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FORECASTING THE REAL WORKFORCE REGION

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The paper analyses the potential working population of the region with respect to its composition, internal and external migration in the region. In the short term, using a scenario approach is the real number of people able to participate actively in the economic activities of the region, without asocial layers of the population.

The problem of attracting investment to the regions of the Russian Federation had become extremely urgent. Volgograd region in this perspective is a typical Russian region. Builds complex mineral fertilizer, to which would require 2.5 thousand people. It is planned to build a cement factory, chemical-pharmaceutical cluster. For these projects will require a significant number of skilled labour. Demographic processes reflect the depopulation trend manages, continued in recent years. In dealing with the problems of attracting investment and development of the regional economy, for the management of economic processes, requires the development of effective population policies. Crucial analysis and prediction of the dynamic workforce.

According to the preliminary data of the all-Russian population census 2010, the population of the Volgograd region amounted to 2611.2 thousand people. [4] In recent years, there is quite a lot of changes in the working-age population projections. Almost all of these predictions are only quantitative, not qualitative in nature of the workforce. Under the capable people in statistical reporting refers to people your age are able to participate in the labor process. These are men aged 16-59 years and women aged 16-54, with the exception of disabled persons in groups I and II. [1]

In fact, among the total number of the working population can be identified and predict the amount of asocial people, who do not participate in the economic life of the country.

This paper seeks to analyze and forecast the real dynamics of the working population according to its composition, adjusted for people who for a variety of reasons, will not be able to participate in economic activities, as well as taking into account the internal and external migration.

In Russia, an increasing number of patients with mental and behavioral disorders associated with drug, alcohol and other psychoactive substances. Such patients are able-bodied only formally. Analysis of drug addiction, chronic alcoholism and alcoholic psychosis of the Volgograd region in 1993-2009 according to socio-hygienic monitoring shows that an average of 2.08% of the total economically active population is suffering from drug addiction, alcoholism and alcoholic psychoses. According to expert estimates the true number is much higher than the number of registered drug users. This can be attributed more to the underestimation of their state themselves sick. [5]

Analysis of primary disease drug and alcohol abuse, alcoholic psychoses for 16 years attests to their uneven "mirror" evolution (the same situation in Russia). Thus, in the Volgograd region the highest level of primary narcomania scored at the beginning of 2001 (874 man), whereas at the beginning of 2000, pointed out the minimum number of cases taken into observation with a diagnosis of alcohol dependence, alcohol psychosis (1808 man). [2]

Figure 1 shows the total number of people exposed to different kinds of dependencies, remains constant, while the difference of price fluctuations due to consumption patterns in the market of psychotropic substances.

In order to assess the possible prognosis socio-prosperous future workforce (number of working-age population, with the exception of patients with drug addiction, alcoholism and alcoholic psychoses) is of interest to determine the 3 possible scenarios. Pessimistic based on what percentage of patients with drug addiction, alcoholism and alcoholic psychoses will grow with an annual growth rate of 0.18% from 2010 onwards, realistic – if you marked in the first decade of the trend rate would remain unchanged at 2.08%, optimistic – the proportion of patients with drug addiction, alcoholism and alcoholic psychoses will fall by 0.18%.

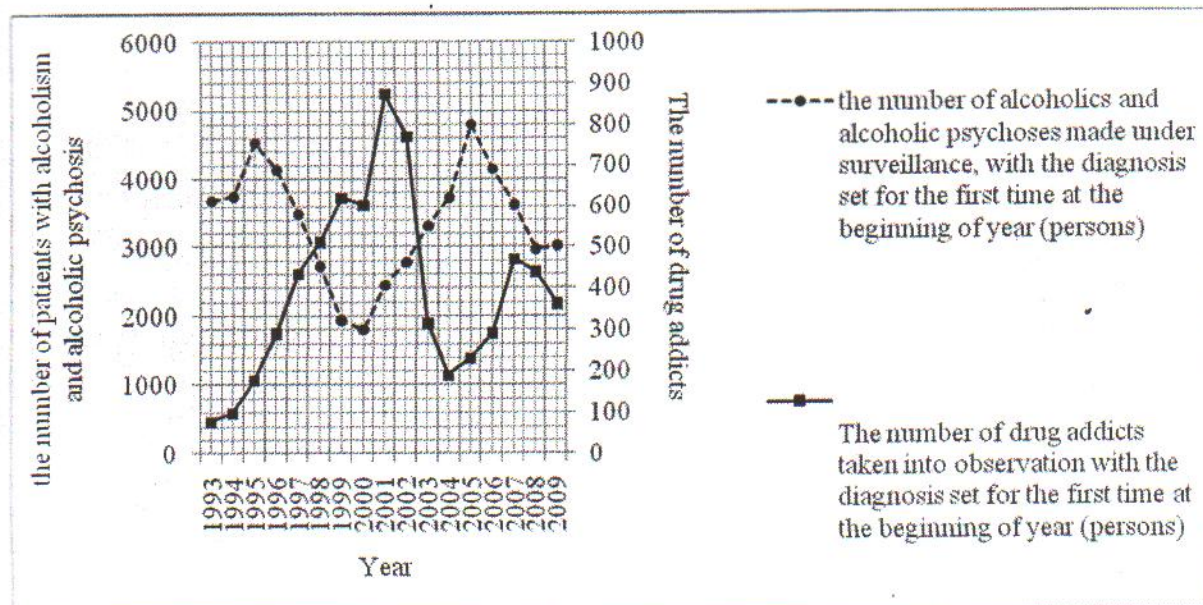


Fig. 1. Changes in the number of patients with drug addiction, alcoholism and alcoholic psychoses (people) made under surveillance, with the diagnosis set for the first time at the beginning of the year in the Volgograd region.

Table 1.

Demographic scenarios (optimistic, realistic, pessimistic).

Year	1	Pessimistic forecast		Realistic forecast		Optimistic forecast	
		2	3	2	3	2	3
2009	1730314	2,08%	35991	2,08%	35991	2,08%	35991
2010	1709641	2,26%	38638	2,08%	35561	1,90%	32483
2011	1699927	2,44%	41478	2,08%	35358	1,72%	29239
2012	1678801	2,62%	43985	2,08%	34919	1,54%	25854
2013	1654097	2,80%	46315	2,08%	34405	1,36%	22496
2014	1625815	2,98%	48449	2,08%	33817	1,18%	19185

Note: 1 – workforce (people), 2 – the proportion of patients with drug addiction, alcoholism and alcoholic psychoses, 3 – the number of patients with drug addiction, alcoholism and alcoholic psychoses (people).

The time series was formed by aggregation of the working population of the Volgograd region at the beginning of the year from 2000 to 2010 year and results of calculations of parameters of trends in various shapes (linear, polinomial, exponential, exponential, hyperbolic, logistics, trend Gompersca) implemented in Statistica 6.0.

The best form is a polynomial trendline (2-nd class), which describes the equation $y = -1789 \cdot t^2 + 23599 \cdot t + 1674355$, where y is the number of working populations, t -temporal parameter). The significance of the regression equation in General (with a value of 0.05) confirmed the Fisher criterion. Double sided student T-test in turn, said the significance of individual regression coefficients, (0.05 significance level). Excel will calculate the average error of approximation.

Formula: $\bar{A} = \frac{1}{n} \cdot \sum_{i=1}^n \frac{|e_i|}{y_i} \cdot 100\%$, where $e_i = y_i - \hat{y}_i$ is the remainder. Is that the error is less

than 8% indicates good quality model. In this case $\bar{A} = 0.42\%$. Therefore, the model quality.

Running on the spot trend forecast changes in the number of working-age population in the Volgograd region until 2014, one can observe the following picture.

Clearly you can see that there has been a downward trend in five working-age population.

One of the components of the working population is the number of asocial persons deprived of their liberty. Russia is the second-largest number of prisoners per capita, behind United States. [3]

Table 2.

Change in the size of the working-age population in the Volgograd region in 2000-2014 period.

Year	Workforce (people)	Year	Workforce (people)
2000	1 709 812	2008	1 746 214
2001	1 711 985	2009	1 730 314
2002	1 716 086	2010	1 709 641
2003	1 729 372	Forecast	
2004	1 742 865	2011	1 699 927
2005	1 756 185	2012	1 678 801
2006	1 762 181	2013	1 654 097
2007	1 755 740	2014	1 625 815

On the basis of the number of working-age population (persons) of the Russian Federation, and also one of the key indicators for the record, namely the number of persons held in detention centres in working age (at the end of the year, thousands of people) in the Russian Federation for the period from 2000 to 2009, the number of prisoners was calculated at 1000000 workforce in Russia.

Table 3.

Change the number of prisoners per 1000000 workforce in Russia in the 2000-2009 period.

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10522	11022	9819	9397	8420	9058	9580	9727	9815	9605

The statistical accounting of individuals in detention is not in the Volgograd region, therefore, to study the situation normalized data on economically active population (persons) of Volgograd region as well as the number of prisoners per 1000000 workforce the average in Russia.

Table 4.

Change in the size of the prison population of working age in the Volgograd region in 2000-2009.

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
17990	18870	16850	16252	14675	15908	16881	17078	17139	16620

The figure reflected changes in the number of persons held in places of deprivation of liberty in the Volgograd region from 2000 to 2009.

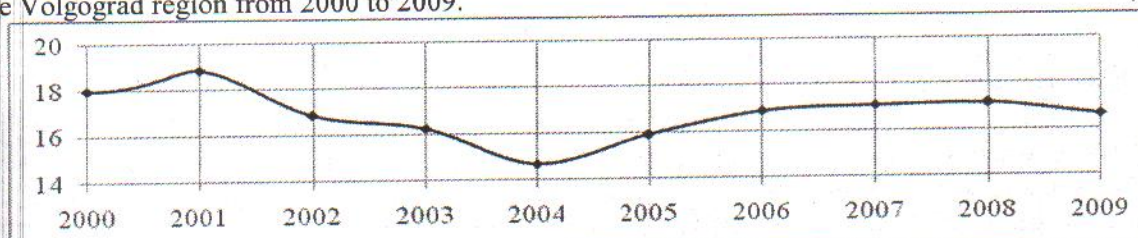


Fig. 2. Number of persons held in places of deprivation of liberty of persons of working age (thousands of persons) in the Volgograd region.

The time series study showed the following results:

1. On average, each year 1% of the working population-persons held in places of deprivation of liberty.
2. Every year, the average number of inmates in the prison in the working age is reduced by 337 people.

The best form of trend that describes the time series, which is the number of persons held in detention at the end of the year from 2000 to 2009 is the trend Gomperca, described by the equation $y = 16396.25 + 4085.75 * 0.513118^t$, where y is the number of detainees in places of deprivation of liberty, t -temporal parameter).

More accurate assessment of the parameters of this trend gives Quasi-Newton method and Rosenbrock & quaqsi-Newton. The coefficient of determination $R^2 \approx 95\%$, indicating a high quality model. In this case $\bar{A} = 4.18\%$. The model of good quality.

In order to assess the possible prognosis socio-prosperous future workforce (number of working-age population, with the exception of the number of persons held in places of deprivation of liberty) is of interest to determine the 3 possible scenarios.

Pessimistic based on what percentage of the prison population will grow with an annual growth rate = 101 people (30% of the annual reduction in the number of persons held in places of deprivation of liberty), starting in the year 2010. Take the probability of this scenario an equal 10%.

Realistic – if checked in the Decade trends among the prison population will be equal to the projected values for constructed trend Gomperca. The probability of this scenario is equal to 30%.

Optimistic-share of persons held in places of deprivation of liberty is going to fall annually on 371 (pers.), equivalent to 110% from the identified throughout the decade, the annual reduction in 337 people. The probability of this scenario is 60%.

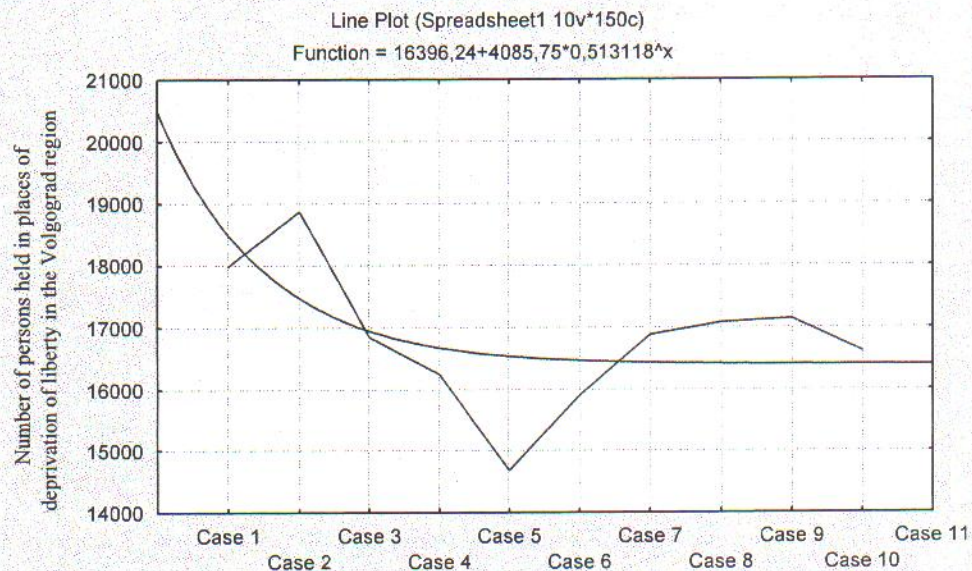


Fig. 3. Dynamics of the number of persons held in places of deprivation of liberty in the Volgograd region, and trend Gomperca describing the process.

Running on the trend of changes forecast point arrived in Volgograd region until 2014, one can observe the following picture (table 5).

Table 5.

Demographic scenarios (optimistic, realistic, pessimistic).

Year	1	Pessimistic forecast		Realistic forecast		Optimistic forecast	
		2	3	2	3	2	3
2010	1 709 641	16 721	1 692 920	16 283	1 693 358	16 249	1 693 392
2011	1 699 927	16 822	1 683 105	15 946	1 683 981	15 878	1 684 049
2012	1 678 801	16 923	1 661 878	15 609	1 663 192	15 508	1 663 293
2013	1 654 097	17 024	1 637 073	15 272	1 638 825	15 137	1 638 960
2014	1 625 815	17 125	1 608 690	14 935	1 610 880	14 766	1 611 049

Note: 1 – workforce (people), 2 – the number of persons held in places of deprivation of liberty, 3-socio-productive perspective, the working age population.

Only a small percentage of persons released from prison, returns to active economic activity. This is due to several reasons: loss of human desire and the will to work, low professional and qualifying level, often lack shelter and permanent registration, making it very difficult to even temporary employment. [2]

In view of the demographic situation in the Volgograd region, it could be argued that migratory movements are the shaper size and qualitative composition of the region.

Change the number of people arriving at the end of the year from 1993 to 2009 best describes the trend Gomperca, realizable equation $y = 13756.77 + 100704 \cdot 0.86^t$, where y is the number of people arriving, t-temporal parameter).

The coefficient of determination $R^2 \approx 98\%$, indicating a high quality model. $\bar{A} \approx 8\%$. The good quality of the model.

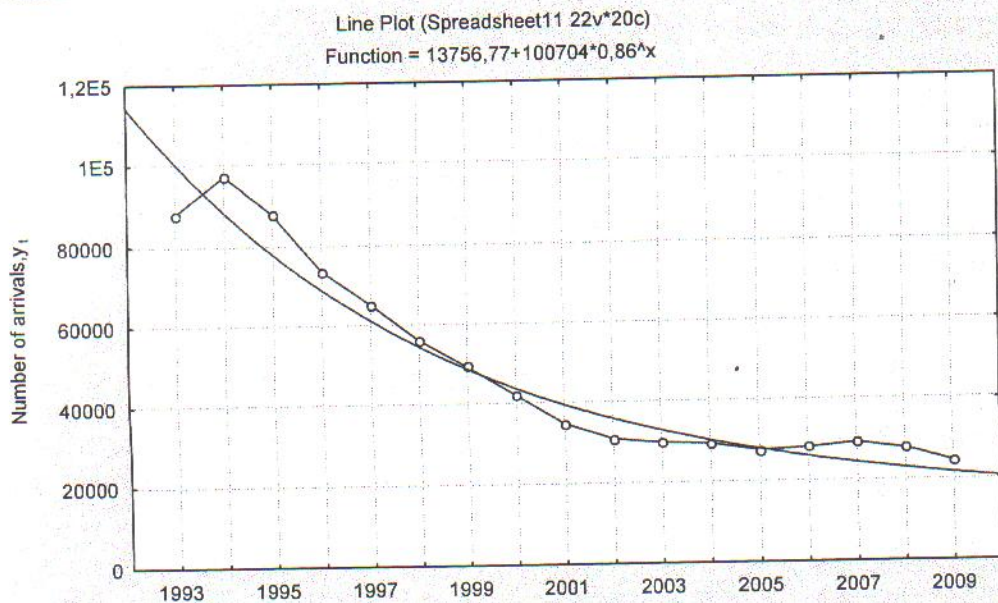


Fig. 4. Evolution of the number of arrivals in the Volgograd region and Gomperca, describing this trend.

Running on the trend of changes forecast point arrived in Volgograd region until 2014, one can observe the following picture (table 6).

Similar to the time series, which is a strength of the population at the end of the year from 1993 to 2009 year and calculate trends in various shapes give the following results. The best form of the model is also a trend of Gomperca, which describes the equation $y = 10216,65 + 60171,2 * 0,92^t$ (y is the number of people arriving, t -temporal parameter). Model metrics also show good quality model.

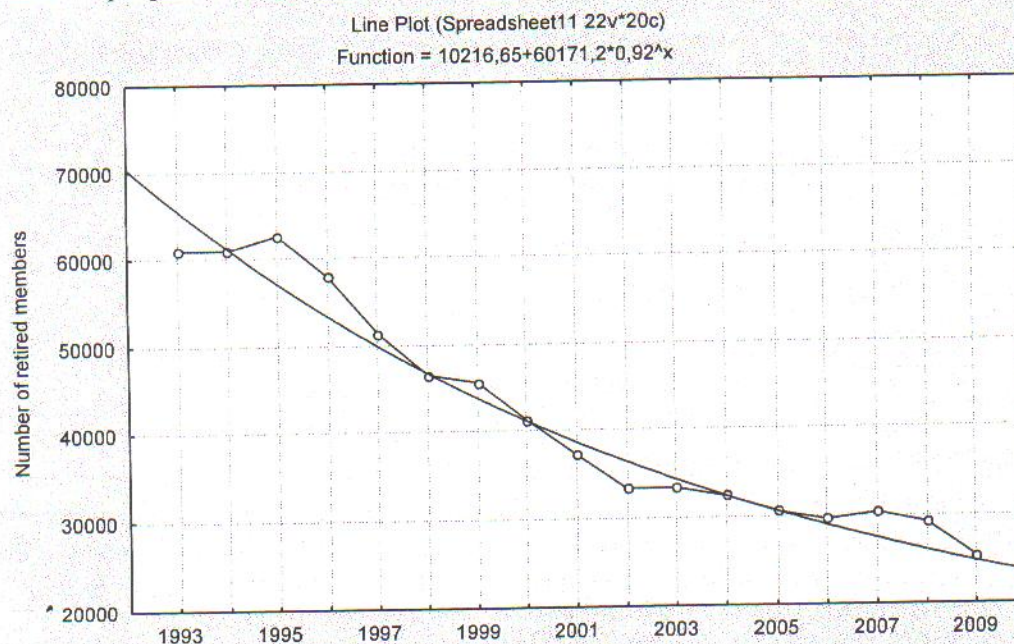


Fig. 5. Evolution of the number of retired members of the Volgograd region and trend of Gomperca describing the process.

Spot forecast changes in the number of population in the Volgograd region until 2014, reflected in table 6.

Accounting of asocial elements working population for forecasting changes in social and prosperous working population can be seen in fig. 6. In all scenarios that there has been a decrease in the working-age population in the Volgograd region, causing adverse effects on development of the regional economy.

Table 6.

Change the number of people arriving and Volgogradsku area in 1993-2014 period.

Year	1	2	3	4	Year	1	2	3	4
1993	87932	60933	23699	17191	2004	29406	32320	-2914	-1855
1994	97256	60929	36327	23131	2005	27545	30515	-2970	-1891
1995	87632	62564	25068	15962	2006	28119	29568	-1449	-923
1996	73507	57935	15572	9915	2007	29276	30286	-1010	-643
1997	65041	51343	13698	8722	2008	27698	29168	-1470	-936
1998	56123	46543	9580	6100	2009	24447	25330	-883	-562
1999	49390	45611	3779	2406	Forecast				
2000	42236	41197	1039	662	2010	21041	23631	-2590	-1649
2001	34876	37210	-2334	-1486	2011	20052	22558	-2506	-1595
2002	30961	33279	-2318	-1476	2012	19198	21571	-2373	-1511
2003	29804	33299	-3495	-2225	2013	18459	20662	-2203	-1403
					2014	17821	19827	-2006	-1278

Note: 1-number of persons, 2 – number of arrivals, 3 – number of retired members, 4 –the proportion of the working population.

Clearly you can see that in the future, there has been a negative number of arrivals. On average, the proportion of the working population in the migration 64%.

Table 7.

Real change in the size of the working-age population in the Volgograd region in 2000-2014 period.

Year	1	2	Year	3	4	5
2000	1709812	1663604	Forecast			
2001	1711985	1659427	2010	1656033	1659481	1652820
2002	1716086	1662011	2011	1646575	1653066	1640321
2003	1729372	1674924	2012	1625974	1635410	1616773
2004	1742865	1690083	2013	1601892	1614173	1589848
2005	1756185	1701858	2014	1574324	1589327	1559557
2006	1762181	1707724				
2007	1755740	1701500				
2008	1746214	1691818				
2009	1730314	1677142				

Note: 1 – workforce, 2 – the number of actual working population (i.e. the working population except for socially disadvantaged people (the sick, drug addiction, alcoholism and alcoholic psychoses prison population), taking into account the internal and external migration, 3 – a realistic forecast of the change in real working population, 4-optimistic forecast changes the real workforce, 5 – pessimistic forecast change in real working population

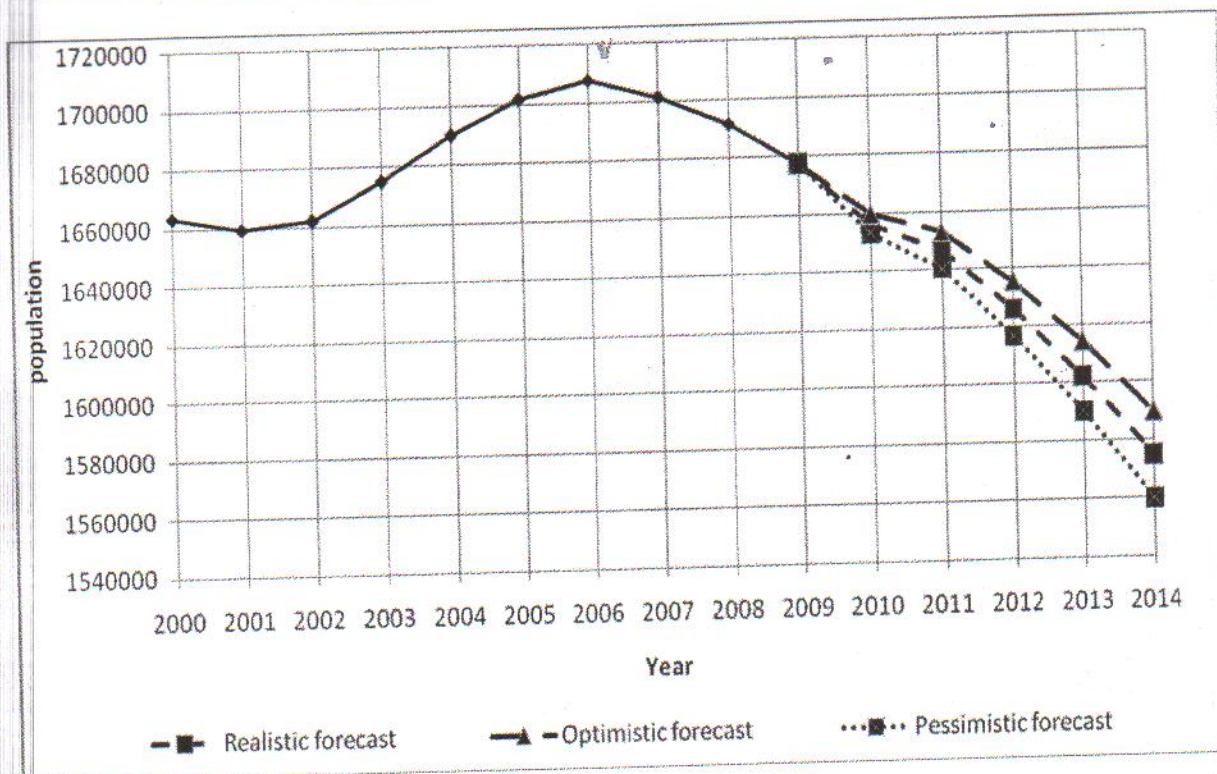


Fig. 6. Dynamics of change of a workforce with the exception of socially disadvantaged people (the sick, drug addiction, alcoholism and alcoholic psychoses prison population), taking into account the internal and external migration.

Application of different methods for analyzing and forecasting the dynamics of the working population, adjusted for the size of asocial elements in the Volgograd region shows how dangerous for development of economy prevailing demographic situation in Russia and in our region. The workforce will be reduced.

The rapid depopulation of the Volgograd region is not only one of the most serious threats to the national security of the region in the near future, but also a significant obstacle to economic growth. A backlog of economic development of the Volgograd region even from advanced and from ordinary and secondary regions of Russia is growing every year. The real quality of the workforce should be subject to increased attention for decision-makers in implementing investment projects and implementation of social policies in the region.

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