. This is the result of the fact that our sample is bounded below by a higher age for men. Otherwise, the average age of women would be greater.

4. Descriptive statistics

The dependent variable of economic activity is designed as a binary variable that takes the value 1 if the individual worked during last 30 days – all types of jobs were considered if they were regular. A value of 1 is also assigned if an individual wanted to get a job, was looking for a job in any way and/or was ready to start working. Otherwise, the variable is set to 0. The result was that 19% of individuals could be called economically active people. Although this figure depends greatly on the year of survey and gender of the respondents (see Figure 1).

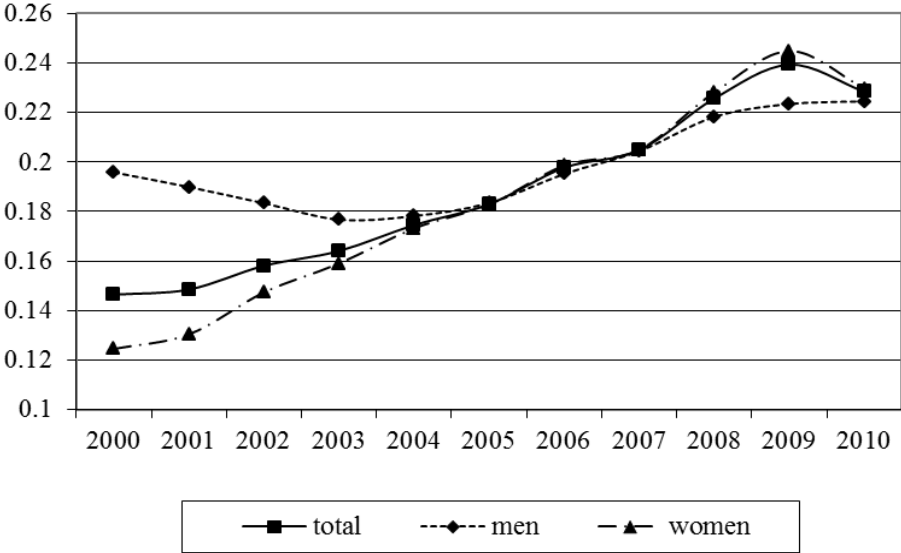


Figure 1. Share of economically active population among seniors

Individual self-rated health was used as an indication of health status. This variable was chosen because according to the literature review it has the greatest impact on labor. The original variable, which had five gradations of health, has been converted into a binary variable: it takes the value 1 if the individual assessed thier health as “very good”, “good” or

“average”. Otherwise the variable is set to 0, corresponding to poor health. It turned out that on average 61% of the older population rate their health positively. Women report slightly worse health than men. Over the years there is a slight improvement of self-estimated health (see Figure 2).

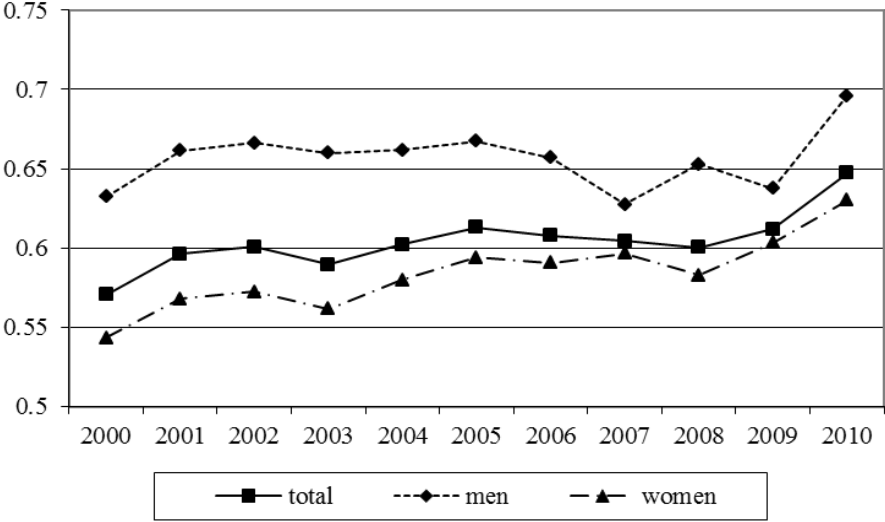


Figure 2. Share of older people, who estimated health positively

The presence of acute and chronic diseases and disability was used as more objective characteristics of the health. For ease of interpretation, the health index variable was constructed from the variables of the presence of certain kinds of chronic diseases using principal component analysis. There are six variables in the available data: the presence of chronic diseases of the heart, lungs, liver, kidneys, gastrointestinal tract and spine. As variables of lungs and kidney diseases turned out to be less important, the total index does not include them and is based only on the remaining four, which are given practically equal weight. The index was normalized from 0 to 4, where 0 corresponds to no chronic diseases, 4 – the presence of all four. Explained variance for the first component is about 45% for all years. According to the health index, the health of individuals in the sample is quite good. The average index value is approximately 1, i.e., indicates the presence of one chronic disease. As well as the variable self-estimated health, women’s health is slightly worse than that of men (see Figure 3, Figure 4).

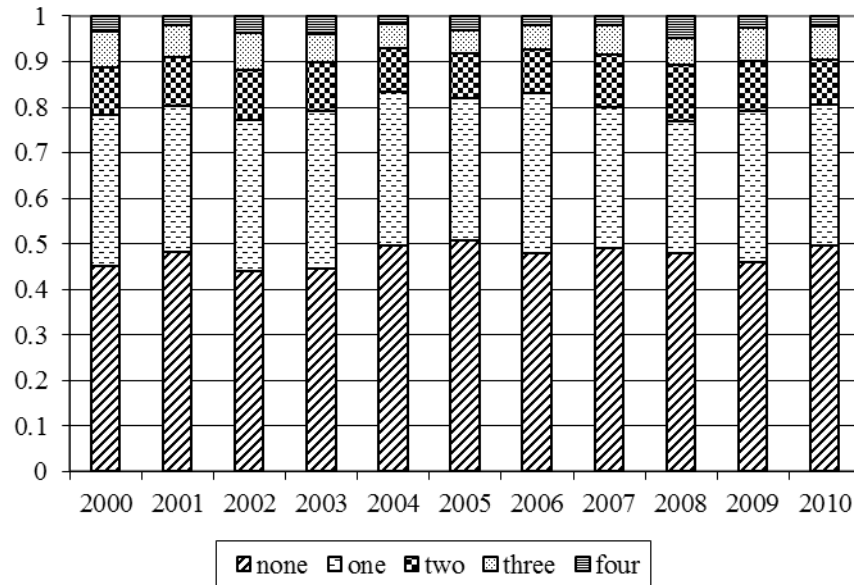


Figure 3. The distribution of men according to the number of chronic diseases (%)

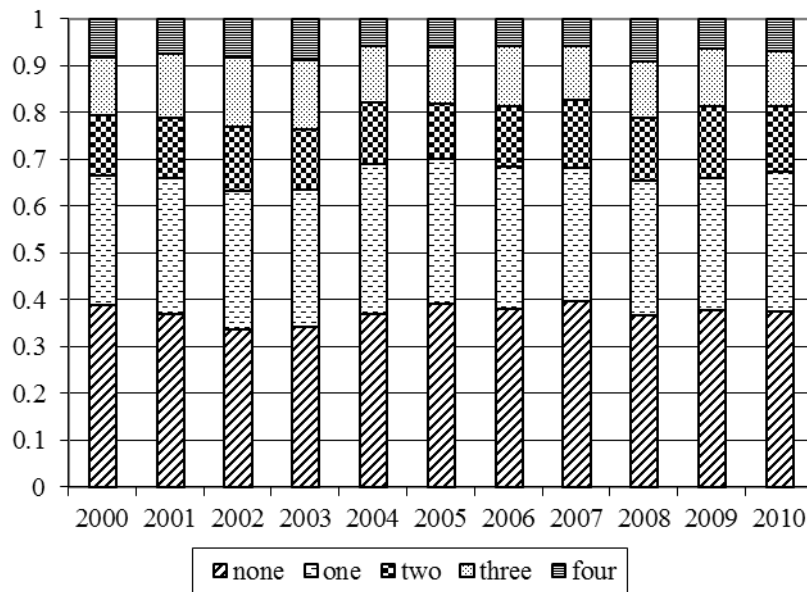


Figure 4. The distribution of women according to the number of chronic diseases

In the sample, 21% of individuals have a disability. A person was considered disabled if she had an official status of disability, and it did not necessarily corresponds to significant limitations for work. However, this figure still indicates not very good health of individuals in the sample. According to this variable, women’s health is also a little worse – 24% compared to 20% for men.

Other characteristics of health are presented in Table 1. For men, tuberculosis is more common, as well as heart attacks and strokes. At the same time, they are less likely to collide with anemia and diabetes and rarely noted increased blood pressure.

Table 1. Descriptive statistics for other health variables

<i>health indicator</i>	<i>women</i>	<i>men</i>	<i>total</i>
being in the hospital	6.50%	8.30%	6.99%
undergoing surgery	3.92%	4.58%	4.10%
diabetes	13.25%	6.57%	11.44%
anemia	5.79%	2.25%	4.83%
tuberculosis	1.28%	2.55%	1.62%
heart attack	5.71%	11.41%	7.25%
stroke	5.42%	7.79%	6.06%
increased blood pressure	73.33%	53.39%	67.97%

The education variable reflects the highest level of education obtained by the respondent. By level of education, the most numerous group of men is a group with incomplete secondary education who attended professional courses or professional school (PTU) without secondary education⁶. In 2000 a relatively large group was one with only primary education. By 2010 it had significantly reduced, outpaced by groups with higher education and specialized secondary education (see Figure 5). Female education level increased, too. But among women the group with incomplete secondary education is quite low. In 2000 the group with primary education and secondary special education made up a large part of the sample. And in 2010 groups with specialized secondary education and higher education were more numerous (see Figure 6).

⁶ On the graphs this group is labeled as “incomplete secondary +”

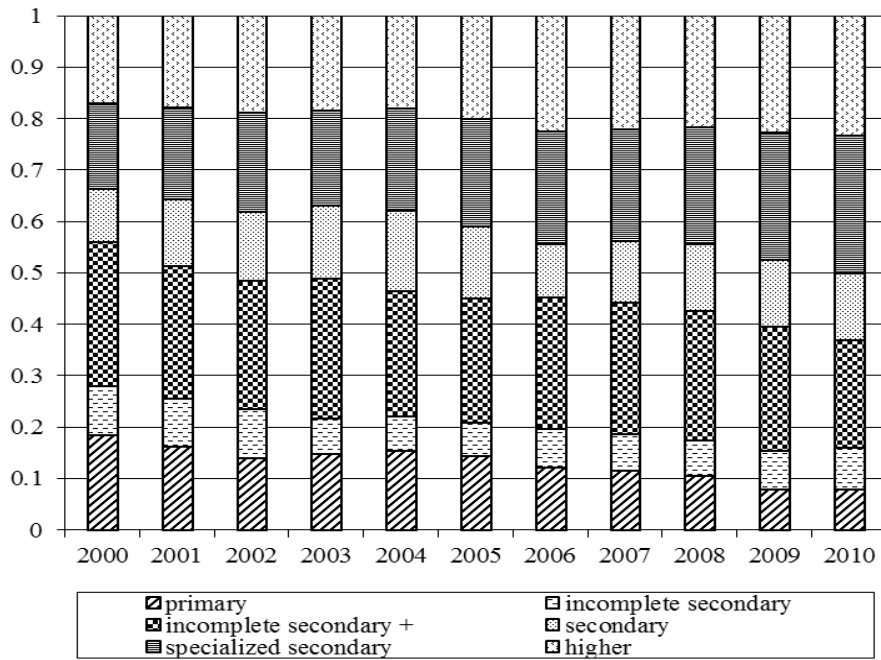


Figure 5. The distribution of men according to the level of education

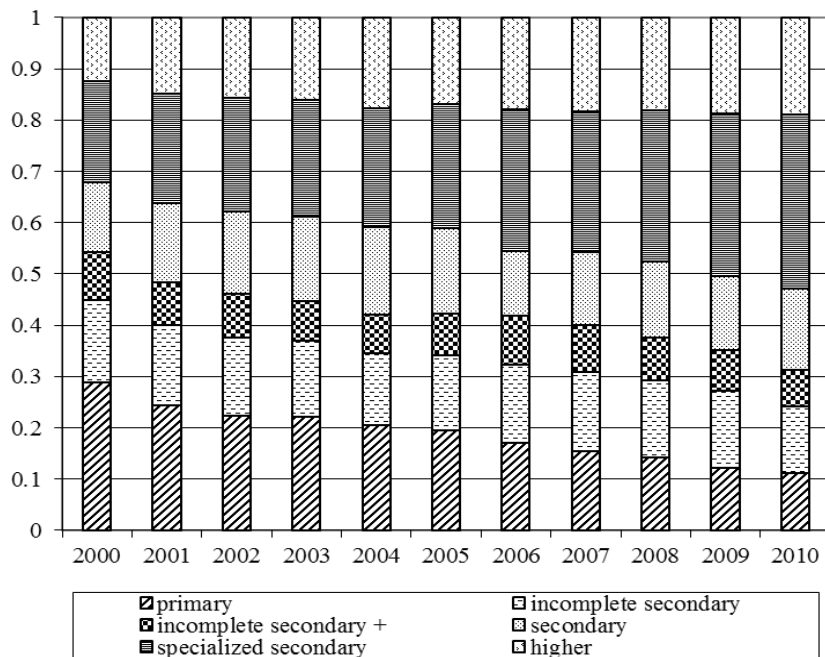


Figure 6. The distribution of women according to the level of education

The life satisfaction variable takes values from 1 (“*Very satisfied*”) to 5 (“*Very dissatisfied*”) according to the individual response to the question: “*How satisfied are you with your life as a whole nowadays?*”. There is no significant difference of satisfaction observed between men and women. Time decreases the level of satisfaction (see Figure 7, Figure 8).

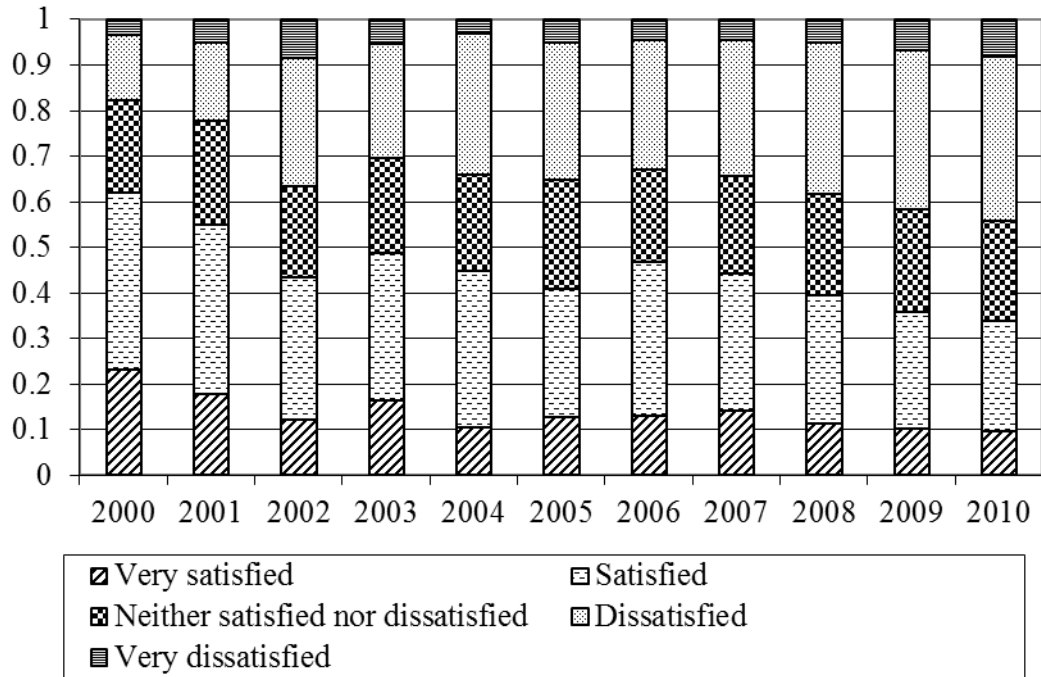


Figure 7. The distribution of men according to the level of life satisfaction

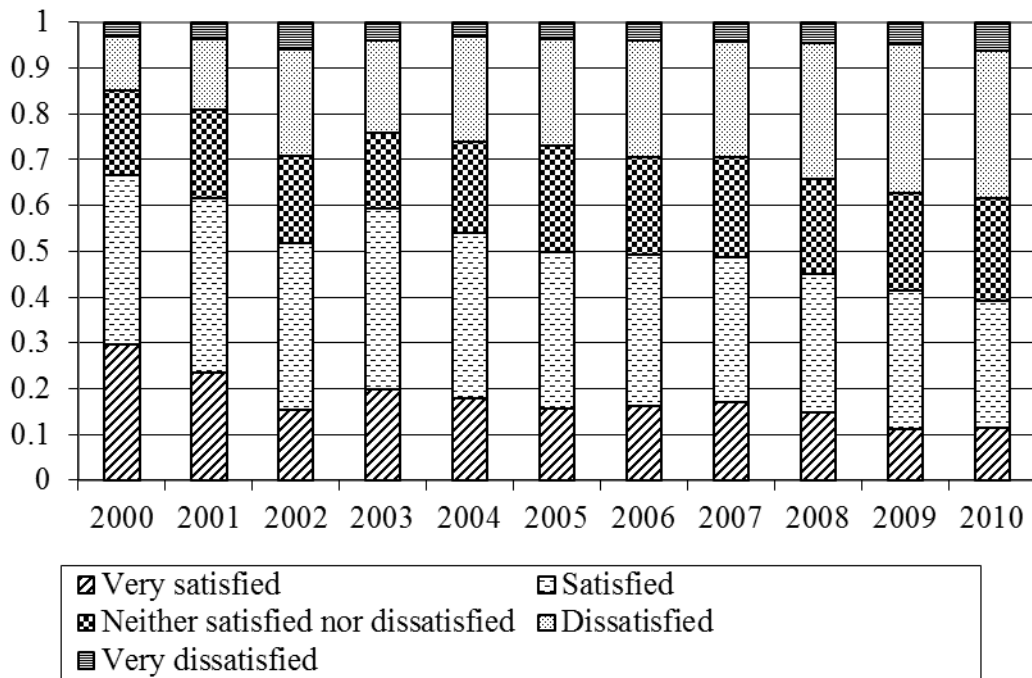


Figure 8. The distribution of women according to the level of life satisfaction

Variables such as locality and region are also included in our analysis as explanatory variables. Since the RLMS sample is not representative by regions, we will not dwell on it in detail. With regard to the type of settlement, the structure of the sample data is fairly constant, except that there is a little reduction in the number of individuals interviewed in rural areas

and an increase in regional centers. For men and women the structure is virtually identical (see Figure 9, Figure 10).

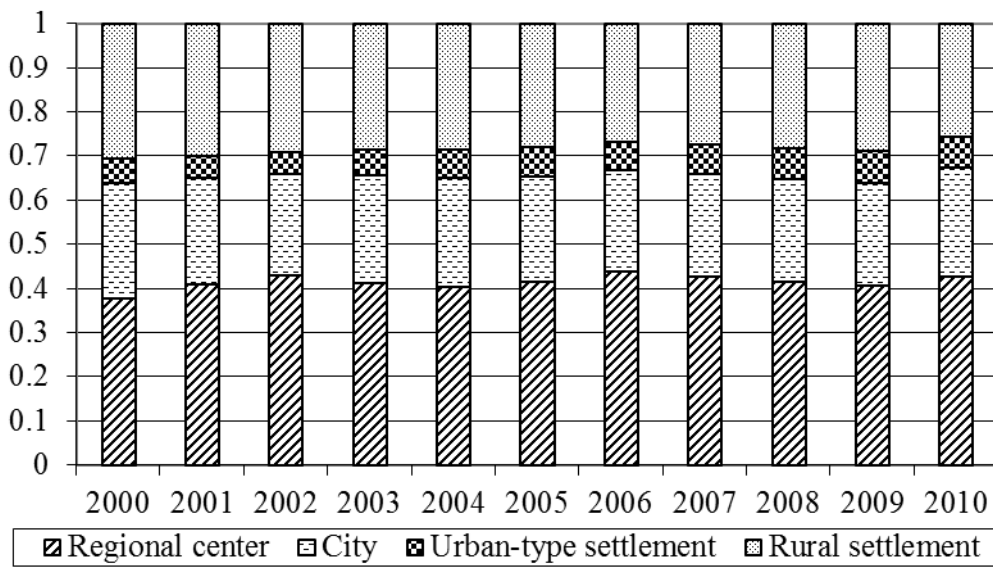


Figure 9. The distribution of men according to the type of settlement

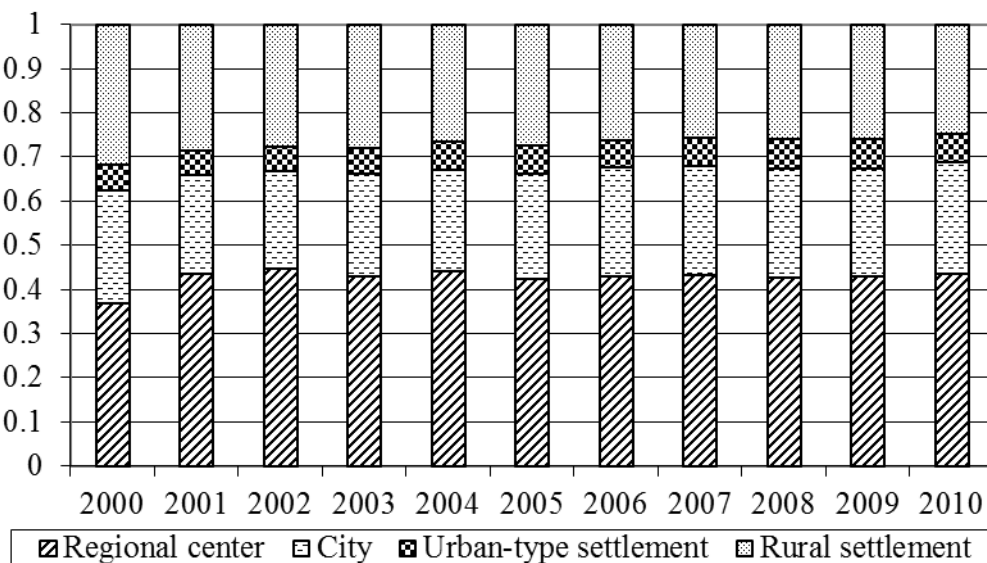


Figure 10. The distribution of women according to the type of settlement

The amount of pension an individual received was used as an indicator of unearned income. For comparability of values by years and regions, pension benefits were normalized by dividing them by the average monthly nominal salary in the region. The resulting indicator can be interpreted as wage replacement rate. For males it is slightly higher than for women – for the majority of men it is from 0.25 to 0.75, while for women it is between 0.25 and 0.5 (see Figure 11, Figure 12). The lowest wage replacement rate was obtained in 2007.

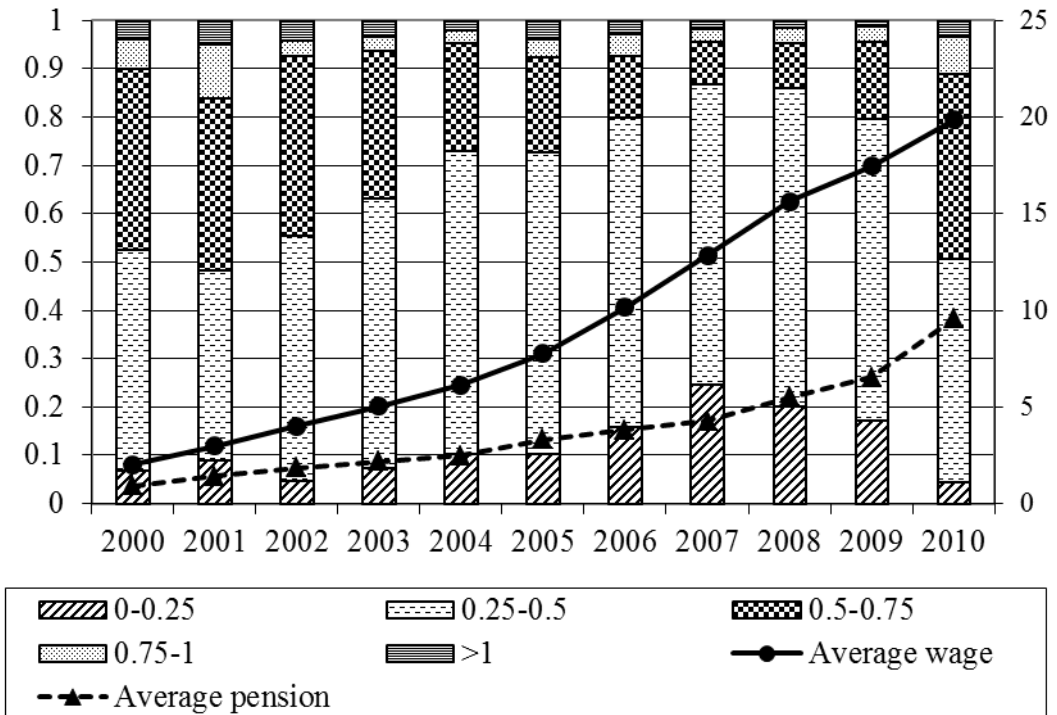


Figure 11. The distribution of men according to the wage replacement rate (main axis) and dynamics of average wage and pension, thousands rub. (additional axis)

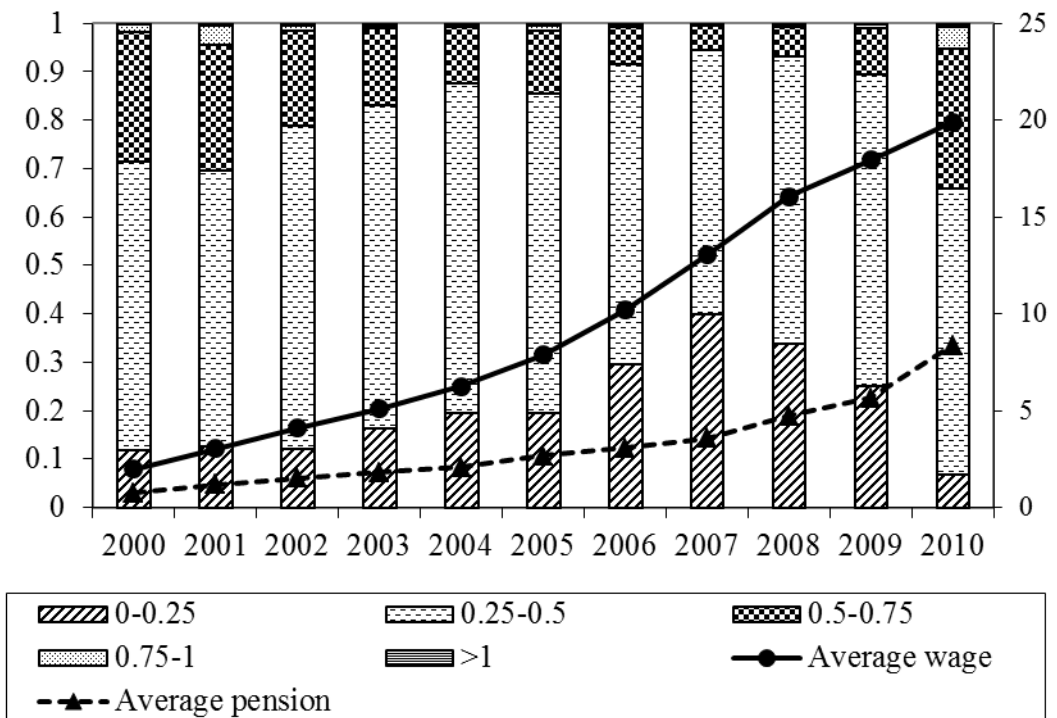


Figure 12. The distribution of women according to the wage replacement rate (main axis) and dynamics of average wage and pension, ths. rub. (additional axis)

Table 2. Average wage replacement rate

	<i>Sample data</i>		
	<i>total</i>	<i>men</i>	<i>women</i>
2000	44.9	51.4	42.1
2001	46.2	54.6	42.5
2002	42.5	50.1	39.4
2003	40.5	47.2	37.8
2004	37.6	43.4	35.5
2005	38.9	45.7	36.6
2006	35.2	41.7	33.0
2007	31.5	36.9	29.6
2008	33.1	38.0	31.4
2009	35.7	40.5	34.1
2010	47.6	52.7	45.7

We gathered the unemployment rate variable in the regions as a measure of the demand for labor from Russian Federation Federal State Statistics Service (Rosstat) data. The regional unemployment rate ranges from 0.8 in Moscow to 15 in the Rostov region. The unemployment rate exceeds these limits only in Kabardino-Balkaria, where it changes in the boundaries from 12.7 to 25.7. By 2010, the average unemployment rate is somewhat reduced.

Descriptive statistics for the rest of the variables used in the model are shown in Table 5. Since they practically do not change from year to year, there are averages for the entire reporting period. It can be seen that among women only 36% are married, while among men – 81%. This is due to the fact that men have a lower life expectancy and many women are widows in old age. Job experience of women is on average five years less than of men because of their earlier retirement. Females are slightly less likely to provide financial assistance and more often receive it. They are also more likely to live in the same household with their children and grandchildren.

Table 3. Mean values for other variables

	<i>men</i>	<i>women</i>
Experience, years	41.9	36.4
Marital status (1 – married)	0.81	0.39
Rendering the assistance (1 – yes)	0.36	0.33
Receipt the assistance (1 – yes)	0.19	0.23
Living with children (1 – yes)	0.30	0.39
Living with grandchildren (1 – yes)	0.20	0.26

5. Econometric specification

As one of the hypotheses is the existence of endogeneity between health and employment of an individual, in this paper the binary system of simultaneous equations will be evaluated to account for the endogeneity explicitly. The dependent variable in the first

equation is economic activity, in the second one it is self-estimated health. The first equation includes self-estimated health as an explanatory variable.

In both equations, explanatory variables were individual characteristics of the respondent, such as gender, age, education, marital status and so on, as well as variables of region and type of settlement. In the equation for economic activity, measures of individual's income and the value of his free time are also included. In the equation for the self-rated health some objective characteristics of health are included. As a result, the model can be represented by Formula 1.

$$\begin{cases} P(Y_1 = 1) = \Phi(x' \beta + \gamma Y_2 + \varepsilon_1) \\ P(Y_2 = 1) = \Phi(z' \delta + \varepsilon_2) \end{cases}, \quad (1)$$

where Y_1 – the economic activity of the individual, Y_2 – self-reported health, x – explanatory variables for the model of economic activity (other than self-estimated health), z – explanatory variables for the model of self-estimated health, $\varepsilon_1, \varepsilon_2$ – errors in each equation, correlated with each other, β, δ, γ – the estimated coefficients.

To assess the quality of the regression we estimate the proportion of correctly predicted observations for different choices of the cutoff, i.e. build an ROC-curve and calculate the square of the area under it.

Since the main objective of the study is to assess the influence of various factors, particular attention will be paid to the calculation of marginal effects of different variables, primarily the variable of self-estimated health. To do this, the marginal effect will be calculated according to Formula 2.

$$P(Y_1 = 1|Y_2 = 1, x) - P(Y_1 = 1|Y_2 = 0, x) = \frac{P(Y_1 = 1, Y_2 = 1, x)}{P(Y_2 = 1, x)} - \frac{P(Y_1 = 1, Y_2 = 0, x)}{P(Y_2 = 0, x)} \quad (2)$$

That is, the marginal effect reflects the change in the probability of being economically active, subject to change in self-estimated health from good to poor. Since in the binary choice model the marginal effect is not constant and depends on the initial characteristics, we consider the marginal effect at mean and its change with respondent's age, gender and education.

We consider separately the effect of disability status as one of the objective characteristics of the respondent's health. Since this is a dummy variable, the marginal effect

for it will be calculated as the difference in the probability of economic activity in the presence of disability status and its absence (see Formula 3).

$$P(Y_1 = 1|\text{disabled}) - P(Y_1 = 1|\text{not disabled}) \quad (3)$$

Another variable, which is of great interest, is the size of pension benefit. First, it is the measure of unearned income, which should significantly reduce the likelihood of economic activity. Second, it is the variable amenable to the direct influence of the state. This variable is only present in the equation of economic activity and is continuous, so its marginal effect is calculated according to Formula 4.

$$\frac{\partial P(Y_1 = 1)}{\partial x_{pension}} = f(x' \beta) \cdot (\beta_{pension} + 2\beta_{pension_sq} \cdot x_{pension}) \quad (4)$$

The last variable, for which marginal effect will be calculated, is the rate of unemployment in the region as it measures the demand for labor, i.e., limitations to a pensioners' employment opportunity. Marginal effect is calculated according to Formula 5.

$$\frac{\partial P(Y_1 = 1)}{\partial x_{unempl}} = f(x' \beta) \cdot \beta_{unempl} \quad (5)$$

Confidence intervals for the marginal effects are calculated by bootstrapping.

Probably, it would be appropriate to estimate the regression separately for men and women, because according to the descriptive statistics, the influence of certain characteristics can vary greatly between men and women. This assumption is verified by means of the Chow test.

6. Results

Optimal model specification was selected by estimating different specifications and comparing Akaike and Baesian information criteria, the significance of variables and the values of the pseudo-R2. Binary probit regression was used to estimate the model, represented by Formula 1. Equations were estimated simultaneously, but for simplicity the results are presented separately in Table 4 and Table 5. Each table contains the results of one equation estimated for the entire study period.

Table 4. Results of estimation for economic activity equation

<i>Economic activity</i>	<i>Total</i>		<i>Women</i>		<i>Men</i>	
	<i>Coef.</i>	<i>Std.Err.</i>	<i>Coef.</i>	<i>Std.Err.</i>	<i>Coef.</i>	<i>Std.Err.</i>

Gender	0.11***	(0.03)	–	–	–	–
Age	-0.13***	(0.00)	-0.13***	(0.00)	-0.12***	(0.01)
Experience	0.08***	(0.00)	0.08***	(0.00)	0.08***	(0.00)
Incomplete secondary	0.15**	(0.07)	0.15*	(0.09)	0.10	(0.14)
Incomplete secondary +	0.12*	(0.07)	0.13	(0.09)	0.14	(0.12)
Secondary	0.44***	(0.07)	0.45***	(0.08)	0.37***	(0.12)
Specialized secondary	0.48***	(0.07)	0.46***	(0.08)	0.55***	(0.12)
Higher	1.02***	(0.07)	1.02***	(0.08)	0.99***	(0.12)
Have disability status (1 - yes)	-0.40***	(0.04)	-0.38***	(0.04)	-0.39***	(0.07)
Self-estimated health (1 - good)	0.63***	(0.08)	0.51***	(0.09)	0.94***	(0.14)
Pension amount	-2.34***	(0.13)	-2.40***	(0.18)	-3.17***	(0.35)
Squared pension amount	0.49***	(0.05)	0.37***	(0.11)	1.37***	(0.25)
Unemployment rate	-0.02***	(0.01)	-0.01*	(0.01)	-0.03***	(0.01)
Rendering of assistance	0.23***	(0.02)	0.18***	(0.03)	0.34***	(0.04)
Receipt of assistance	-0.18***	(0.03)	-0.17***	(0.03)	-0.20***	(0.05)
Living with children	0.14***	(0.03)	0.08**	(0.03)	0.30***	(0.05)
Living with grand children	-0.08**	(0.03)	-0.08**	(0.04)	-0.10*	(0.06)
Saint Petersburg	0.46***	(0.06)	0.34***	(0.07)	0.87***	(0.13)
Central Federal District	0.44***	(0.05)	0.34***	(0.06)	0.71***	(0.09)
Northwestern Federal District	0.64***	(0.07)	0.56***	(0.09)	0.81***	(0.14)
Southern Federal District	0.42***	(0.07)	0.33***	(0.08)	0.70***	(0.13)
Volga Federal District	0.35***	(0.06)	0.29***	(0.07)	0.54***	(0.11)
Ural Federal District	0.25***	(0.06)	0.16**	(0.08)	0.50***	(0.12)
Siberian Federal District	0.34***	(0.07)	0.25***	(0.08)	0.59***	(0.12)
Far Eastern Federal District	0.36***	(0.08)	0.11	(0.10)	0.95***	(0.14)
City	-0.10***	(0.03)	-0.06	(0.04)	-0.23***	(0.06)
Urban-type settlement	-0.29***	(0.05)	-0.32***	(0.06)	-0.24**	(0.09)
Rural settlement	-0.38***	(0.03)	-0.25***	(0.04)	-0.73***	(0.07)
2000 year	-0.33***	(0.06)	-0.42***	(0.07)	-0.14	(0.10)
2001 year	-0.41***	(0.05)	-0.50***	(0.06)	-0.22**	(0.09)
2002 year	-0.35***	(0.05)	-0.42***	(0.06)	-0.21**	(0.09)
2003 year	-0.28***	(0.05)	-0.35***	(0.06)	-0.14	(0.09)
2004 year	-0.24***	(0.05)	-0.31***	(0.06)	-0.09	(0.10)
2005 year	-0.17***	(0.05)	-0.20***	(0.06)	-0.13	(0.09)
2006 year	-0.24***	(0.05)	-0.25***	(0.05)	-0.26***	(0.09)
2007 year	-0.26***	(0.05)	-0.30***	(0.05)	-0.22**	(0.09)
2008 year	-0.11**	(0.05)	-0.13**	(0.06)	-0.12	(0.10)
2009 year	-0.01	(0.04)	-0.02	(0.05)	-0.03	(0.09)
Constant	4.03***	(0.22)	4.36***	(0.26)	3.68***	(0.46)
Number of observations	27,823		20,271		7,552	
Log Likelihood	-23810		-17192		-6508	
Wald Chi2	11068		8177		2880	
Probability	0		0		0	
ρ	-0.147***		-0.111*		-0.216**	
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Table 5. Results of estimation for health equation

<i>Self-estimated health</i>	<i>Total</i>		<i>Women</i>		<i>Men</i>	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Gender	0.08***	(0.02)	–	–	–	–
Age	-0.04***	(0.00)	-0.04***	(0.00)	-0.04***	(0.00)
Incomplete secondary	0.20***	(0.03)	0.23***	(0.03)	0.09	(0.07)
Incomplete secondary +	0.19***	(0.03)	0.22***	(0.04)	0.09*	(0.05)
Secondary	0.35***	(0.03)	0.37***	(0.04)	0.28***	(0.07)
Specialized secondary	0.37***	(0.03)	0.40***	(0.03)	0.25***	(0.06)
Higher	0.59***	(0.03)	0.62***	(0.04)	0.49***	(0.06)
Health index	-0.36***	(0.01)	-0.34***	(0.01)	-0.43***	(0.02)
Marital status (1 - married)	0.02	(0.02)	0.04*	(0.02)	-0.04	(0.04)
Saint Petersburg	-0.11**	(0.05)	-0.11*	(0.06)	-0.14	(0.11)
Central Federal District	-0.22***	(0.04)	-0.22***	(0.04)	-0.18***	(0.07)
Northwestern Federal District	-0.20***	(0.05)	-0.21***	(0.05)	-0.16*	(0.09)
Southern Federal District	0.04	(0.04)	0.03	(0.05)	0.09	(0.08)
Volga Federal District	-0.29***	(0.04)	-0.28***	(0.04)	-0.28***	(0.07)
Ural Federal District	-0.01	(0.04)	-0.01	(0.05)	0.01	(0.08)
Siberian Federal District	-0.18***	(0.04)	-0.21***	(0.05)	-0.11	(0.08)
Far Eastern Federal District	-0.06	(0.05)	-0.07	(0.06)	-0.02	(0.10)
City	-0.11***	(0.02)	-0.13***	(0.03)	-0.04	(0.05)
Urban-type settlement	-0.22***	(0.04)	-0.24***	(0.04)	-0.15**	(0.07)
Rural settlement	-0.27***	(0.02)	-0.29***	(0.03)	-0.23***	(0.05)
Constant	3.56***	(0.10)	3.49***	(0.11)	3.76***	(0.22)
Number of observations	27,823		20,271		7,552	
Log Likelihood	-23810		-17192		-6508	
Wald Chi2	11068		8177		2880	
Probability	0		0		0	
ρ	-0.147***		-0.111*		-0.216**	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First, it should be noted that the correlation coefficient for the equation error is significantly different from zero and is approximately -0.15, confirming the first hypothesis of an interdependence between the variables of economic activity and self-estimated health. Thus, the evaluation of the system of equations is appropriate.

The model has a pretty good predictive power. The area under the ROC-curves for the entire sample is 0.9 for the equation of economic activity and 0.76 for the equation of self-estimated health (see Appendix 1). For regressions on men and women separately, approximately the same results are obtained – 0.75 and 0.89; 0.77 and 0.91, respectively.

For a quantitative analysis of the impact of significant variables, marginal effects should be considered. An individual with average characteristics was chosen for the calculation. This is an individual who lives in Moscow, without children and grandchildren in

a household without a husband/wife with one chronic illness (health index), not disabled, with the experience of 38 years, with a salary pension replacement rate of 40%, who does not receive assistance from relatives and does not render it.

First, consider the marginal effect for self-estimated health of the individual. For people with higher education, good health has a significant positive impact on the probability of being economically active (see Figure 13). The impact achieved maximum value of 0.14 at the age of 60-61. For people with primary education positive impact reduces with age. After 75 years for people with higher education and 68 for those with primary education, health does not have a significant effect on the probability of economic activity. This result is related to the fact that at these ages there are few economically active individuals. In the sample, only 8% of those aged 70–74 years were economically active, and among those older than 74 years there were only 1.5%.

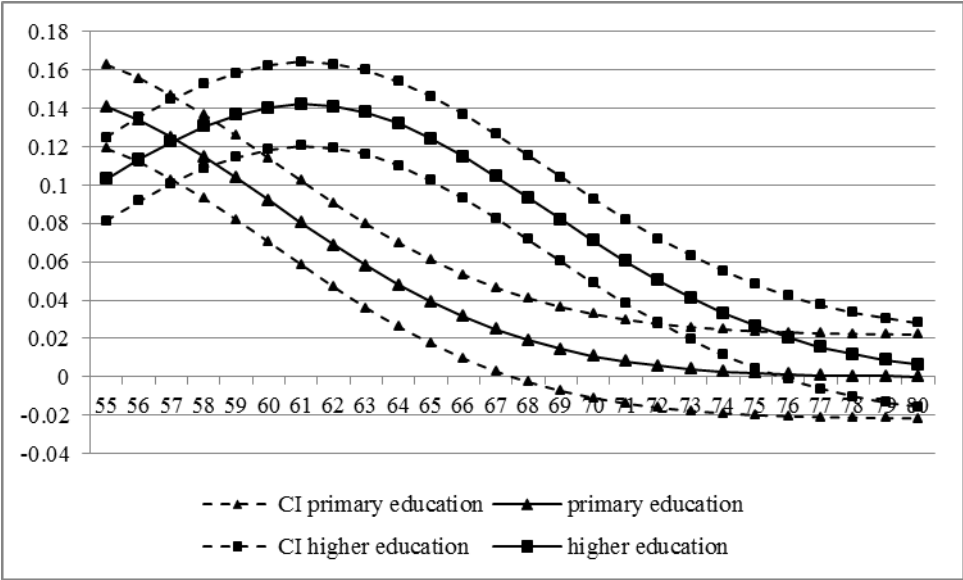


Figure 13. Marginal effects of health for persons with primary and higher education, with confidence intervals (CI), by age

Charts for men and women practically do not differ from each other, which is why we will examine only graphs for women.

We also examine the impact of disability as an objective health characteristic, which should reflect the very poor health of the respondent. Marginal effect of it is unsurprisingly negative. For people with higher education the reduction in the probability of being economically active is around 12–17%, for people with primary education it is 10% and decreases with age (see Figure 14).

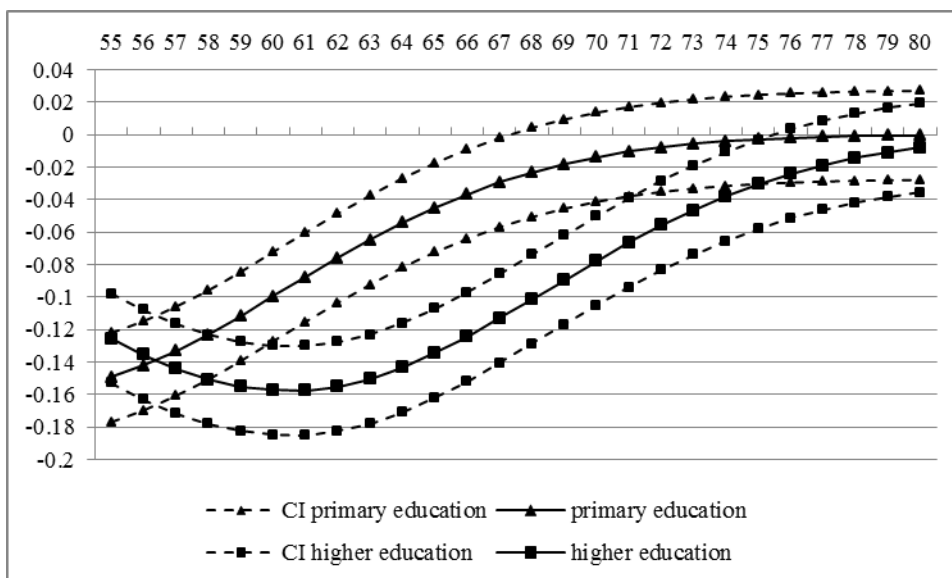


Figure 14. Marginal effects of disability status for persons with primary and higher education, with confidence intervals, by age

Summarizing, we can say that the hypothesis that health is an essential limitation for labor supply is partly confirmed: it is more important for people with higher education and under the age of 70. The impact of disability is greater than the impact of bad self-estimated health.

Another variable of particular interest is the amount of the pension benefit received (the replacement rate). The marginal effect of an increase in pension benefit turned to be significantly negative, and it is stronger than the effect of poor health. It remains significant even at the age of 69 for people with primary education and 76 for people with higher education (see Figure 15). The impact of the pension benefit increase is greatest at the age of 55 for people with primary education and at the age of 61-63 for people with higher education. That is, it turns out that the main reason for retirees to work is a want to improve their financial situation, and retirees with higher education tend to maintain their standard of living as long as possible, whereas for those with primary education, this factor becomes less important with age, which can be due to the fact that they cannot find a well-paid job.

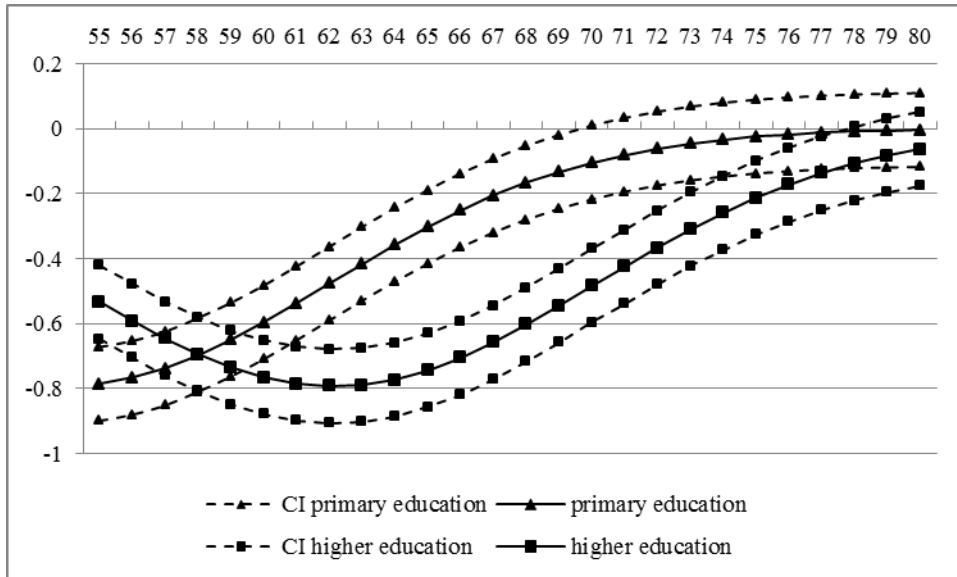


Figure 15. Marginal effects of pension benefit for persons with primary and higher education, with confidence intervals, by age

It is also interesting to examine how the marginal effect of pension changes with the size of the pension benefit at a certain age. We calculate the marginal effect for a person at the age of 75 for change in the replacement rate from 0 to 1 (0 corresponds to zero pension, 1 to a pension equal to wage). It turned out that the effect is strongest at low levels of income and decreases when it grows, which confirms the hypothesis that a retiree works to maintain their customary standard of life (see Figure 16).

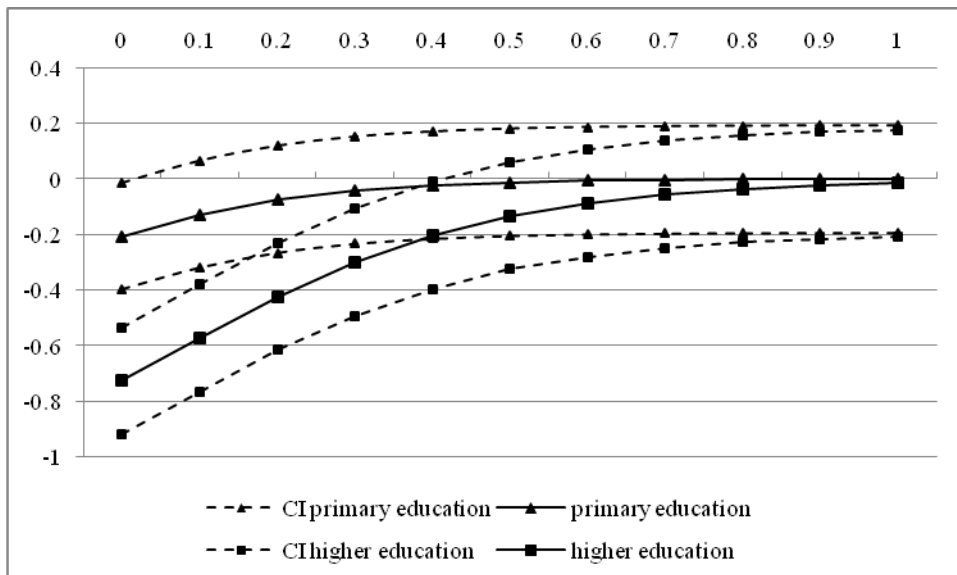


Figure 16. Marginal effect of pension amount for person with primary and higher education with confidence intervals by pension amount (replacement rate)

Marginal effect was also calculated for the unemployment rate, since this variable reflects the limitations imposed by the demand side of the labor market. In the regression, this variable is significant only at the 10% significance level for the entire sample and for the subsample of women. Marginal effect is significant at a 5% level only at age 55-59 for people with primary education and at age 56-68 for people with higher education, but its value is around -0.008. So the unemployment rate in the region has almost no influence on the probability of being economically active (see Figure 21). Although, this measure of demand-side restrictions has some disadvantages, it shows why the impact of the labor demand on seniors' employment should be further investigated.

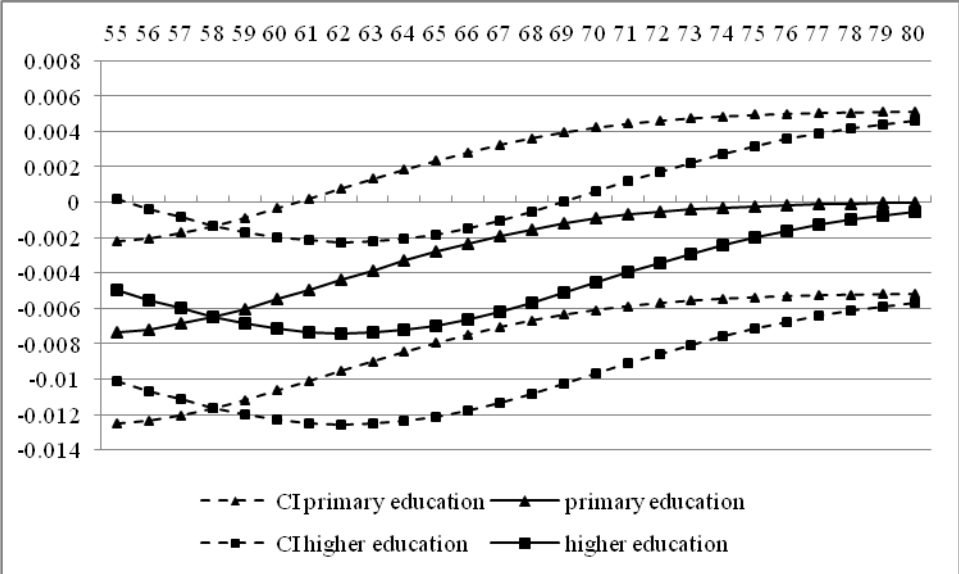


Figure 17. Marginal effects of unemployment rate for persons with primary and higher education, with confidence intervals, by age

7. Conclusions

In this paper we analyzed the factors determining labor supply of persons in retirement age, calculated the effects of the most important factors, and revealed the presence of interdependence between the self-estimated health of an older person and their economic activity.

According to the results, it can be concluded that the main incentive for the continuation of work in the retirement age is the desire to preserve individual income at a worthy level. This means that with a low pension/wage replacement rate, many people who do not have any additional sources of income will try to compensate the income's shortage

via paid work. As only few older people in Russia have significant unearned income (Kuzina, 2012) we can expect that the employment of retirees will not decrease.

The restrictions of poor health are much less significant than poor financial situation. Some retirees who do not have enough money for their needs continue working even if they have bad health or a disability status.

Possessing a high level of education is a significant advantage – the retiree may retain his professional skills and capabilities for longer. For well-educated seniors it is more important to preserve wealth than for pensioners with lower education levels.

Restrictions imposed by labor demand are not that significant, at least in regard to the possibility of being employed. This is unsurprising, as older people often agree to hold less attractive and less-paid jobs compared to younger workers.

Based on the research results we can draw some conclusions regarding pension reform in Russia. First, the claim that the factor of poor health and low life expectancy is a major obstacle to increase the retirement age is not quite correct. At the same time, it would be wrong to think that this factor is not at all significant. In general, it can be argued that if the retirement age is to be raised, many individuals will be able to continue working. However, the group of people with the greatest potential is the healthy and those with higher education.

Second, a key factor stimulating employment of seniors is the desire to maintain a sufficient level of financial security. Thus, the possibility of postponing the retirement age to increase pensions in future may prove effective if the level of pensions is to rise significantly (so that the replacement rate tends to 100%) and if the individual is confident in her future prolonged life. Nowadays it is hardly possible to satisfy both conditions. As yet, the optimal strategy is continuing work after the official retirement (assuming that there are no restrictions on the pension amount of working pensioners). In this case it is possible to obtain higher payments in the present time, comparable with the salary of the individual prior to retirement.

Third, although in this study no effect of labor demand restrictions was found, they may exist in various forms. It is necessary to ensure that these restrictions will not prevent the employment of retirees.

The possible development of this study may include a more accurate account for labor demand restrictions including age discrimination. Also, it is worth considering the panel structure of the data to estimate the models with fixed and random individual effects.

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Appendix 1

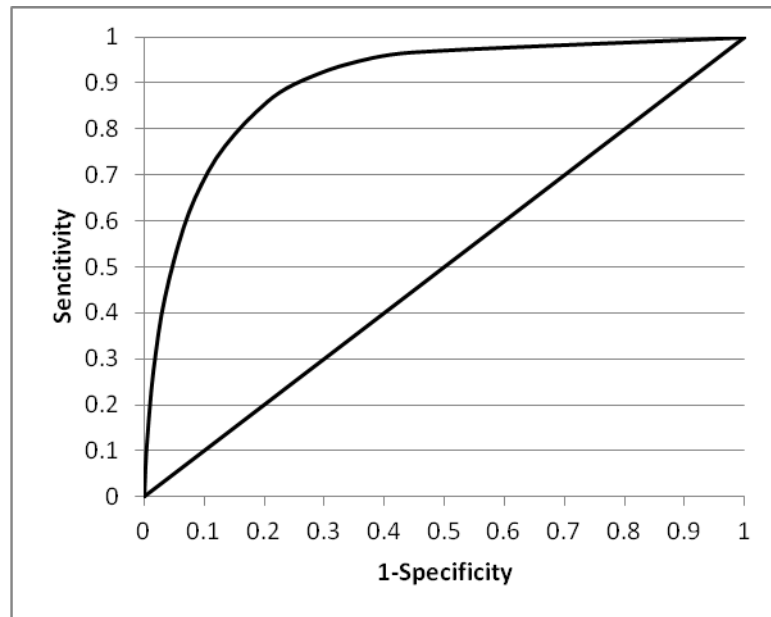


Figure 18. ROC-curve for economic activity regression for all sample

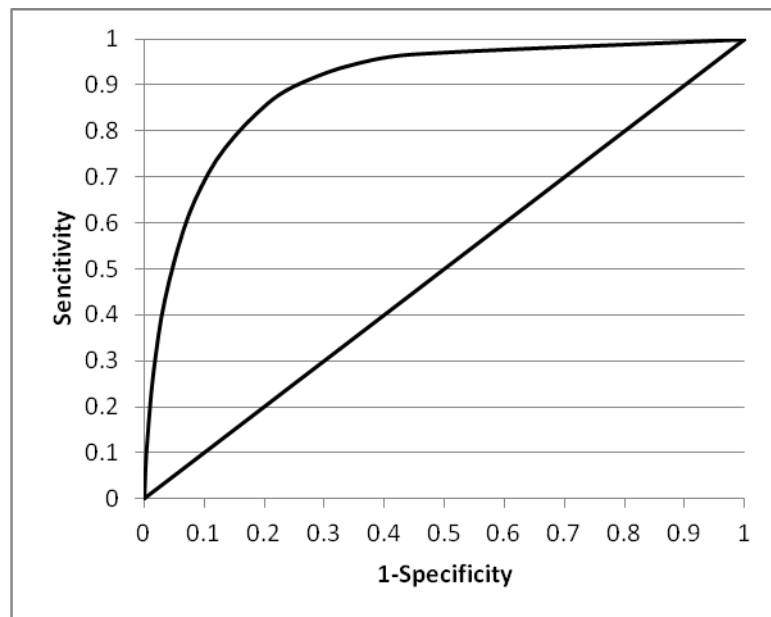


Figure 19. ROC-curve for health self-estimation regression for all sample

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