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FORECASTING OF POPULATON AND EMPLOYMENT IN LATVIAN MACRO- AND MULTISECTORAL MODELS

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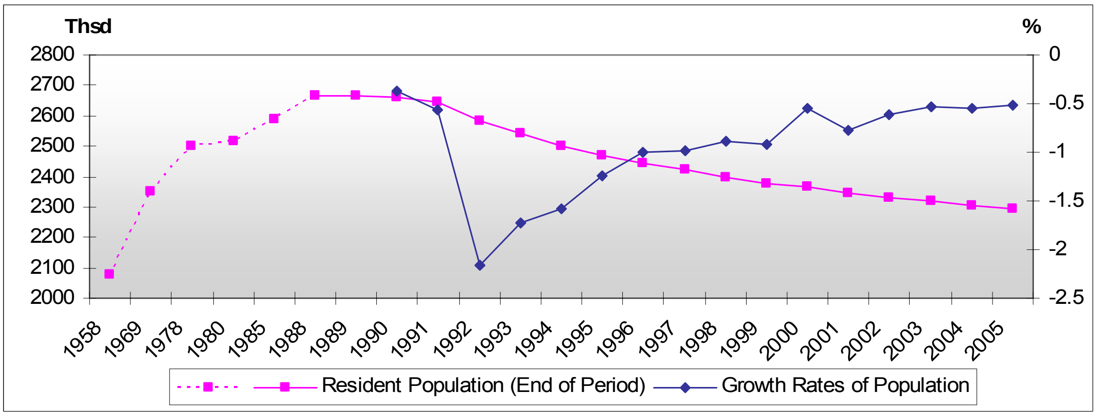
When making forecasts with macro- or multisectoral models, there is a need for prognoses of the population and its structure, economic activity and employment of the population. These forecasts are necessary to compute different living conditions and welfare indicators, wages, productivity, social security indicators, unemployment rate and other indicators.

For the purposes of forecasting of population and employment in Latvian macro- or multisectoral models the econometric approach is approved. Several econometric models have been developed, the mathematical form and the parameters of these models have been substantiated and the assessment of the usability of the models has been made. On the basis of the econometric models specified the segment for analyses and forecasts of indicators of population and employment was made and incorporated in the Latvian macroeconometric model.

During the specification process of econometric models, there is a need for detailed information on the dynamics of different indicators and evaluation of trends of these indicators. When describing the changes in the Latvian population, it can be seen that in the last 15 years (beginning with 1990) the number of Latvian inhabitants is continuously decreasing (see figure 1). What can be observed here is depopulation. In 1989, there were 2668 thousand people in Latvia (historically the highest level[1]), however, in 1991, the figure was 2643 thousand (a decrease by 25 thousand), in 1995 – 2470 thousand (a decrease by 200 thousand as compared with 1989), and in 2000 – 2377 thousand (a decrease of additional 100 thousand people). Hereafter the decrease was not as dramatic as before. Until 2005, the decrease of population was 70 thousand people. The highest decrease rate of population was recorded in 1992, when it was 2.2 % or 57 thousand people. Starting from 2002 the decrease of population is more or less stable – 0.5 – 0.6 % or 12 – 13 thousand people a year.

[1] 1897 – 1929 thsd, 1920 – 1596 thsd., 1925 - 1845 thsd., 1930 – 1900 thsd, 1935 – 1906 thsd (see [1])

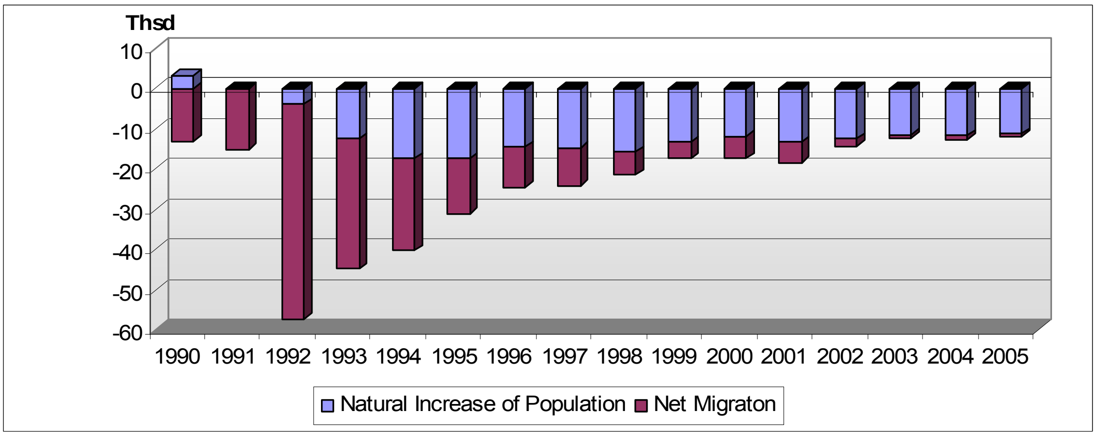


Source: Databases of the Central Statistical Bureau of Latvia

Figure 1. Resident population and its growth rates

The main factors influencing the decrease of population are negative natural increase of population, which depends on birth and death rates, and negative net migration. In 1990 – 1994, depopulation was more dependent on net migration. After 1994 the importance of this factor gradually lowered and in 2005 net migration was only minus 564 people, as compared with minus 53 thousand in 1992.

Negative net migration jointly with other factors has also influenced the natural increase of population. Together with the decrease of the population of ages 15 – 64, which is the population in the working age, as well as in the reproductive age, the birth rate has also decreased. The birth rate has stabilized and even shown a slight growth tendency only in 1997. In 1993 – 1994, the mortality increase together with the decline in the birth rate caused a rapid growth of the negative natural increase of population. In the next few years the mortality had lowered and stabilized at the level of 32 thousand. As a result of the two previously mentioned trends, the negative increase of population since 1994 (excluding 1997, 1998, 2001 and 2004) has gradually decreased – from – 17.5 thsd till – 11.3 thsd in 2005.



Source: Databases of the Central Statistical Bureau of Latvia

Figure 2. The factors of the decrease of the population in Latvia

In order to take into account these trends of demographic processes in making the forecasts of population as well as to explain their influence on the labour force and employment, several econometric models were developed. With the help of these models the possible demographic and employment situation was evaluated, assuming the more realistic hypothesis concerning the trends of the natural increase of population and international migration, changes in economic activity and employment.

For the forecasts of population the following mathematical model was accepted:

$$N = N_{t-1} + \Delta N$$
$$\Delta N = \Delta N_{nat} + \Delta M$$
$$\Delta N_{nat} = k_{nat} \cdot N_{t-1}$$
$$k_{nat} = f(t)$$
$$\Delta M = f(t).$$

According to this model the number of population at the end of the year (N) is equal to the number of population at the end of the previous year (N_{t-1}) plus the increase of population (ΔN). The increase of population forms from the natural increase of population (ΔN_{nat}) (births minus deaths) and net migration (ΔM) (immigrants minus emigrants). The natural increase of population is calculated by multiplying the number of population at the end of the previous year with the coefficient of the natural increase (k_{nat}) (ratio of the natural increase to the number of population in the previous year). The coefficient of the natural increase of population and net migration are calculated as time trends.

If the first three equations are mathematical and at the same time statistic identities, then the coefficient of the natural increase and net migration are incorporated as econometric equations depending on time factor (t), therefore there is a need for application of accordant econometric methods, assuming definite hypothesis on the dynamics of the coefficient of natural increase and net migration.

The quarterly data from 1995 used in modelling is given in Table 1.

Table 1

Indicators of the changes of population in Latvia (thsd)

Years quart.	Resident popul. (end of period)	Increase of population	Live births	Deaths	Natural increase of population	Coefficient of the natural increase (per 1000 residents)	Immigrants (intern. migration)	Emigrants (intern. migration)	Net migration (intern. migration)
1995 I	2492.2	-8.404	5.683	10.435	-4.752	-1.900	0.682	4.334	-3.652
II	2483.8	-8.372	5.697	10.136	-4.439	-1.781	0.646	4.579	-3.933
III	2477.1	-6.772	5.526	8.782	-3.256	-1.311	0.756	4.272	-3.516
IV	2469.5	-7.501	4.689	9.578	-4.889	-1.974	0.715	3.327	-2.612
1996 I	2462.8	-6.683	4.891	9.519	-4.628	-1.874	0.595	2.650	-2.055
II	2456.8	-5.990	5.334	8.396	-3.062	-1.243	0.658	3.586	-2.928
III	2451.0	-5.823	4.986	8.033	-3.047	-1.240	0.752	3.528	-2.776
IV	2444.9	-6.123	4.571	8.372	-3.801	-1.551	0.742	3.064	-2.322

Table 1 (concluded)

1997 I	2438.8	-6.105	4.695	9.005	-4.310	-1.763	0.731	2.526	-1.795
II	2433.6	-5.243	5.159	8.291	-3.132	-1.284	0.628	2.739	-2.111
III	2427.7	-5.842	4.745	7.654	-2.909	-1.195	0.784	3.717	-2.933
IV	2420.8	-6.933	4.231	8.583	-4.352	-1.793	0.770	3.351	-2.581
1998 I	2415.2	-5.641	4.423	8.672	-4.249	-1.755	0.839	2.231	-1.392
II	2409.6	-5.578	4.741	8.498	-3.757	-1.556	0.748	2.569	-1.821
III	2404.7	-4.913	4.732	7.862	-3.130	-1.299	0.779	2.562	-1.783
IV	2399.2	-5.409	4.514	9.168	-4.654	-1.935	0.757	1.512	-0.755
1999 I	2393.9	-5.396	4.668	9.264	-4.596	-1.916	0.394	1.194	-0.800
II	2389.9	-3.951	5.093	8.037	-2.944	-1.230	0.377	1.384	-1.007
III	2386.2	-3.681	5.081	7.324	-2.243	-0.939	0.509	1.947	-1.438
IV	2381.7	-4.505	4.554	8.219	-3.665	-1.536	0.533	1.373	-0.840
2000 I	2376.6	-5.106	5.103	9.271	-4.168	-1.750	0.471	1.409	-0.938
II	2373.2	-3.422	5.359	7.493	-2.134	-0.898	0.399	1.687	-1.288
III	2369.1	-4.104	5.056	7.176	-2.120	-0.893	0.350	2.334	-1.984
IV	2364.3	-4.829	4.730	8.265	-3.535	-1.492	0.407	1.701	-1.294
2001 I	2359.6	-4.668	4.982	8.504	-3.522	-1.490	0.410	1.556	-1.146
II	2355.3	-4.319	5.142	8.058	-2.916	-1.236	0.306	1.709	-1.403
III	2351.3	-4.015	4.972	7.595	-2.623	-1.114	0.348	1.740	-1.392
IV	2345.8	-5.484	4.568	8.834	-4.266	-1.814	0.379	1.597	-1.218
2002 I	2341.8	-3.920	4.999	8.623	-3.624	-1.545	0.307	0.603	-0.296
II	2338.2	-3.602	5.002	8.079	-3.077	-1.314	0.200	0.725	-0.525
III	2335.5	-2.770	5.231	7.368	-2.137	-0.914	0.438	1.071	-0.633
IV	2331.5	-3.996	4.812	8.428	-3.616	-1.548	0.483	0.863	-0.380
2003 I	2327.7	-3.767	5.022	8.625	-3.603	-1.545	0.206	0.370	-0.164
II	2324.8	-2.887	5.312	7.990	-2.678	-1.150	0.268	0.477	-0.209
III	2322.6	-2.185	5.535	7.405	-1.870	-0.804	0.448	0.763	-0.315
IV	2319.2	-3.438	5.137	8.417	-3.280	-1.412	0.442	0.600	-0.158
2004 I	2315.1	-4.139	4.950	8.852	-3.902	-1.682	0.332	0.569	-0.237
II	2312.1	-2.933	5.247	7.898	-2.651	-1.145	0.361	0.643	-0.282
III	2310.0	-2.148	5.398	7.175	-1.777	-0.769	0.494	0.865	-0.371
IV	2306.4	-3.549	4.739	8.099	-3.360	-1.455	0.478	0.667	-0.189
2005 I	2302.8	-3.585	5.301	8.752	-3.451	-1.496	0.342	0.476	-0.134
II	2300.0	-2.860	5.418	8.143	-2.725	-1.183	0.424	0.559	-0.135
III	2298.1	-1.849	5.646	7.366	-1.720	-0.748	0.596	0.725	-0.129
IV	2294.6	-3.550	5.132	8.516	-3.384	-1.473	0.524	0.690	-0.166

Sources: 1. Databases of the Central Statistical Bureau of Latvia
2. Macroeconomic Indicators of Latvia. Quarterly bulletin, #4/2004, Riga: Central Statistical Bureau of Latvia, 2005.

The analysis of the coefficient of natural increase of population given in Table 1 (see the thick line in figure 3) shows that it has a seasonal pattern, particularly after 2001. It can also be seen that the trend is positive – the negative increase is falling, especially in the last 5 years. This is more clearly seen in the seasonally adjusted series (see the thin line in figure 3).

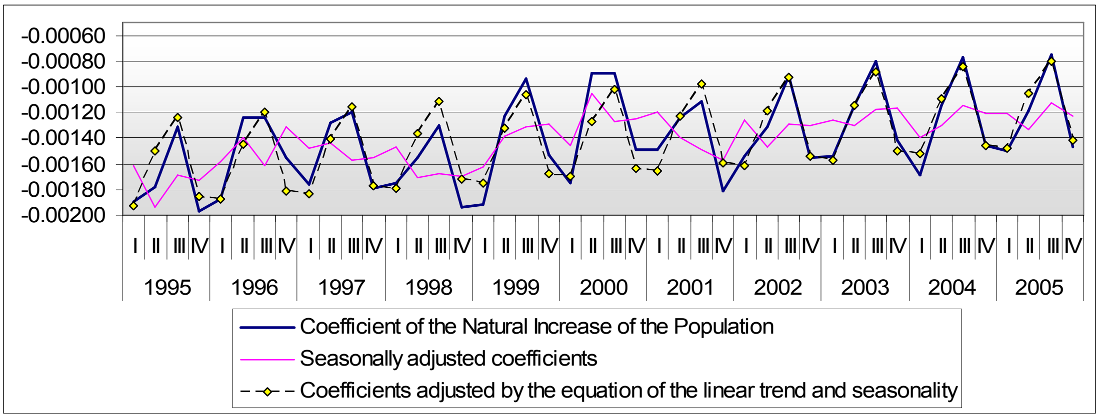


Figure 3. Dynamics of the coefficient of natural increase of population

Seasonality and the positive trend of the coefficient of natural increase of population have been taken into account in the estimation process of the accordant econometric equation. The equation includes factors, which characterise seasonality, and estimated positive parameter of the linear trend. Moreover, the estimation of the equation includes the hypothesis that the positive trend of the coefficient of natural increase continues, however, in the next 25 years it will not exceed the null level (births will not exceed deaths). This hypothesis is probably one of the most realistic ones, because Latvian age structure is characteristic with a great share of elderly people (above 65 years of age) (16.8 % of population at the end of 2005 [6]) showing the growth tendency (see Table 5). As a result the following equation for the coefficient of natural increase of population was estimated:

$$k_{nat} = \underset{(6.5)}{0.000011} \cdot t - [\underset{(34.5)}{0.00193} \cdot (@SEAS(1)) + \underset{(26.6)}{0.00152} \cdot (@SEAS(2)) + \underset{(21.9)}{0.00138} \cdot (@SEAS(3)) + \underset{(32.0)}{0.00190} \cdot (@SEAS(4))]$$

$R^2 = 0.84$ DW = 1.48 S.E. = 0.000143 n = 44

where
in brackets under coefficients – t-statistics;
t – time (trend factor) t = 1,2, ..., n;
n – number of observations;
@SEAS(i) – factors, which characterise seasonality for each quarter i (i = 1,2,3,4);
R^2 –coefficient of determination;
DW – Durbin – Watson criterion;
S.E. – standard error of the equation.

As can be seen, the equation is of high approximation precision (see the dashed line in figure 3) and the parameters of the equation are statistically significant (the critical value of t-statistics is 3.56 with probability 99 %). The equation has a high determination coefficient and has no error autocorrelation (critical values of DW – dL = 1.3263, dU = 1.7199). Therefore the authors consider the equation to be appropriate for short term forecasting of natural increase of population. The equation also shows seasonality of natural increase. When comparing the coefficients of seasonality with their mean (0.00168), it can be seen that the highest positive seasonality is in the first and fourth quarters (accordingly 14.7 % and 12.9 %) and the highest negative seasonality is in the second and third quarters (-9.7 % and -18.0 %).

The analysis of dynamics of net migration given in Table 1 (see the thick line in figure 4) shows that there is a trend of decrease of its negative value. However, there is no reason to assume that the number of immigrants will exceed the number of emigrants (i.e., that net migration will be positive), therefore the equation is estimated as logarithmic trend, which inclines to zero. Also in other prognoses of Latvian population (see, for example, the forecasts of different institutions summarized by P. Zvidriņš [7]) there is an assumption that net migration will be negative at least until 2020.

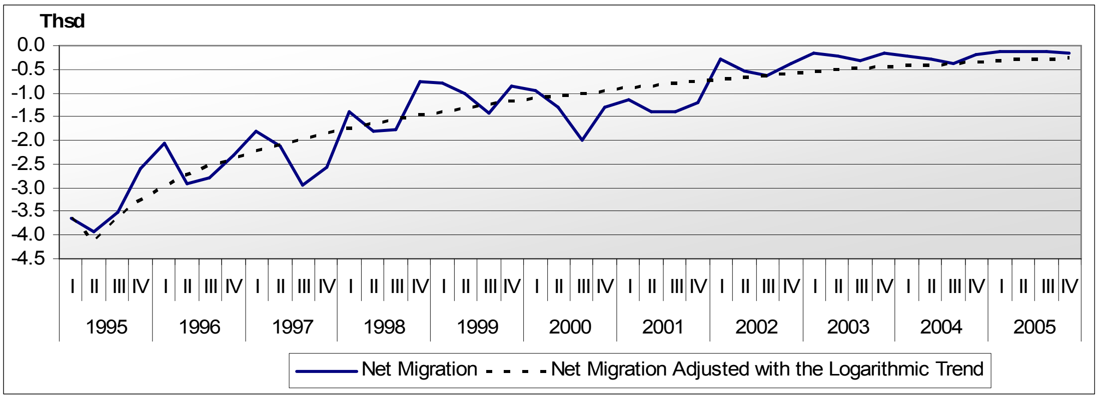


Figure 4. Dynamics of net migration (international migration)

In order to specify such an equation, the censored method of regression (tobit) provided by the programme Eviews was used. As a result two equations were specified. The first describes the trend and the second – the assumption that net migration cannot exceed zero:

1. $i\_\Delta M = -5.05 + 1.29 \cdot \log(t)$
$\qquad (-14.7) \quad (11.7)$

2. $\Delta M = 0 \cdot [1 - @CNORM((0 - i\_\Delta M)/0.408)] + [@CNORM((0 - i\_\Delta M)/0.408)>0) \cdot$
$\cdot (i\_\Delta M *(@CNORM((0 - i\_\Delta M)/0.408)) +$
$+ 0.408*(-@DNORM((0 - i\_\Delta M)/0.408))]$

$R^2 = 0.77 \qquad S.E. = 0.43 \qquad n = 40$

where
CNORM, DNORM – fictive variables generated by the programme Eviews;
$i\_\Delta M$ – additional variable generated by Eviews, which characterises the trend of net migration.

The data of 1995 were not included in the equation, because otherwise the gap between the forecasts and the actual data in 2005 would be significant. The accuracy of the equation is high enough (see the dashed line in figure 4) and the coefficients are statistically significant, therefore this equation is assumed to be appropriate and can be used for short-term forecasts of net migration.

The following short-term prognoses of the indicators characterising the changes in the number of population are made by using the previously mentioned equations:

Table 2

Short-term forecasts of indicators of the changes of population in Latvia (thsd)

Year	Quart.	Resident population (end of year)	Increase of population	Natural increase of population	Coefficient of natural increase (per 1000 residents)	Net migration (international migration
2006	I	2290	-3,5	-3,3	-1,44	-0,2
	II	2287	-2,5	-2,3	-1,01	-0,2
	III	2285	-1,9	-1,7	-0,75	-0,2
	IV	2282	-3,3	-3,1	-1,37	-0,2
2007	I	2278	-3,3	-3,2	-1,39	-0,2
	II	2276	-2,4	-2,2	-0,96	-0,2
	III	2274	-1,8	-1,6	-0,71	-0,1
	IV	2271	-3,1	-3,0	-1,32	-0,1
2008	I	2268	-3,2	-3,1	-1,35	-0,1
	II	2266	-2,2	-2,1	-0,92	-0,1
	III	2264	-1,6	-1,5	-0,67	-0,1
	IV	2261	-3,0	-2,9	-1,28	-0,1
2009	I	2258	-3,0	-2,9	-1,30	-0,1
	II	2256	-2,1	-2,0	-0,87	-0,1
	III	2255	-1,5	-1,4	-0,62	-0,1
	IV	2252	-2,9	-2,8	-1,23	-0,1
2010	I	2249	-2,9	-2,8	-1,26	-0,1
	II	2247	-1,9	-1,9	-0,83	-0,1
	III	2246	-1,4	-1,3	-0,58	-0,1
	IV	2243	-2,7	-2,7	-1,19	-0,1

As can be seen, at the end of 2010 the number of population is forecasted to be 2243 thsd (see also figure 5), therefore, in the next five years the decrease of the population will be about 50 thsd people as a result of natural movement of population and international migration.

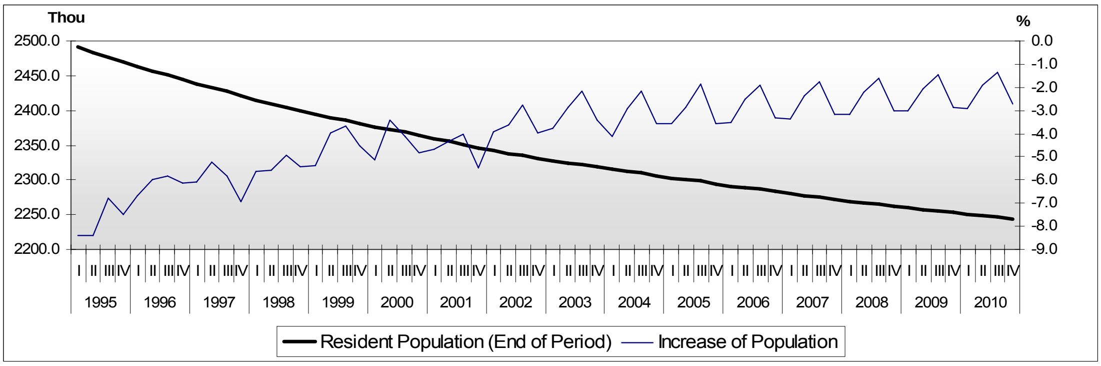


Figure 5. Short-term forecasts of the resident population of Latvia

In the process of long-term forecasting other equations must be used, taking into account long-term trends. In order to obtain the equations for long-term forecasts, similar assumptions were made: i.e., that the coefficient of natural increase will move to zero, but will not reach it in the next 25 years, and net migration in this period will not exceed zero. In order to obtain more precise long-term trends the yearly data were used in the estimation process.

The following equations were specified:

$$k_{nat} = -0.00667 + 0.000176 \cdot t$$
$$(-28.1) \qquad (5.0)$$
$$R^2 = 0.74 \quad DW = 2.35 \quad S.E. = 0.000366 \quad n = 11$$
$$i\_\Delta M = -14.17 + 5.59 \cdot \log(t)$$
$$(-19.3) \quad (13.3)$$
$$\Delta M = 0 \cdot [1 - @CNORM((0 - i\_\Delta M)/0.991)] + [@CNORM((0 - i\_\Delta M)/0.991)>0) \cdot$$
$$\cdot (i\_\Delta M \cdot (@CNORM((0 - i\_\Delta M)/0.991)) +$$
$$+ 0.991 \cdot (-@DNORM((0 - i\_\Delta M)/0.991))]$$
$$R^2 = 0.94 \quad S.E. = 1.17 \quad n = 11$$

The coefficient of natural increase follows the linear trend, but future values of net migration are obtained similarly as in the short-term forecasts – by using the censored equation according to the initial hypotheses. These equations represent the actual data precisely enough and the parameters are statistically significant.

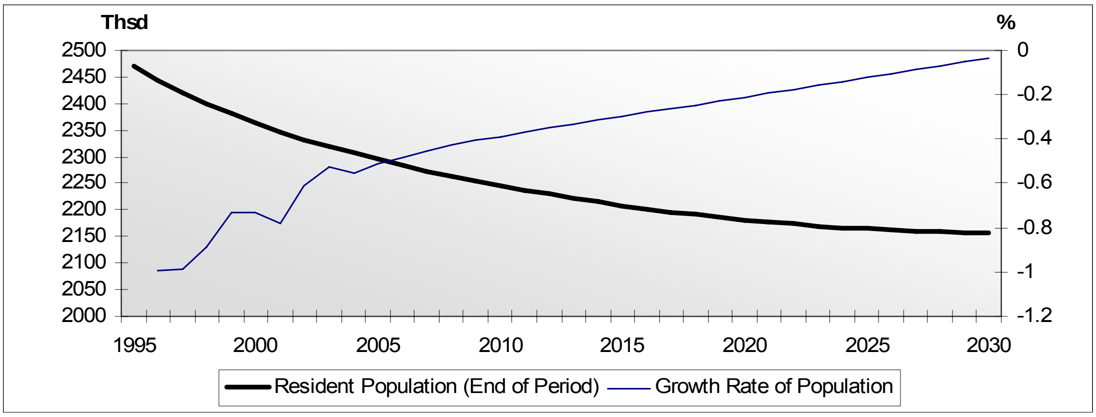
The forecasts developed with these models are given in Table 3.

Table 3

Long-term forecasts of indicators of changes of population in Latvia (thsd)

Year	Resident population (end of year)	Increase of population	Natural increase of population	Coefficient of natural increase (per1000 residents)	Net migration (international migration
2006	2284	-11,0	-10,5	-4,56	-0,5
2007	2273	-10,3	-10,0	-4,39	-0,3
2008	2264	-9,7	-9,6	-4,21	-0,2
2009	2254	-9,2	-9,1	-4,03	-0,1
2010	2246	-8,7	-8,7	-3,86	0,0
2015	2208	-6,6	-6,6	-2,98	0,0
2020	2181	-4,6	-4,6	-2,10	0,0
2025	2164	-2,7	-2,7	-1,22	0,0
2030	2157	-0,7	-0,7	-0,35	0,0

With the given assumptions and taking into account current trends, the number of population in 2030 will be 2157 thsd. That means that the number of people in Latvia during the next 20 – 25 years may decrease by 138 thsd, if the current demographic trends remain (see figure 6).



1995-2005– actual data

Figure 6. Long-term forecasts of resident population of Latvia

The long-term forecasts differ only slightly from the short-term forecasts – the number of population in the short-term prognosis is on average 2 – 3 thsd lower than in the long-term prognosis. However, this difference is within the limits of precision – 0.1 %.

The obtained forecasts can be characterised as the inertia variant of prognoses of demographic indicators with a normative assumption of about zero net migration in the perspective. When comparing these prognoses with the forecasts of Latvian population made by other institutions (see Table 4 and figure 7), it can be ascertained that the results are close to the conditional variant made by Eurostat, CSB of Latvia and the Centre of Demography of LU [7, p.100], which includes hypothetical conditions of natural migration, excluding international migration (the difference 0.04 % in 2010, 0.96 % in 2020 and 5.19 % in 2030). These forecasts are also close to the main variant of the US Census Bureau [7, p.95] (the difference 0.27 % in 2010, 1.79 % in 2020 and 6.40 % in 2030) and the maximum variant of P. Eglīte and co-authors [8, p.132] (the difference 0.67 % in 2010, 0.18 % in 2020 and 0.6 % in 2025).

Table 4

Forecasts of Latvian population (thsd)

	2000	2010	2020	2030
Centre of Demography of LU, conditionally real variant, 1999	2418[1]	2275	2170	2115[5]
Population Division of the UN Secretariat, mean variant, 2001	2421	2288	2161	2015
P. Eglīte and co-authors, maximal variant, 2003	2373	2231	2177	2144
P. Eglīte and co-authors, minimal variant, 2003	2373	2183	1997	1897[5]
US Census Bureau, main variant, 2004	2367[2]	2252	2142	2019
Eurostat, CSB of Latvia and the Centre of Demography of LU, main variant, 2005	2319[3]	2240	2115	2022
V. Ozoliņa, R. Počs, 2006	2301[4]	2246	2181	2157

[1] – 1998; [2] – 2002; [3] – 2004; [4] – 2005; [5] – 2025

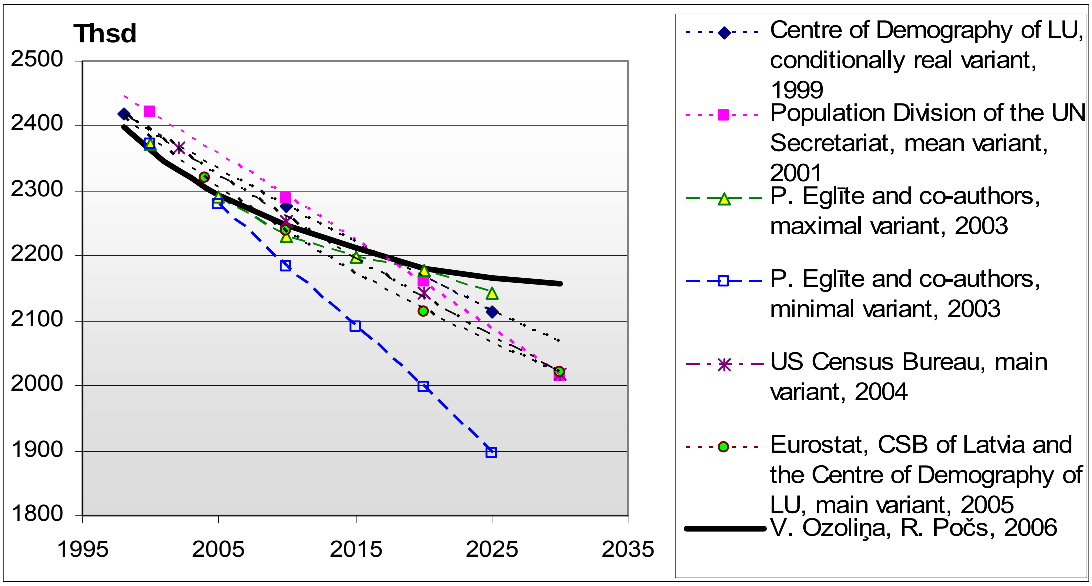


Figure 7. Forecasts of resident population of Latvia (thsd)

How can the forecasted decrease in the number of population influence the number of economically active population and employment in the economy?

Here the age structure and its possible dynamics must be taken into account beginning with the dynamics of the population in the working age bracket (15 – 64 years). The research and hypotheses concerning this issue are far and wide described, e.g., in the publication [8]. Knowing the latest statistical data and therefore having the possibility to update the forecasts for 2005, for the purpose of modelling, the perspective age structure of the population was modified, taking into account the trends of the number of the population in different age groups and therefore the assumptions about the possibility of an increase or decrease of the number of the population in the specific age group (see table 5).

Table 5

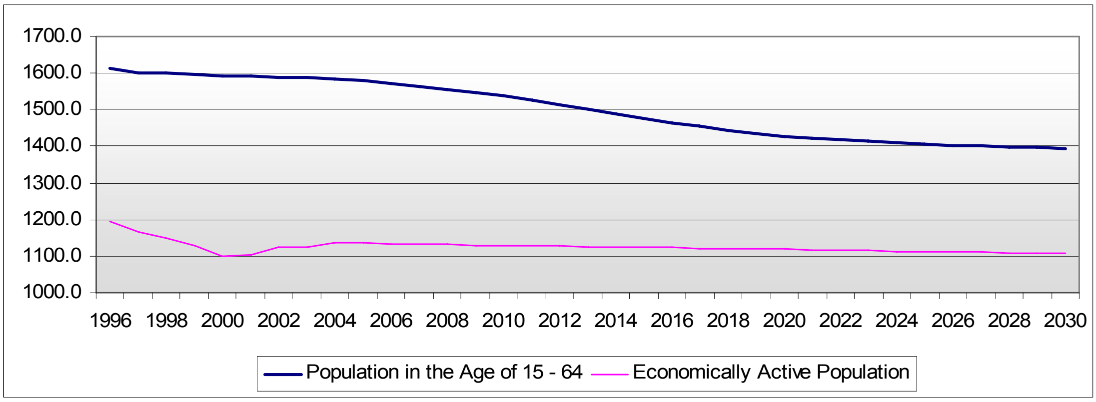
Estimated age structure of Latvian population (end of year, %)

Age group	2005*	2010	2015	2020	2025
0 – 14	14,32	14,25	15,66	16,80	16,90
15 – 64	68,88	68,55	66,84	65,40	65,00
65 +	16,81	17,20	17,50	17,80	18,10

* Actual data

Based on this estimate and the forecasts of the population at the end of the year, we can calculate (by multiplying the number of population at the end of the year with the share of the population in each age group) that in 2025 the population in the working age bracket (15 – 64 years) may reach 1400 thsd. Accordingly, the number of population in the age of 0 – 14 is forecasted as decreasing at the beginning, but after 2010 – as increasing till about 366 thsd. However, the number of people of the age 65 and older is forecasted as increasing over the whole period.

Up to now the share of economically active population in the working age population group has been about 70 %. Since 2001, economic activity of the population has slightly increased (from 1100 thsd people in 2000 to 1136 thsd in 2004), however, in 2005 the number of economically active individuals once again decreased and such a tendency is forecasted to continue, as it is seen in figure 8. If the number of economically active population is decreasing to a smaller extent than the number of population in the working age, it is possible that the share of economically active population may increase.



Source: 1995 - 2004 Databases of the Central Statistical Bureau of Latvia

Figure 8. Economic activity of population (actual data and forecasts), thsd

According to the results of the calculations, in 2020 there may be even 79 % of economically active persons among the population in the working age or about 1100 thsd persons. In other European countries the share of economically active people is also above 70 %. For example, the share of the employed persons of the age 15 – 64 among the population in the working age is 75.9 % in Denmark, 72.5 % in Sweden and 71.7 % in England, which means that in these countries the share of economically active population is even higher.

The population in the working age and their economic activity is the basis for employment (if the hypothesis about the small net migration stands). However, real employment in the first place depends on the trends of development of the economy and the level of labour productivity. Therefore, to establish the connections between employment forecasts and employment structure by industries, elasticity coefficients (ε) of employment (L) to the value added (VA): ($\varepsilon = \Delta L/\Delta VA \cdot VA/L$) were analysed. These coefficients show the complex trends of economic development and the changes in labour productivity. They show the percent changes in employment per each percent change in the value added. At the same time they show, whether there is a connection between employment and production. Then accordant employment equations can be made based on the analysis and assumptions on the possible dynamics of productivity indicators, by assessing the possible technological progress perspective in different industries (the lower the coefficient, the higher the increase of productivity). The absolute values of the coefficients are given in Table 6.

Table 6

Elasticity coefficients of employment to the value added by industries

	1997	1998	1999	2000	2001	2002	2003	2004
Agriculture, hunting and forestry	3,17	3,50	2,70	-1,22	0,80	0,52	-16,2	-0,51
Fishing	-0,16	3,78	-0,23	-6,39	-1,00	-9,78	-3,75	-3,64
Mining and quarrying	-7,89	4,59	0,92	6,29	-0,33	6,52	-3,67	-1,15
Manufacturing	-0,02	0,04	1,19	-0,01	-0,26	0,11	0,42	-0,74
Electricity, gas and water supply	4,04	9,20	1,83	0,70	-1,41	3,94	-1,59	3,82
Construction	0,10	0,29	0,89	-0,38	3,45	-1,04	1,70	1,28
Wholesale, retail trade	0,95	0,47	-0,21	0,26	0,36	-0,16	0,29	-0,09
Hotels and restaurants	2,82	1,52	2,30	0,95	0,03	-74,7	0,08	0,27
Transport and communications	-0,43	1,32	17,0	-0,51	-0,07	3,01	1,08	0,11
Financial intermediation	-6,47	-14,1	-0,50	0,83	1,44	-1,43	2,28	1,99
Real estate	-1,74	3,59	1,11	0,75	-0,64	-0,99	3,92	-0,55
Public administration	-0,54	19,0	7,74	36,3	-1,79	0,13	-0,24	1,38
Education	-2,63	-3,42	15,9	-0,63	1,49	-0,60	-3,12	2,38
Health care and social work	-4,01	0,83	-0,41	-21,8	-42,9	16,8	-0,69	-6,29
Other service activities	-0,16	-1,51	0,30	0,03	2,63	2,77	1,46	0,28

Source: Databases of the Central Statistical Bureau of Latvia (before recalculation of the GDP in December 2005)

For the industries, where elasticity coefficients of employment to the value added are relatively stable, they can be used for forecasting as their mean values or assuming grounded hypotheses concerning their future dynamics.

Thus in electricity, gas and water supply the substantial increase in the number of employment is not expected, therefore the value of the elasticity coefficient can be assumed as the mean value of several past years with the following decrease till zero, foreseeing stabilisation of employment.

In the construction industry and financial intermediation, the elasticity coefficient in the last two years exceeds 1, which means that the number of persons employed is increasing faster than the value added. However, in both cases the value of the coefficient is decreasing, therefore it can be assumed to be decreasing, but positive.

In the fishing industry the trend of value added and employment are opposite (with the exception of 1998) – the value added increases while the employment decreases and vice versa. There is no reason to assume that in the near future this situation may change. At the same time, it is unlikely that the number of employees will sharply decrease, while the value added increases. Therefore the assumption is that the negative value of elasticity will decrease and in 2020 will be close to zero.

In mining and quarrying the elasticity of employment in different periods is positive. However, the negative values (int. al. in 2004), as well as the growth perspectives of this industry indicate that the increase of employment in this industry is unlikely to occur.

The elasticity coefficient in the transport and communications industry fluctuates, however, taking into account the negative trend of the last few years, it can be assumed as decreasing, but still positive.

In the real estate industry the elasticity coefficient fluctuates within a wide range. For example, in 2003 the number of employment grew almost 4 times faster than the value added, while in 2004 this relation was negative. Because of the uncertain tendency in dynamics, the future values of the elasticity coefficient should be considered as zero.

The value of the elasticity coefficient in the manufacturing industry over the given period of time is fluctuating. However, taking into account the potential of this sector, it can be assumed that the number of employees in this industry will grow, therefore from 2006 the elasticity coefficient will be positive, but close to zero.

The analysis of the data shows that the dynamic trends in agriculture, wholesale and retail trade, hotel and restaurant businesses and other service activities does not match the dynamics of the value added in the same industries (the elasticity coefficients widely fluctuate). Therefore, there is no reason to use the elasticity coefficients in these industries for forecasting purposes. For the prognosis in these segments of employment it is better to use employment trends, because the growth of employment in these industries increases or decreases according to the respective trends.

Elasticity coefficients cannot be used in the industries, which are traditionally connected with the public sector – public administration, education and health care and social work (elasticity coefficients also fluctuate). In these industries the dynamics of employment is influenced by many other factors (the amount of budget finances etc.) and therefore it is more accurate to use employment growth rates, which correspond to the dynamics of GDP. For example, in the governance sector and education the employment growth is assumed to be moderate – at the beginning 3 – 4 % a year, in the long term – less than 1 %. However, in the health care industry the employment could initially decrease, following recent trends, but in the long term it would stabilize.

Considering the proposed hypothesis, for the forecasting of the number of the employed by industries, the following models and equations can be used:

$L_{01} = 54{,}981 + 236{,}004 \cdot (1 / t^{0.5})$	Agriculture, hunting and forestry
$\quad (2{,}21) \qquad (3{,}75)$	
$R^2 = 0{,}74 \quad DW = 1{,}55 \quad S.E. = 10{,}11 \quad n = 7$	
$L_{02} = L_{02,\,t-1} \cdot (1 + \Delta VA_{02} \cdot \varepsilon_{02})$	Fishing
$L_{03} = L_{03,\,t-1} \cdot (1 + \Delta VA_{03} \cdot \varepsilon_{03})$	Mining and quarrying
$L_{04} = L_{04,\,t-1} \cdot (1 + \Delta VA_{04} \cdot \varepsilon_{04})$	Manufacturing
$L_{05} = L_{05,\,t-1} \cdot (1 + \Delta VA_{05} \cdot \varepsilon_{05})$	Electricity, gas and water supply
$L_{06} = L_{06,\,t-1} \cdot (1 + \Delta VA_{06} \cdot \varepsilon_{06})$	Construction
$L_{07} = 160{,}893 - 85{,}140 \cdot (1 / t)$	Wholesale, retail trade
$\quad (90{,}36) \quad (-11{,}82)$	
$R^2 = 0{,}95 \quad DW = 2{,}77 \quad S.E. = 2{,}66 \quad n = 9$	
$L_{08} = 9.408 + 6{,}894 \cdot \log(t)$	Hotels and restaurants
$\quad (8{,}65) \quad (11{,}11)$	
$R^2 = 0{,}95 \quad DW = 1{,}87 \quad S.E. = 6{,}20 \quad n = 9$	
$L_{09} = L_{09,\,t-1} \cdot (1 + \Delta VA_{09} \cdot \varepsilon_{09})$	Transport and communications
$L_{10} = L_{10,\,t-1} \cdot (1 + \Delta VA_{10} \cdot \varepsilon_{10})$	Financial intermediation
$L_{11} = L_{11,\,t-1} \cdot (1 + \Delta VA_{11} \cdot \varepsilon_{11})$	Real estate

$L_{12} = L_{12,\,t-1} \cdot (1 + \Delta L_{12})$ Public administration

$L_{13} = L_{13,\,t-1} \cdot (1 + \Delta L_{13})$ Education

$L_{14} = L_{14,\,t-1} \cdot (1 + \Delta L_{14})$ Health care and social work

$L_{15} = 80{,}701 - 183{,}773 \cdot (1 / t)$ Other service activities

$\quad (16{,}5) \quad (-5{,}46)$

$R^2 = 0{,}88 \quad DW = 1{,}57 \quad S.E. = 2{,}81 \quad n = 6$

where

L_i – the number of employed in the i-th industry;

i – the index of the industry, i = 1, 2, ... 15;

ΔVA_i – growth rate of the value added in the i-th industry;

ε_i – employment elasticity coefficient with the respect to the value added in the i-th industry;

ΔL_i – growth rate of employment in the i-th industry.

By using these equations (as well as the forecast data of VA from the Macroeconometric Model of Latvia) the number of employed persons in 2020 could reach 1077 thsd, incl. about 62 % in the service industries.

Conclusions:

1. Taking into account the acceptable statistics of the specified equations and the fact that at least in the near perspective the results of the forecasts do not considerably vary from the prognoses made by other institutions (variants with similar assumptions) it would be absolutely justified to include and use these equations in macroeconomic calculations and macromodels, making both short-term and long-term forecasts. These can be easily used, making short-term quarterly prognoses, which is harder using other methods, for example, by using the component method.
2. Including such equations in the system of macromodel equations allows calculating the most important endogenous demographic and employment indicators and thus allows developing different macromodel forecast scenarios more promptly and, if necessary, adjusting the parameters of the equations.
3. The pro of using the specified econometric equations is that in this case it is not necessary to constantly wait for the forecasts to be made and published by other authors or institutions using more precise but also more complicated methods, which take more time to update.
4. With these equations it is possible to obtain acceptable for macroeconomic calculus forecasts of main demographic and employment indicators by using different hypotheses in the short time after the release of the latest data or when the new information about the possible future trends is obtained, or when new hypotheses about the possible demographic or employment situation are proposed.

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