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STOCHASTIC FORECAST OF THE LITHUANIAN  
POPULATION 2001 – 2050

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# STOCHASTIC FORECAST OF THE LITHUANIAN POPULATION 2001 – 2050

By Juha Alho<sup>1</sup>

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## 1 INTRODUCTION

After the independence from the Soviet rule, Lithuania - along with the other two Baltic states Estonia and Latvia - has gone through a turbulent period which has left its marks on the country's demography. Lithuania is ethnically homogeneous: 82% of the population was Lithuanian, 8% Russian, and 6% Polish, in 1998. This suggests that the Lithuanian demographic trends may well display idiosyncracies not shared by the neighboring countries. During independence, Lithuanian total fertility rate has dropped from 2.0 in 1989 to 1.4, thus continuing the earlier, declining trend. Mortality increased in the mid-1990's, but it has since declined to the pre-independence level. It is thought that thousands of Lithuanians have emigrated to Western countries to work. A major difficulty in forecasting is caused by the fact that their number is not accurately known.

Due to the factors noted above, the forecasting of the Lithuanian population poses a particular challenge. Past trends have clearly been disrupted by the political events. Yet, they form the only available starting point for the exercise. Lithuania plans to join the EU, so the current EU or other European demographics may give an indication of how the future trends in Lithuania may be. Yet, it is difficult to say when the joining might take place, and which of the demographically heterogeneous European countries Lithuania might be closest to. For example, current total fertility rate is 1.2 in Italy and Spain but 1.8 in Norway.

An informed debate about such issues is certainly of interest to a demographic forecaster. However, it seems clear that one cannot get rid of the inherent uncertainty of the demographic development by merely considering alternative scenarios. As a contribution to the debate, we offer an alternative approach in which we describe the most likely future demographic trends, but recognizing that we cannot know them accurately, we use modern forecasting tools to quantify the uncertainty one should expect.

Estimates of uncertainty can be based on Lithuanian data, experience from other countries, and on judgment similar to that we exercise in formulating the most likely trends. The estimates lead to wide variety of alternative population paths that Lithuania may be faced with. The Lithuanian retirement system, in particular, should be planned in a way that is robust against a variety of reasonable future contingencies. An advantage of the stochastic formulation is that no single path of development is considered inevitable, some types of paths are just more likely than others.

## 2 FORECAST ASSUMPTIONS

### 2.1 Jump-off population

The population will be considered disaggregated by single years of age (0, 1, 2,..., 100+) and by sex. The starting (or jump-off) population is that resident in the country as of January 1, 2000. Official estimates put the total population at that time to 3.699 million. These estimates are based on an earlier census and vital registration data. The results of the Census of 2001 have not been released. However, it has been announced that the enumerated population on April 1, 2001, was 3.496, a difference of 0.203 million (or 5.5% of the official estimates). A key question is, what should be taken as the jump-off value in our forecast.

In the absence of a post-enumeration survey (cf., Hogan 1992), any adjustment of the census count must be speculative. However, based on informal discussions with Lithuanian experts, we have analyzed the situation as follows.<sup>2</sup> First, due to undocumented emigration in 1990-1994 of Slavs (some may have worked in the communist party and related institutions; some may have feared for new language requirements; some may have had an economic motive such as cashing in on their newly privatized apartment; yet others may have left simply to join their family), the official statistics may be roughly 50 thousand too high, leaving an adjusted count of 3.649 million. On the other hand, the Lithuanian census may suffer from an undercount of possibly 50 thousand inhabitants. This figure represents 1.4% of the census count, a figure somewhat lower than the recent past census undercounts in the United States. Thus the adjusted census figure would be 3.546 million. The rate of natural increase was approximately zero during year 2000. Therefore, the difference, 0.103 million is thought to consist of undocumented emigration to Western countries.<sup>3</sup> Most of this is thought to have happened in 1995-2000. This would mean an annual out-migration of about 17,000 inhabitants. Since the census day is April 1, 2001, the population on January 1, 2000, should be about 22,000 thousand inhabitants higher, or our final estimate of the jump-off population is 3.568 million. That is, we need to take out  $3.699 - 3.568 = 0.131$  million out of the official estimate.

The sex distribution is assumed to be the same as in the official estimates.

The age-distribution of the out-migrants is not known, nor are the census figures available before fall 2001. We will use the age-distribution of the official statistics as a basis.



**Figure 1. Adjusted population size by single years of age, in Lithuania as of January 1, 2000, for males (solid line) and females (dashed line).**

<sup>2</sup> The judgment involved in the following estimations is our own responsibility.

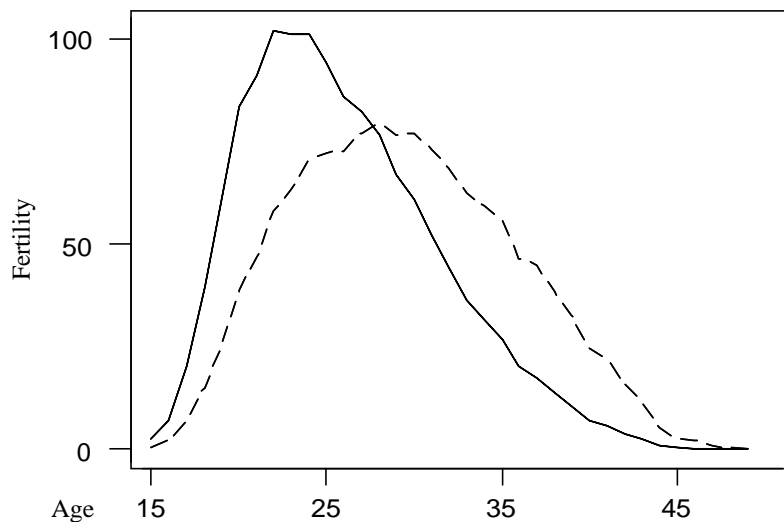
<sup>3</sup> It is plausible that the earlier census also suffered from an undercount, but it is thought that during the Soviet years the level would have been low.

Using rates of internal migration, we take away a higher proportion from those ages that experience a high rate of internal (and presumably external) migration than from ages that experience low internal migration (Lazutka 2001). The so-called Karup-King method (cf., Shryock and Siegel 1976) was used to interpolate the figures to single years of age. A graph of the estimated jump-off population is given in Figure 1. The actual numbers are in Appendix I.

As discussed in Alho and Spencer (1985), it is possible to express the uncertainty of the jump-off population in probabilistic terms. This has not been done, because the current version of PEP does not support this source of uncertainty. Therefore, population uncertainty as expressed in the predictive distributions below will be somewhat too low, especially in the first few forecast years. We will show via sensitivity analysis that in later years other sources of uncertainty dominate.

### 3 FERTILITY

Apart from a few periods of temporary reversal, the Lithuanian fertility has declined at a variable rate, since 1960. Instead of reflecting a trend, the decline in the 1990's could also be attributed to the political upheavals after independence. A key question in forecasting fertility is whether the decline will continue or possibly reverse itself.



**Figure 2. Age-specific fertility in 1999 (solid line) and the assumed fertility in 2025 (dashed line).**

The 2000 revision of the U.N. world population forecast (U.N. 2001) assumes that the decline in total fertility rate will continue from a recent value 1.38 children per woman, to 1.19 in 2010-2015. Then, fertility is assumed to start to grow to reach 1.90 in 2045-2050. Our interpretation of the U.N. assumption is that the initial decline is based on the assumption of continuing trend, and the later increase is based on a general convergence hypothesis that nearly all countries of the world will be close to the replacement level of approximately 2.1, in 2050. In our view, the evidence supporting such a hypothesis is weak, at best.

A comparable World Bank (cf., White Book of Pension Reform, Vilnius, p. 29) forecast assumed that the Lithuanian total fertility would stay at 1.40 until 2010, and then increase to 2.07 in 2030, to stay at that level. The increase seems to correspond to the idea that the past trend is not relevant, and fertility will start to approach the replacement level in a decade. The choice of replacement level target is even more questionable than the assumption of the U.N.

Our point forecast (or most likely value) for fertility will be today's value 1.35 for the whole forecasting period. I.e., we see no convincing argument that fertility will increase or decrease. Since it could do both, we need to acknowledge both possibilities. The current value is also close to the current EU average, so if one thinks that Lithuania will increasingly become like the EU countries, the value is credible.

In Lithuania in 1998, the average age at marriage was 22.9 for women, and the average age of the fertility schedule was 26.3. We think it is possible that childbirths will be postponed further, and assume that the age-distribution of fertility will resemble that of the Nordic countries, in 2025. More precisely, we will assume that the average age of fertility schedule will be 30 in 2025. Technically, this is achieved by lowering rates in ages below 26, and making them higher in ages over 26 using an exponential transformation. The result is shown in Figure 2. This assumption is uncertain also, and the uncertainty will be described by a probability structure that maintains the uncertainty specified for the total fertility rate, but allows for differential age-specific variation from the point forecast (cf., Alho 1998).

Using empirical analyses of Finnish fertility from 1776-1996, a period that includes structural breaks, changes of level, and periods of high and low volatility, it is possible to calculate how large the variation in the Lithuanian fertility might be, if it is equally variable. These analyses have been described in detail in Alho (1998). To characterize the uncertainty implied by those estimates, one can calculate that the standard deviation of the forecast error in 2025 is about 14% of the point forecast, and a 95% prediction interval is [1.06, 1.80]. This can be compared to the most likely values given by the U.N. and W.B. forecasts that are approximately 1.5 and 2.07, respectively. We cover a good part of the range those forecasts form, but acknowledge the possibility that fertility may remain low or even go lower than it is now.

## 4 MORTALITY

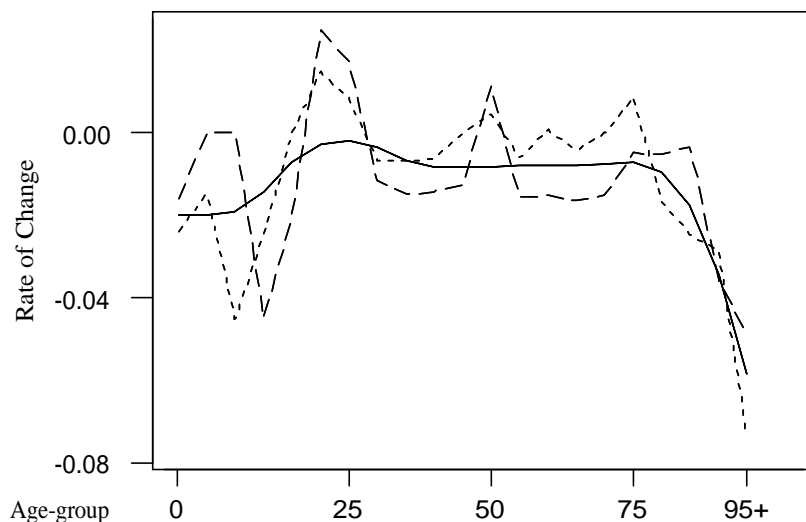
Age-specific mortality increased in Lithuania in nearly all ages, during 1990-1994. Subsequently, mortality has declined in most ages, but not all. We will treat the period as an aberration, and base on our forecast on the observed decline between the years 1989 and

1999. However, the relative rate of change given in Figure 3 shows considerable variation across age. The smoothed version has been obtained by applying the RSMOOTH procedure of Minitab to the averages of the age-specific rates of change. The transformation removes part of the effect of temporary random variation, and serves as a basis for further refinement. In particular, especially in the oldest ages there is a tremendous decline that may be due to data errors.

A comparison of the Lithuanian age-specific mortality to that of the Nordic countries shows that the Lithuanian mortality is higher than that of the Nordic countries in ages 0-89 for females and in ages 0-79 for males, but lower in older ages. For example, in 1999 mortality (per 1,000) in ages 95+ in Lithuania, and in the Nordic countries (Denmark, Finland, Norway, Sweden) was

Country	LI	DK	FI	NO	SE
Females	240	354	348	391	409
Males	211	453	412	429	495

In other words, the Lithuanian rates are approximately one half of those of the Nordic countries. Another peculiarity is that male mortality is estimated to be lower in Lithuania than female mortality. On the other hand, in 1990 the Lithuanian rates were 373 for females and 409 for males, which is more in line with the rates elsewhere.



**Figure 3. Annual rate of change in mortality between 1990-1999, in Lithuania by age-group, for females (dashed Line), males (dotted Line), and the smoothed average of the two.**

A comparison of rates for the highest age might be confounded by variations in the age distribution. However, in age 90-94 the Lithuanian mortality is estimated at 185.9 for females and 203.3 for males in 1999, whereas in the Nordic countries (in alphabetical order) the female rates were 212, 227, 221, and 225 for females, and 272, 277, 278 and 303 for males. A possible bias in the Lithuanian old-age mortality data could be caused by underenumeration of deaths, overestimation of population, or overstatement of age. The latter may be the most credible. Being old may have meant that one is exempt from military or other duties.

A simple adjustment of the Lithuanian old age mortality figures can be made by using the average of age-specific mortality in the four Nordic countries for Lithuania in ages 90-94 and 95+ for females, and in ages 85-89, 90-94, and 95+ for males. The two estimates for the females are 221.3 and 375.2. the three estimates for the males are 175.5, 282.6, and 447.2. We will use these figures in place of the official estimates (Appendix II). The life expectancies implied by these assumptions are 77.4 and 67.0 years for females and males respectively. For comparison, the U.N. estimate of Lithuanian life expectancy (both sexes combined) in 1995-2000 is 71.4 years.

We note that logically, an adjustment of the mortality rates on account of possible age-overstatement should be accompanied by an adjustment of the jump-off age-distribution, as well. The effect would be to further decrease the size of the old age population. An adjustment has not been made, however.

Given the uncertainty of the basic estimates, the age-specific rates of change are also suspect. It is plausible that the rate of decline in young ages is the fastest. It is also plausible that the decline in young working ages is the slowest. However, we will assume that in the highest ages the smoothed rate of decline remains at the level it is in age 80. The net effect of the assumptions is the mortality schedule for 2050 given in Appendix II. These schedules correspond to a point forecast of life expectancy of 83.2 years for females and 73.2 years for males. We do not know what principles the U.N. followed in their forecast, but it is reported that life expectancy at birth in 2045-2050 is 79.6 years for both sexes combined. The average of our values is 78.2, so the results are fairly close from this perspective. However, our assumptions correspond to faster decline in infant mortality than those of the U.N. Our point forecast for 2050 is approximately 3.2 per 1,000 whereas the U.N. assumption is 5.4, in 2045-2050. Therefore, we suspect that the U.N. may assume a faster improvement in mortality in the working ages, than implied by the smoothed curve of Figure 3.

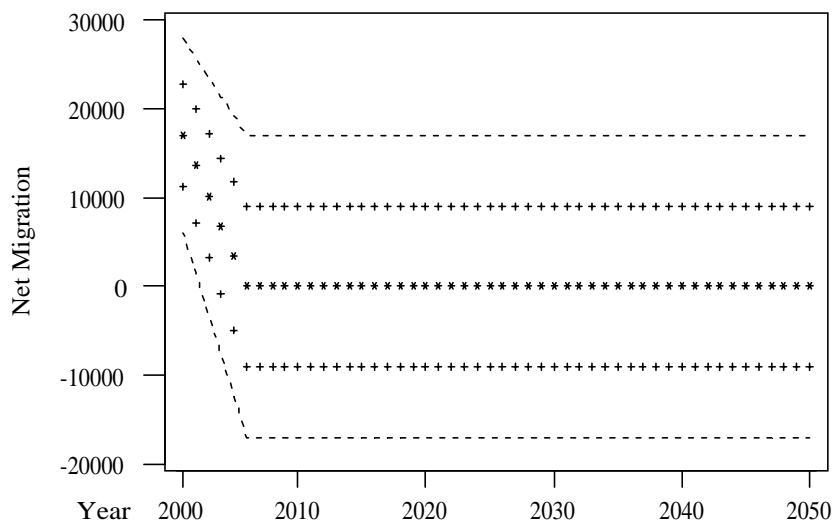
In the case of mortality, we also have empirical estimates of uncertainty from Finland available. A direct way to understand what they mean is to note that for Finnish females an 80% prediction interval for life expectancy in 2050 was [82.3, 89.0] years, and for males it was [76.5, 86.5] years. Apparently, the narrower band for females was due to their lower level of mortality. These intervals can be compared to those calculated by Lee and Carter (1992) for the United States. In their application, a 50 year ahead 95% interval forecast for life expectancy (both sexes combined) had a total width of about 8.4 years. This implies that an 80% interval would have the width of 5.5 years, approximately. However, as we have pointed out in the discussion of the Lee and Carter paper (Alho 1992), the authors did not include all sources in their error estimates. Including all sources would have lead to intervals that are approximately 1/2 wider than those they report. Therefore, the two methods actually give estimates that are quite close. In fact, in large countries with heterogeneous sub-populations, one would expect trends to be more stable due to cancellation of variation among sub-populations. Therefore, the Finnish estimates might be, if anything,

too low as compared to the adjusted Lee and Carter estimates. While it seems reasonable to apply them in the Lithuanian context, one should recognize that the current jump-off value of old-age mortality and the current rate of decline in Lithuania is uncertain. Therefore, the Finnish estimates may underestimate the uncertainty of the Lithuanian future mortality.

The net effect of coupling the above assumptions on point estimation, and the Finnish estimates of uncertainty lead to the following percentiles of the predictive distribution of life expectancy:

Year	Males			Females		
	10%	50%	90%	10%	50%	90%
2010	66.8	68.5	70.2	77.0	78.9	80.8
2025	66.6	70.1	73.7	76.7	80.6	84.5
2050	65.1	72.5	79.9	75.7	83.4	92.8

These figures are based on 1500 simulations from the true predictive distribution, as carried out using PEP. The interpretation is that the probability is 10% that the male life expectancy exceeds 73.7, in 2025, for example.



**Figure 4. Predictive distribution of net out-migration, with median (\*), 50% prediction intervals (+), and 80% prediction intervals (-).**

## 5 MIGRATION

The uncertainty of the jump-off population was intimately tied up with the assessment of undocumented migration. Our judgmental assessment placed the recent level of net out-migration at 17,000 per year. One can argue, that if Lithuania will become a member of the EU, then migration will further increase. This argument is supported by some survey findings (e.g., Survey of living conditions conducted by Lithuanian experts and the Norwegian FAFO) suggesting that possibly 2.7% of the population, or 100,000 inhabitants, are interested in leaving the country. On the other hand, recent migration may be a reflection of the existence of pool of potential migrants who could not leave, before the independence. In that case one would expect migration to be lower in the near future. The survey findings may also be expressions of interest rather than indications of actual intention to go.

We think that if taken at face value, the survey results are likely to overstate the level of migration in the near future. Our point forecast will start out from out-migration of 17,000 per year, but it will decline to 0 by the year 2006. This implies that we think it is likely that another 40,000-50,000 inhabitants will leave the country in the near future. We will assume that the number of net migrants is evenly split between males and females, with an age-distribution that corresponds to that of internal migration.

After 2006 it is difficult to argue for either a positive or a negative net migration. While some Lithuanians may still want to migrate to get a better job, the ageing of the Lithuanian society will lead to a rapid shortage of working age people in the society. An increase in fertility could offset the decline, but only slowly. Instead, there could well be an influx of workers from the neighboring countries, or there could be return migration, if the Lithuanian economy is successful. These considerations lie behind the zero net migration assumption as the most likely value.

However, future migration is potentially even more uncertain than future fertility or mortality. There is no systematic time-series data that could be used to assess past uncertainty in quantitative terms. Therefore, judgement must play a central role. (This was the case in the Finnish forecast also, see Alho 1998.) We consider three test years: 2006, 2020, and 2050. For each year we think, how likely it is that emigration is as large as the current level (17,000), or that the immigration is as large as the current emigration. The following probabilities were used as starting points: 80%, 67%, and 50%. These would correspond to our willingness to bet 4:1 that the future value is in the interval in 2010, to bet 2:1 that the value is in the interval in 2020, and to bet 1:1 that the value is in the interval in 2050.

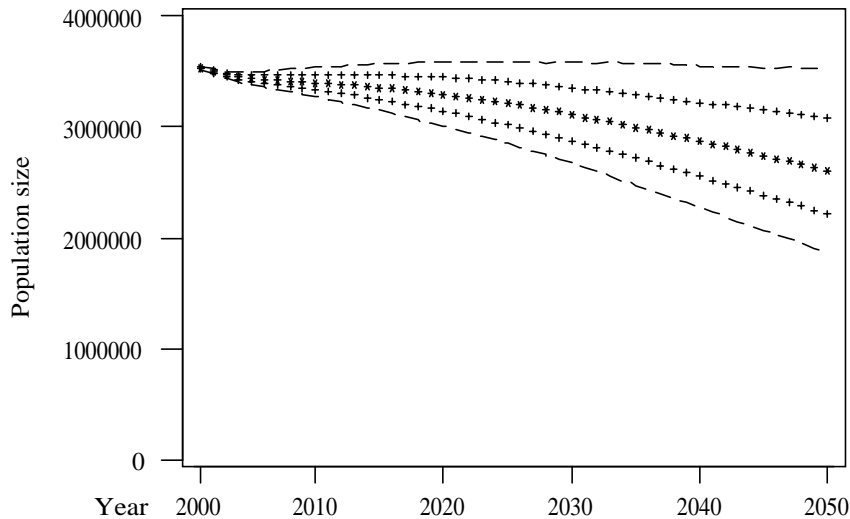
Due to the uncertainty of the jump-off value the probabilities could be revised downwards suggesting a higher level of uncertainty. On the other hand, a comparison to the Finnish forecast in Alho (1998) shows that our basic assumptions concerning Lithuania postulate a level of uncertainty that would be about 15% higher than that determined empirically for Finland in 1945-1995 using ARIMA models. This was a volatile period that included the opening of the Nordic labor market in the 1950's, and a very large out-migration to Sweden in the 1960's. Since the Finnish population is approximately 1.4 times as large as the Lithuanian population, the level of uncertainty seems somewhat too high for Lithuania, despite the admittedly uncertain present. This suggest that the initial probabilities should be adjusted up instead of down, especially for the longer forecast horizons.

Another factor to be taken into account is that while in any given year net migration might be much higher or lower than the most likely value, there can be cancellation of error over

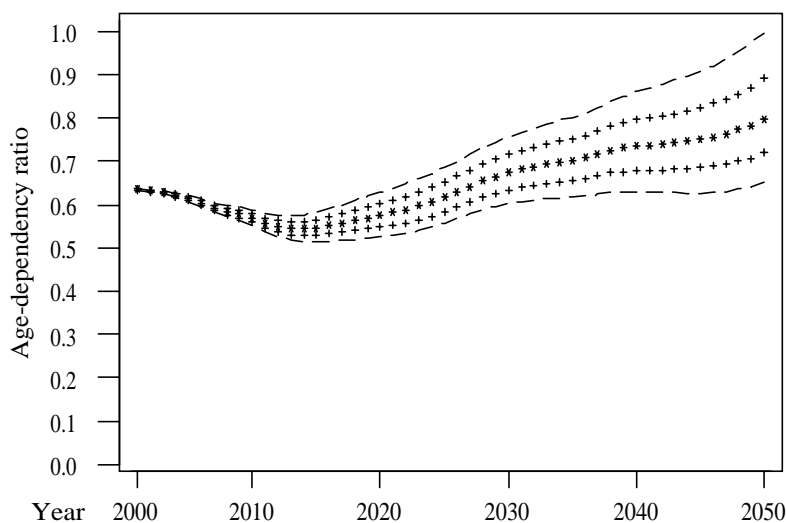
time. In the Finnish forecast, a constant correlation of 0.7 was assumed based on an empirical analysis. In the Lithuanian case one might expect a higher level of variance but a lesser level of autocorrelation. In fact, return migration is a significant possibility, in the future.

Based on these considerations, we chose a constant autocorrelation of 0.5 for net-migration, across forecast years. In this case half of the variance is due to the overall level, and another half is due to unpredictable annual fluctuations. The probabilities used as a starting point were adjusted up to 80% for all future years after 2006. This brings the level of uncertainty to a level close to that determined empirically for Finland. The uncertainty of the jump-off value was accommodated by assuming that with a probability  $2/3$  the jump-off net-migration was in the interval  $-17000 \vee 8500$ . These values were transformed into standard deviations of net migration. In Figure 4 we give a 50% and an 80% prediction interval for the annual future net migration that these assumptions imply.

Another view of the migration assumption can be obtained by calculating the predictive distribution of the cumulative net migration during the forecast period of 50 years. The median is 42500 and the standard deviation is 467000. We see that from a probabilistic point of view, the use of zero net migration point forecast does not mean that the role of migration would have been neglected.



**Figure 5. Quantiles of the predictive distribution of the Lithuanian population in 2001-2050: median (\*), first and third quartiles (+), and first and ninth deciles (-).**



**Figure 6. Predictive distribution of the Lithuanian age-dependency ratio: median (\*), first and third quartiles (+), and first and ninth deciles (-).**

## 6 PREDICTIVE DISTRIBUTIONS

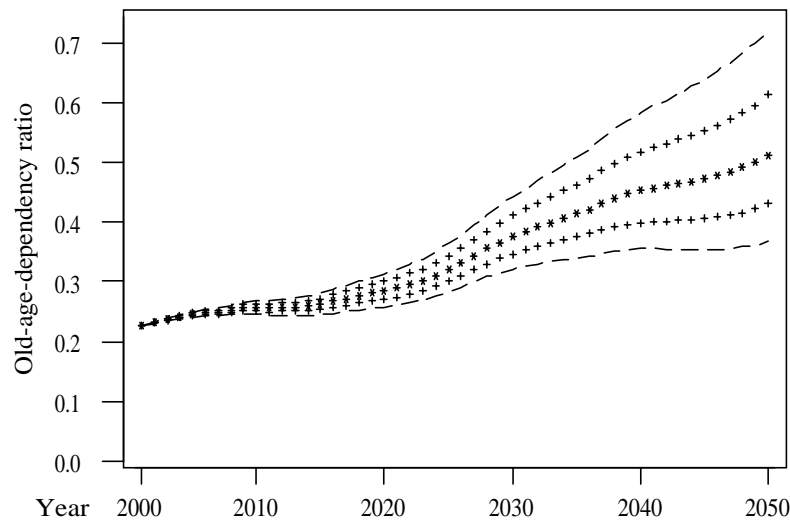
Figure 5 contains the median, the first and third quartiles, and the first and ninth deciles, of the predictive distribution of the Lithuanian population. The numbers on which the figure is based are given in Appendix III. The interpretation is that the probability is 50% that the population is between the quartiles, is 50%, for example. After a stable period of about ten years, the population is forecasted to decline to 2.6 million in 2050. With 90% probability the population is then in the interval [1.9, 3.5] million.

The medium variant of a recent U.N. forecast puts the Lithuanian population in 2050 at 3.0 million, whereas ours puts it at 2.6. One cause of the difference appears to be the upturn of fertility forecasted by the U.N. but not considered equally likely by us. However, this accounts for less than 0.1 million, so both our migration and mortality forecasts may also be less optimistic. The probability that the Lithuanian population will exceed the U.N. point forecast is 30%, so the two forecasts are actually not that different.

In Appendix F of the book “Beyond Six Billion” (National Research Council 2000) an empirical analysis of past U.N. population forecasts is described. The models describe statistically the error of past forecasts for the total population of all countries of the world. Unpublished data on Lithuania indicate that the 80% prediction interval for Lithuania in 2050 (centered around the U.N. point forecast) is [2.0, 3.7] million. Or, apart from the point forecast, the two intervals are similar, despite the difference in the methods.

How large is the effect of leaving the uncertainty of the jump-off population out of the calculation? Our point estimate was 3.568 million. A relative error that reflects fairly well the

reasoning behind the adjusted figure is 1.5%, or a 95% prediction interval for the total population is [3.465, 3.674] million based on a lognormal assumption. For comparison, the relative errors obtained for the total population without the jump-off uncertainty are 1.6%, 3.3%, 7.2% and 25.6% for the years 2005, 2010, 2020 and 2050, respectively. If the jump-off error can be assumed to be approximately independent of the other sources of error, then an adjusted standard error for the year 2010 would be  $(0.015^2 + 0.033^2)^{1/2} = 0.036$ , or 3.6%, so we see that after about ten forecast years, the effect of the jump-off error is negligible.



**Figure 7. Predictive distribution of the Lithuanian old-age-dependency ratio: median (\*), first and third quartiles (+), and first and ninth deciles (-).**

The ageing of the Lithuanian population can be described using the so-called age-dependency ratio. In this application we have defined it as the population in ages 0-18 and 65+ divided by the population in ages 19-64. Frequently the lowest age-group is taken to be 0-15, but our aim is to approximate the burden on the potentially working population. Figure 6 has a quantiles of the predictive distribution with similar interpretation as those of Figure 5. We see that initially the ratio improves. This appears to be due to the recent decline in fertility. There will be fewer children to feed and educate. However, after about 20 years an increase begins that is caused by population ageing. The increase due to mortality is gradual as shown by Figure 7 that gives us the predictive distribution of the old-age-dependency ratio, or the ratio of population in ages 65+ over the population in ages 19-64. Together Figures 6 and 7, and Appendix IV, vividly demonstrate the effect of the low level of fertility on population structure.

While our calculations do not preclude the possibility of a significant upturn in fertility, we have considered it much less likely than the U.N. or the World Bank. For those disagreeing this judgment, we remind that the population ageing will put an increasing burden on the working population at the same time the fertility increase is assumed to occur.

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**Appendix I. The Adjusted Lithuanian Population, January 1, 2000.**

<b>Age</b>	<b>Males</b>	<b>Females</b>	<b>Age</b>	<b>Males</b>	<b>Females</b>	<b>Age</b>	<b>Males</b>	<b>Females</b>
0	17493	16282	45	21108	22826	90	2312	2707
1	17984	16502	46	21542	23845	91	1041	2103
2	18281	17063	47	21118	23600	92	696	1737
3	18866	17880	48	21403	23960	93	261	1417
4	19799	18839	49	20925	24411	94	544	1063
5	20742	19526	50	19052	22347	95	244	888
6	22659	21310	51	17470	20553	96	334	974
7	25935	24541	52	16549	19668	97	87	290
8	27541	26077	53	17981	21792	98	239	259
9	27652	26163	54	15016	18417	99	33	23
10	27701	26631	55	17307	21530	100+	125	465
11	28886	27685	56	19196	23853			
12	30118	28501	57	18650	23220			
13	29061	28146	58	16930	21408			
14	28383	27357	59	16664	21590			
15	28389	26574	60	16713	22377			
16	26001	25103	61	16043	22312			
17	25245	24084	62	16433	22506			
18	25215	24140	63	15585	21406			
19	24810	23838	64	13739	20059			
20	24451	23677	65	14560	21130			
21	24176	23313	66	14577	21997			
22	24149	23182	67	13152	20453			
23	23676	23620	68	13173	20714			
24	23910	23947	69	11996	19604			
25	25323	24406	70	12370	20375			
26	26711	25924	71	11053	19027			
27	28162	27131	72	8274	18196			
28	29034	27232	73	8103	17820			
29	27748	25401	74	7235	16353			
30	26487	25936	75	7045	15236			
31	26980	26051	76	6020	13622			
32	27343	26198	77	5386	11230			
33	27393	26078	78	4605	10507			
34	28662	27324	79	3312	7864			
35	28353	27679	80	2202	6240			
36	28999	29278	81	2424	5424			
37	30482	30547	82	2495	6077			
38	29826	30728	83	2181	5603			
39	28729	29903	84	2546	6537			
40	28409	29570	85	1844	5429			
41	26288	27556	86	2068	5545			
42	24044	25700	87	1244	3955			
43	23621	25088	88	1271	3939			
44	22621	24288	89	1337	2984			

**Appendix II. Adjusted age-specific mortality rates in 1999, and their point forecasts in 2050.**

Year	1999		2050	
	Females	Males	Females	Males
Age				
0	0.0085	0.0088	0.0032	0.0033
1-4	0.0005	0.0007	0.0002	0.0003
5-9	0.0003	0.0004	0.0001	0.0002
10-14	0.0002	0.0004	0.0001	0.0002
15-19	0.0005	0.0013	0.0003	0.0009
20-24	0.0005	0.0024	0.0004	0.0021
25-29	0.0007	0.0028	0.0006	0.0025
30-34	0.0009	0.0032	0.0008	0.0027
35-39	0.0014	0.0048	0.0010	0.0034
40-44	0.0022	0.0069	0.0015	0.0046
45-49	0.0033	0.0106	0.0022	0.0070
50-54	0.0051	0.0148	0.0034	0.0098
55-59	0.0066	0.0196	0.0044	0.0132
60-64	0.0103	0.0281	0.0070	0.0191
65-69	0.0156	0.0385	0.0106	0.0262
70-74	0.0266	0.0565	0.0183	0.0389
75-79	0.0514	0.0854	0.0357	0.0593
80-84	0.0829	0.1070	0.0576	0.0743
85-89	0.1410	0.1755	0.0979	0.1219
90-94	0.2213	0.2826	0.1537	0.1962
95+	0.3752	0.4472	0.2605	0.3105

**Appendix III. Quantiles of the predictive distribution of the Lithuanian population.**

Year	0.10	0.25	0.50	0.75	0.90
2001	3516	3522	3528	3534	3540
2002	3472	3483	3495	3506	3518
2003	3434	3450	3468	3485	3500
2004	3402	3424	3449	3472	3493
2005	3377	3403	3435	3464	3493
2006	3357	3387	3426	3464	3501
2007	3335	3373	3418	3464	3510
2008	3314	3358	3410	3464	3518
2009	3293	3342	3402	3465	3525
2010	3269	3326	3394	3464	3532
2011	3245	3311	3387	3464	3536
2012	3223	3294	3379	3462	3545
2013	3198	3280	3370	3463	3552
2014	3168	3263	3360	3463	3558
2015	3148	3242	3348	3459	3565
2016	3117	3223	3339	3458	3572
2017	3090	3204	3328	3453	3572
2018	3060	3185	3316	3450	3576
2019	3031	3165	3306	3445	3580
2020	3002	3139	3290	3443	3580
2021	2972	3116	3276	3435	3583
2022	2942	3090	3262	3430	3581
2023	2914	3065	3241	3423	3588
2024	2886	3039	3226	3413	3587
2025	2850	3017	3210	3400	3585
2026	2815	2989	3191	3395	3586
2027	2778	2959	3171	3383	3583
2028	2744	2931	3152	3376	3576
2029	2707	2899	3132	3361	3581
2030	2671	2870	3112	3346	3577
2031	2636	2840	3084	3334	3577
2032	2600	2812	3066	3325	3575
2033	2561	2779	3041	3314	3581
2034	2514	2748	3019	3297	3576
2035	2476	2715	2993	3286	3575
2036	2435	2684	2970	3272	3576
2037	2397	2652	2946	3258	3567
2038	2357	2622	2921	3244	3560
2039	2318	2586	2900	3230	3551
2040	2275	2551	2869	3212	3546
2041	2233	2520	2845	3202	3542
2042	2192	2483	2818	3191	3540
2043	2146	2451	2793	3179	3536
2044	2106	2417	2772	3164	3542
2045	2069	2383	2742	3151	3532
2046	2032	2348	2709	3136	3532
2047	1992	2317	2685	3123	3536
2048	1950	2288	2659	3106	3528
2049	1908	2252	2632	3096	3518
2050	1868	2214	2609	3078	3514

**Appendix IV. Graphs on zero-age, and young-age-dependency ratios.**

