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Item 9 – Forecasting demographic components: migration

Forecasting migration flows to and from Norway using an economic model[1]

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ABSTRACT

Immigration to Norway has increased rapidly in recent years, with net immigration tripling in only three years. Net immigration currently makes up more than half of the population growth and it is, therefore, important to make realistic assumptions about the migration flows to be used in the population forecasts. A large part of the increased immigration to Norwegian is caused by labour migration. At the same time, the expansion of EU to Eastern Europe in recent years has vastly expanded the potential supply of labour to Norway. Through Norway's membership in the European Economic Cooperation area (EEA), citizens of EU member countries have almost unrestricted access to work and live in Norway. A large part of the recent immigration increase is due to labour immigration, the other main categories being refugees and asylum seekers, establishing and reunification of families, and education.

The high immigration level is to a large extent caused by the favourable economic situation in Norway in recent years, with one of the lowest unemployment rates and highest income levels in the world. This has made it easy for immigrants to obtain employment with relatively high wages

To produce more realistic population forecasts, we have estimated an econometric model where net immigration to Norway from the EEA is a function of the unemployment rate in Norway and the income level in Norway relative to the average of OECD countries, adjusted for purchasing power differences. The estimation yields stable parameters and these are consequently used to forecast net immigration to Norway, based on forecasts of unemployment and level and relative income. It is expected that the growth in the Norwegian e|conomy will decreased in the future, in the short run because of deteriorating international business cycles, and in the long run because of reduced revenue from oil and gas production. The petroleum reserves in the North Sea are expected to be depleted in 2040-2050. The model implies that net immigration will continue in the short run, followed by a rapid fall as a consequence of declining relative income of Norway.

The resulting net immigration flows have been incorporated into recently published population forecasts by age and sex for all of Norway, as well as for each of 430 municipalities. These flows have also been used to project the immigrant population by two groups of country of origin (1) EEA/EFTA, North America, Australia and New Zealand, and (2) The rest of the world.

The financial and economic crisis has so far affected Norway less than most other countries, but there has nevertheless been a decline in economic activity, especially in the construction industry, with reduced the demand for labour. The net immigration Norway has now peaked and is expected to decline further in future years.

This modelling approach has proved very useful and has greatly improved the basis for our migration assumptions. Previously these were made as a rather ad hoc simple extrapolation of past trends, which is the prevalent approach in most countries.
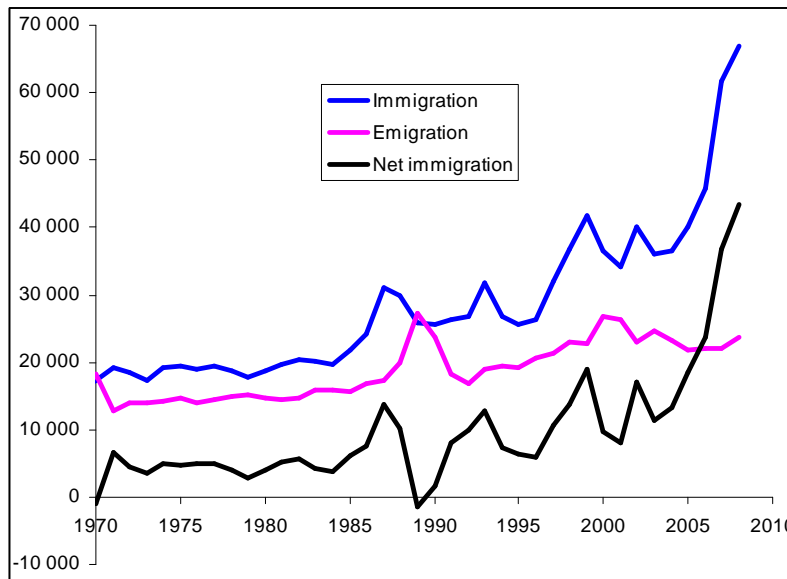
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1. INTRODUCTION

Global migration flows have increased significantly in the last decades. This is caused both by income disparities between countries and to crises and conflicts in many regions of the world. There is an upward trend in migration to industrial countries although significant annual variations. This presents a challenge for population forecasters, especially after the onset of the financial and economic crisis in 2008. Will the level of immigration to industrial countries remain high - or perhaps increase further - because income differences between poor countries will remain in spite of the financial crisis, or will the reduced demand for labour in the rich countries result in reduced immigration and increased emigration? The answers to these questions depend on a number of factors, including migration policies and the emergence of crisis situations, but not the least on the economic development in the coming years, in both rich and poor countries.

In this paper we present an econometric analysis of migration between Norway and other countries, both individual countries and groups of countries. The analysis is based on demographic and economic data for the period 1970-2008, and is used to project migration flows to and from Norway. Although the literature abounds with theoretical and empirical studies of the relationship between economic factors and migration, there are very few attempts at utilizing such analyses to project future migration flows. One of the reasons for this is the lack of a general theory of international migration but also that it is usually more difficult to project economic parameters than demographic factors such as fertility and mortality.

Around 1970 Norway changed from being a country of net emigration to becoming a country of net immigration. Since then net immigration has increased steadily, but with significant fluctuations from year to year. Since 2004 net immigration to Norway has been increasing very fast, with net immigration tripling in only three years (Figure 1). Net immigration currently makes up more than half of the population growth and it is, therefore, important to make realistic assumptions about the migration flows to be used in the population forecasts. A large part of the increased immigration to Norwegian is caused by labour migration, which has been facilitated by the expansion of EU to Eastern Europe in 2004 and 2007. Through Norway's membership in the European Economic Cooperation area (EEA), citizens of EU member countries have almost unrestricted access to work and live in Norway. The growth has been particularly rapid for Polish citizens, whose net immigration to Norway grew from 300 in 2003 to 12 000 in 2008.

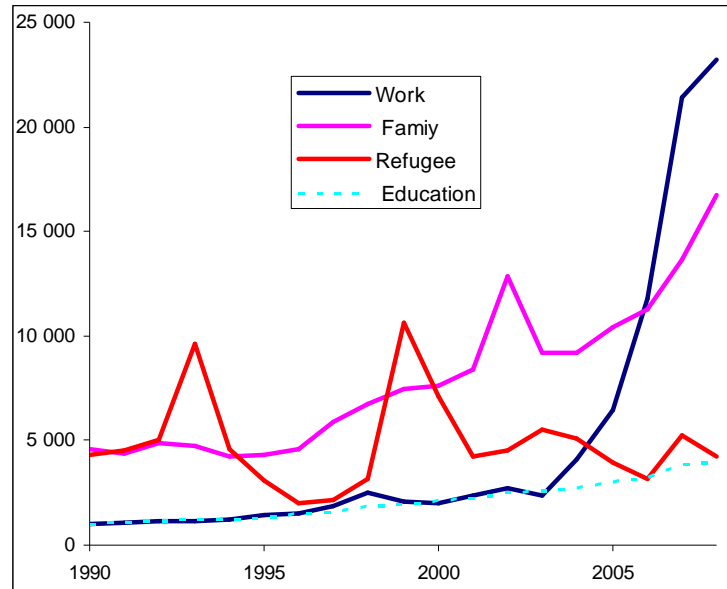Figure 1 - Migration to and from Norway, 1970-2008

The rapidly increasing immigration to Norway has made it even more difficult to make population projections. The past practice of more or less ad hoc extrapolation of past trends of net immigration, with stable levels after some years seems unsatisfactory. In 2005, for example, the projected net immigration for the first projection year, 2005, was fully 23 per cent below the actual number that was registered a few months after the projections had been published.

Making a stochastic time series projection is tempting, but with rapidly changing migration flows the confidence intervals easily become so large that they are of little or no value for users of the projections. Keilman et al. (2001) found that a random walk model gave totally unusable estimates whereas an ARMA (1,1) model resulted in large but useful confidence intervals.

The growth has been particularly rapid for labour migration to Norway, which multiplied 12 times from 2003 to 2008, as shown in Figure 2. This is an indication that the growth in immigration to Norway obviously is related to economic factors, both in Norway and in other countries, i.e., both demand for labour in Norway and supply of labour elsewhere.

Thus, it seems natural to look at economic theory of international migration and try to develop a model that can be used to forecast migration to and from Norway.

Figure 2 - Immigration to Norway by registered reason for immigration*

Does not include citizens of the other Nordic countries (Denmark, Finland, Iceland and Sweden)
Source: Statistics Norway

2. HOW ARE MIGRATION FLOWS PROJECTED?

"A projection of population must rest, in part, on a projection of immigration. Yet most official immigration projections, both in the United States and abroad, continue to rely on ad-hoc assumptions based on little theory and virtually no definable methodology." (Howe and Jackson 2006)

Most official population forecasts made by statistical offices are based on trend-based extrapolation of migration. The most common approach is to assume constant net immigration for all or most of the projection period. In the Eurostat Demographic Outlook for 2007 and 2008 for most European countries only two countries appear to have based their migration assumptions on an analysis taking economic or other factors specifically into consideration. Migration to and from Belgium is based on "… an indicator of the standard of living that is supposed to reflect the relative attractiveness of the Belgian economy in the whole of Europe." (Eurostat 2009a). Statistics Sweden assumes that immigration from several countries, especially labour migration due to the deteriorating economic situation, will decline in the coming years, but there is no formal modelling of the future migration flows (Statistiska centralbyrån 2009).

In the Convergence scenario of EUROPOP 2008, which includes population projections of the 27 EU member countries, Norway and Switzerland until 2061, it is assumed that fertility, mortality and migration will converge in the final convergence year, which was fixed at 2150, implying zero net migration between EU member countries (Eurostat 2009b; Lanzieri 2009). This is based on the hypothesis that these countries will be more or less similar in 2150 with regard to social and economic conditions. This implicitly assumes that there will be no driving factors causing net migration between these countries, including income differentials. EUROPOP 2008 is not, however, based on any modelling or estimation of the relationship between net migration and income differences.

Howe and Jackson (2006) mention several countries that make more sophisticated projections of international migration (USA, France, Germany, The Netherlands, UK, Australia, Canada), although they are not based on specific economic models.

There are very few examples of forecasting of migration flows that are based on economic modelling. Some examples, although not of official statistical agencies forecasting international migration, include Gorbey, James and Poot (1999), who have looked at migration forecasting between Australia and New Zealand … "… in a Bayesian or unrestricted vector autoregression (VAR) model, which includes foreign and domestic economic variables." Schrier and McRae (1999) have used provincial unemployment rate differentials and the differential between the British Columbia and the rest of Canada growth in real GDP to forecast net interprovincial migration for British Columbia.

3. THEORETICAL FRAMEWORK

Our basic model dates back to Roy (1951) and is elaborated by Borjas (1987). For a recent application see also Mayda (2009). There are two countries: (o)rigin and (d)estination. The log of wages that an individual living in the origin country would receive if not migrating (w_o) is

(1) $\ln w_o = \mu_o + \varepsilon_o$ where $\varepsilon_o \sim N(0, \sigma_o^2)$.

Here μ_o is interpreted as determined by individual observables such as education, gender etc., while ε_o captures unobservable characteristics with zero mean and a constant variance. To simplify, for individuals who migrate there is a similar wage model in the destination country

(2) $\ln w_d = \mu_d + \varepsilon_d$ where $\varepsilon_d \sim N(0, \sigma_d^2)$.

The error terms are possibly correlated with a correlation coefficient ρ.

The decision to migrate or not, is determined by the sign of an index I:

(3) $I = \ln(w_d/(w_o + c)) \approx (\mu_d - \mu_o - \delta) + \varepsilon_d - \varepsilon_o$,

where c is the level of mobility costs while δ is the wage equivalent mobility cost. Migration occurs if the index I is positive. The emigration probability (P) from the origin country is then given by

(4) $P = \Pr(\varepsilon_d - \varepsilon_o > -(\mu_d - \mu_o - \delta)) = 1 - \Phi(-(\mu_d - \mu_o - \delta)/\sigma_\varepsilon)$.

Here, σ_ε^2 is the variance for the error term difference $\varepsilon_d - \varepsilon_o$ and Φ is the standard normal distribution.[4] Equation (4) captures some important features of empirical models of migration. Higher income in the origin country lowers P, while higher income in the destination country increases P. In addition, the income effects are the same but with opposite signs and this has strong implications for the econometric specification. Notice also that P is the emigration probability defined as emigration divided by the population in the origin country. If we re-specify the model using the number of emigrants as the endogenous variable while the size of the population of the origin country enters as a regressor, one could test this restriction. This is done by Karemera et al. (2000) who include the (log) population in the emigration equation but their results do not support using the emigration rate specification.

Higher costs of migration relative to income in the destination country reduce migration. A theoretical model of the effects of mobility costs is the focus of Carrington et al. (1996). The idea here is that mobility costs decrease with the number of migrants already settled in the destination country because they send information about job and housing markets to friends and family in the origin country and generally provide a network for new entrants. The empirical specification of mobility costs is a central part of econometric analyses of migration. Standard proxies used are language differences, geographical distance, and migration policy indicators. It is common to include social indicators like crime and corruption indicators of political systems in order to explain migration flows. All studies referred to earlier use more or less these variables in their econometric specifications.

The model by Borjas (1987) also includes the income distribution as a feature affecting migration. He finds that countries with more income inequality have lower emigration rates and that this negative effect is consistent with his model if there is a negative selection in the immigrant pool. For this to be the case there must be a strong positive correlation between earnings for immigrants in the origin and the destination countries and less income inequality in the destination country. If the mean income in the destination country is higher than in the origin country – which is a major motive for emigration in the first place – and inequality increases in the origin country, then high-income persons in that country will have less incentives to emigrate while low-income persons in the origin country are not affected. Total emigration is then reduced. Thus, changes in the distribution of income in the origin country select or motivate on average different people to emigrate.[5]

One issue not discussed much in the theoretical literature referred to earlier is the effect of income taxes and government spending on education and social transfers. The model in equations (1) and (2) focuses on wages but is not precise on how to measure wages in empirical applications. The standard method is to use GDP per capita (adjusting for purchasing power differences, PPPs) as an indicator. However, tax rates vary a lot between countries and consequently income differences adjusted for taxes may be quite different from GDP figures. On the other hand, government services and transfers will usually moderate these tax differences. One possibility is therefore to include government spending (and even only on certain items) to take into account the wedge between GDP and take home pay. However, one should be careful when interpreting a variable like this. If taxes are high in, say, the destination country, government spending will usually also be high. To the extent that government spending provides services in the destination country free of charge, using a gross income measure is not so problematic since taxes net of government spending on individual services like education and social services may not differ much between countries.

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[4] σ_ε^2 is a function of the other variances and the covariance of the ε's.
[5] Mayda (2008) argues for including the square of relative income inequality and finds empirical support for this specification.

Migration often involves young people who study abroad for some years and then return to their native country. Likewise, people move to a country to work for some years in order to earn enough money to buy a house, etc. The intention may not be to settle down for a long time but it may turn out that the transaction costs related to moving were larger than expected, resulting in a reversal of the decision. In order to capture this possibility we include previous gross migration flows in our model so that, say, emigration from Norway to Sweden in year t is made a function of immigration from Sweden to Norway in a previous year.

4. DATA

The demographic data on the number of migrants to and from Norway are taken from the Central Population Register (CPR) of Norway, which was established in 1964. The register includes information on personal identification number (PIN), date of birth, sex, date of immigration, country of origin, country of birth, and reason for immigration. It also included the PIN of family members migrating to Norway simultaneously or who are already living in Norway. Our analysis is based on macro data, although micro data are also available for migrants, but with limited information on socio-economic variables for most immigrants to Norway.

A person is considered an *immigrant* to Norway when he or she intends to stay in Norway for at least 6 months. Citizens from the other Nordic countries (Denmark, Finland, Iceland and Sweden) do not need a permit to settle in Norway, an arrangement that was introduced in the 1950s. Norway is not a member of the European Union but Norway's membership in the European Economic Cooperation area (EEA) gives citizens of EU member countries almost unrestricted access to work and live in Norway. For citizens from the Eastern European EU countries certain conditions need to be met (i.e. having a job) to get residence and work permits, but these conditions are very liberal and were abolished in 2009 (except for Bulgaria and Romania). Citizens of non-EEA countries need to apply for a residence permit.

There is some under-registration of emigration as some people do not report their move. Thus, there are some people in the CPR who are registered as living in Norway but who have left the country.

People who come on short-term work contracts or commute from other countries to work in Norway are registered as residents and not included in the CPR.

Asylum seekers and other people who want to live in Norway are given a unique personal identity number (PIN) and registered in the Central Population Register (CPR) only after their applications have been approved. This implies that there are several thousand asylum seekers who live transitionally in Norway in special institutions and who are not included in the population projections.

The number of unauthorized foreigners has been estimated at 18 200, with a 95 per cent confidence interval of between 10 500 and 31 900 (Zhang 2008).

The income data used in the estimation are all taken from OECD databases. We approximate wages by GDP per capita where GDP is measured using purchasing power parities (PPPs). These data are downloaded from the OECD web-site. The same is the case for unemployment series which are defined as "standardized unemployment rates" by the OECD. Measures of income distribution are defined as the Gini-coefficient of income distribution and are downloaded from the web-site of the Luxembourg Income Study (LIS).

The forecast for unemployment and GDP for Norway are taken from Statistics Norway (2009c).

5. EMPIRICAL RESULTS FOR IMMIGRATION AND EMIGRATION TO NORWAY

Our analysis concerns immigration and emigration to Norway only. This makes our study somewhat different from many other studies in the literature. We study gross flows between Norway and two other Nordic countries, Denmark and Sweden, and for the "OECD-countries" as well as "Asia and Africa".[6] For the Nordic countries there are no changes in the migration policy regime in our estimation period. There have been no restrictions on labour mobility or passport controls since the 1960s and our estimation period covers 1970-2008. Language, culture and religious effects are negligible so the standard "non-economic" variables often included in the empirical literature on migration are not relevant. Even migration costs are small. In many cases there are just as large or even larger migration costs related to internal migration inside Norway as there are between Norway and Sweden. Our basic model for the gross migration flow, or actually the gross migration probability from country i to country j, is

(5) $\log(M_{ij}/Pop_i) = a_0 + a_1 * \log(income_i/income_j) + a_2 * Gini_i + a_3 * U_i + a_4 * U_j + a_5 * M_{ji\ t-1}.$

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[6] The whole of America is included in "the rest of the OECD" but migration to and from Latin-America is normally very small. Japan and South-Korea are likewise included in their geographical region and not in the OECD. Again this is due to minute migration flows between Norway and these two countries.

M_{ij} is migration from country i to j and is related to the population Pop_i in country i. The first term is the relative income between the two countries (measured by GDP per capita in PPPs), and $Gini_i$ is the coefficient of income distribution based on the Luxembourg income study (LIS). The Us are unemployment rates. The last term in eq. (5) captures the possibility that previous immigration from a country may increase later emigration to the same country. The time sub-script is only indicative in the sense that we leave it to the data in order to arrive at a more precise dating of the effect. All data come from OECD data or national sources.

5.1. Results for the Scandinavian countries

Traditionally there has been substantial mobility between the Scandinavian countries[7]. Labour mobility has been unrestricted since the 1960s and there has been no passport control since that time. It is the mobility between Sweden and Norway that is most important and this has been increasing for quite some time, although with large fluctuations related to business-cycles in Norway and Sweden, see Figure 3. Flows between Denmark and Norway show less variation and trend over time, cf. Figure 4. Cultural and language differences between these countries are quite small.

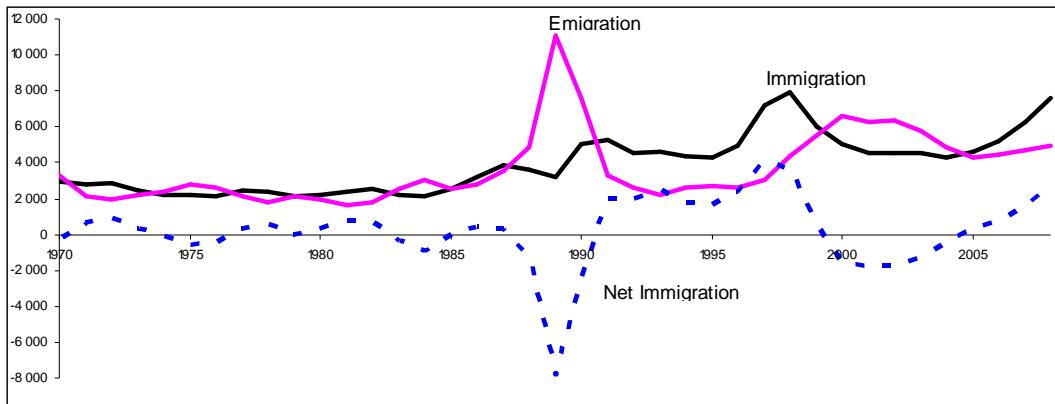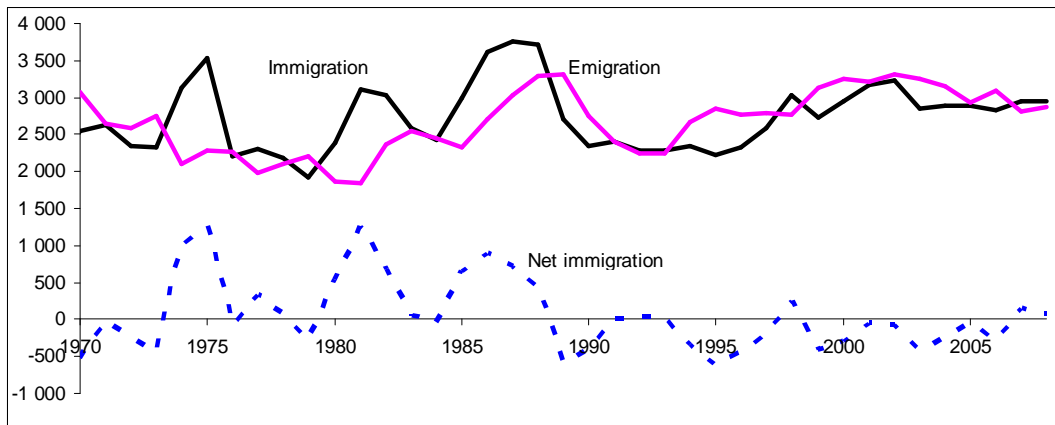Figure 3 - Migration flows between Norway and Sweden

Figure 4 - Migration flows between Norway and Denmark

Results from estimating the model in (5) for the Scandinavian countries are shown in Table 1. In this table we show only the estimated long run effects implied and not the model actually estimated in order to highlight the main result in the text.

Table 1 - Estimation of the rate of migration from Sweden and Denmark to Norway (eq. 5)

	Migration from			
	Sweden to Norway	Norway to Sweden	Denmark to Norway	Norway to Denmark
Constant	-10.029 (-24.6)	-13.80 (-14.50)	-7.25 (-37.4)	-13.60 (-19.8)
Relative income	**- 0.504 (-2.97)**			**0.131 (1.41)**
Inequality	**9.254 (5.01)**			
Unempl. Origin	**0.035 (2.76)**	**0.140 (4.26)**		**0.060 (5.69)**
Unempl.destination	**- 0.223 (-3.31)[8]**	**-0.474 (-4.82)**	**-0.089 (-1.77)**	**-0.035 (-4.21)**
Prev. immigration		**0.814 (7.00)**		**0.787 (9.20)**
Period	1972-2008	1973-2008	1973-2008	1975-2008
σ (of eqcm)	0,071	0.111	0.098	0.046
AR_{1-2}	$F(2,26)=1.66\ (0.21)$	$F(2,27)=0.83\ (0.45)$	$F(2,28)=2.07\ (0.14)$	$F(2,23)=0.19\ (0.83)$
$ARCH_{1-1}$	$F(1,26)=0.58\ (0.45)$	$F(1,27)=1.58\ (0.22)$	$F(1,28)=2,31\ (0.14)$	$F(1,23)=1.58\ (0.22)$
Normality	$X^2(2) = 1.85\ (0.40)$	$\chi^2(2)=0.35\ (0.84)$	$\chi^2(2)=0.63\ (0.73)$	$\chi^2(2)=1.22\ (0.54)$
Heterosc.	$F(15,12)=0.27\ (0.99)$	$F(11,17)=0.87(0.58)$	$F(9,20)=1.21\ (0.34)$	$F(15,9)=0.25\ (0.99)$

Estimation was carried out using PcGive 10.3, cf. Doornik and Hendry (2000). The AR test is based on Harvey (1981), the ARCH-test is based on Engle (1982), the normality test is based on Doornik and Hansen (1994), and the heteroske-dasticity test is based on White (1980). Estimated t-values are shown in parentheses. The estimated standard error of regression is that of the actual equilibrium correction model (eqcm) estimated.

In the first column of Table 1 we show the result from estimating a model for migration from Sweden to Norway. In line with theory we have significant effects of relative income so that higher incomes in Sweden relative to Norway reduce emigration from Sweden to Norway. We also find that higher unemployment in Sweden increases emigration. A partial increase in unemployment in Norway reduces migration but a significant estimated effect was only found for *changes* in unemployment, meaning that in the very long run there is no effect on migration of the level of unemployment. There is a positive effect of Swedish inequality on migration so that more unequal incomes within Sweden increase emigration. This does not go against the arguments made earlier because the Swedish distribution of income is more equal than Norway's so the argument is simply turned on its head. The short run effect of increased inequality is quite strong and so is the effect of higher unemployment in Sweden. In the long run, a one per cent increase in Norwegian earnings relative to the Swedish increases the migration probability by half a percentage point.

In the second column we show the long run model of Norwegian migration to Sweden. Here there are few separate effects. Nearly all effect in the long run come through the previous migration from Sweden to Norway, i.e. through the a_5 coefficient being positive.

The third column shows Danish emigration to Norway being influenced only by labour market conditions in the long run. However, there are short run income effects present that are in line with theory. The fourth column of Table 1 shows that Norwegian emigration to Denmark is affected by relative income effects and labour market factors. In addition, there is an effect of previous Danish immigration to Norway on later emigration from Norway to Denmark as was the case for Sweden. These effects fit well with anecdotal observations of young people from Denmark and Sweden working in Norway for a few years before returning home. Given that unemployment is much lower in Norway than in the other two countries, it has usually been easy for young people to find employment in Norway.

5.2. Results for broad aggregates of countries

We have also estimated a version of eq. (5) for two broad aggregates Europe, America and Oceania ("EurAm") on the one hand and Africa and Asia ("AfrAsia") being the other. For the first aggregate we have used OECD-averages instead of actual data corresponding to the country group. The error we make is that Latin-America is included in the migration data but not in the explanatory variables. As migration from Norway to Latin-America is very small, this error is minor. Migration for people from African and Asian countries is generally more restricted than for people belonging to the first group of countries. Estimation result for long run effects are shown in Table 2.

For migration to and from "EurAm" there is a strong income effect explaining migration to Norway. There is no significant income effect explaining outmigration from Norway but implicitly there is an income effect through the variable "previous immigration". We have tried to include also relative government expenditures to capture differences in

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[8] This estimate is for the change in unemployment and not the level.

welfare spending, but without any significant or sensible results. Unemployment effects are significant in both migration models but there are *no longterm effects*. We have included these terms in the table in spite of them being short run effects while the income effects are long run. Notice also that the effects are quite symmetric in explaining migration to and from Norway. This would indicate that a pooled model that explains migration to and from Norway with identical marginal parameters and only a fixed effect could work well as the signs are opposite. However, the income effects are quite different.[9] We do not show dummy variables related to changes in migration policies in Table 2. These are shown in the appendix. The expansion of the European Union to include Eastern European countries has affected regulation of labour markets in many European countries since 2004. A significant change in the constant term captures this event. It could be argued that this event may lead to a more substantial change in the model structure than only a change in the constant but we would need more historical data and experience to identify this. There are also two step dummies to take account of the influx of people for Bosnia (1993) and Kosovo (1999).

The third and fourth columns of Table 2 model migration to and from Africa and Asia. For migration to Norway there is a strong income effect. We should, however, be careful in interpreting the size of this effect as we to simplify have used average income in the OECD for these countries and not income for the relevant country group. For this group of countries there are no reliable time series for unemployment dating back to 1970. It is noticeable that we have not been able to model migration *from* Norway to these countries very successfully in terms of economic variables except that a level effect of unemployment is significant. This means that if there is high unemployment in Norway more people migrate to these countries. The explanation is perhaps that some ants to Norway from these countries return to their country of origin if they are not able to get a job.

Table 2 - Estimation of migration for broad aggregates of countries

	Migration from			
	"EurAm" to Norway	Norway to "EurAm"	"AfrAsia" to Norway	Norway to "AfrAsia"
Constant	-8.55 (-7.89)	-12.58 (-17.90)	-2.29 (-0.79)	7.50 (64.20)
Relative income	**0.953 (4.17)**		**2.34 (3.88)**	
Unempl. origin[10]	0.078 (1.49)	**0.079 (5.01)**		**0.089 (3.09)**
Unempl.destination	- 0.132 (-3.81)	-0.111 (-3.52)	-0.62 (-1.69)	
Prev. immigration		0.713 (10.00)		
Period	1972-2008	1973-2008	1973-2008	1972-2008
σ (of eqcm)	0,069	0.062	0.071	0.061
AR$_{1-2}$	F(2,27)=1.28 (0.29)	F(2,27)=0.79 (0.47)	F(2,27)=0.89 (0.42)	F(2,31)=1.62 (0.21
ARCH$_{1-1}$	F(1,27)=3.15 (0.09)	F(1,27)=0.12 (0.73)	F(1,27)=1,07 (0.31)	F(1,31)=0.99 (0.33)
Normality	X^2 (2) = 1.87 (0.39)	χ^2 (2) = 1.22 (0.54)	χ^2 (2) = 2.79 (0.25)	χ^2 (2) = 0.30 (0.86)
Heterosc.	F(11,17)=0.41(0.93)	F(11,17)=1.82(0.13)	F(10,18)=0.65(0.75)	F(6,26)=0.46 (0.83)

Estimation was carried out using PcGive 10.3 cf. Doornik and Hendry (2000). The AR test is based on Harvey (1981), the ARCH-test is based on Engle (1982), the normality test is based on Doornik and Hansen (1994) and the heteroskedasticity test is based on White (1980). Estimated t-values shown in parenthesis.

The specification tests shown in Table 2 all indicate that the migration models are not misspecified. Recursive estimates of the parameters indicate reasonably stable models since the mid 1990s so that these models are candidates for forecasting gross migration flows to and from Norway, see the Appendix.
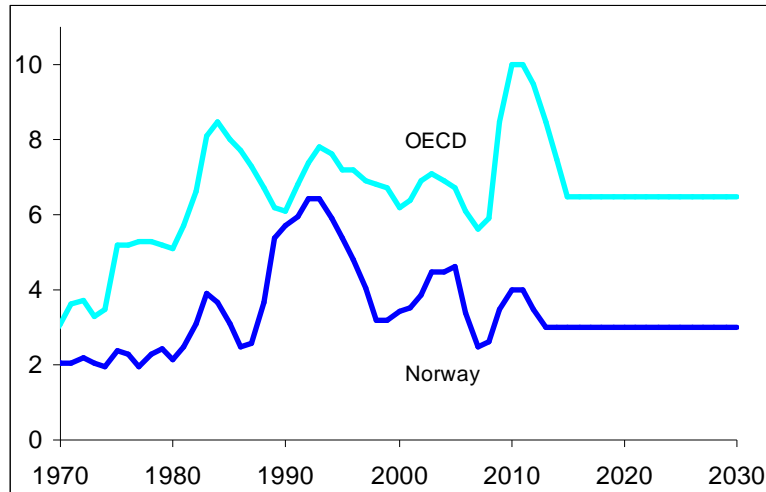

6.   FORECASTING MIGRATION

The main purpose of estimating these models is to use them as input to a demographic model that is used regularly for forecasting the population of Norway. This focus for modelling migration is somewhat different from what is common in the demographic literature. When the model is used for forecasting, we need to check that our equations fulfil some design criteria so that we can have confidence in the quality of our forecasts. One way to do this is to run a large set of statistical specification tests on our models. These are shown in the appendix. If our model passes these tests to a reasonable extent, we think there are reasons for assuming that they may perform well in forecasting. However, these tests are of course no guarantee against future structural changes making our model inadequate.

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[9] A formal test should be undertaken but has not been done yet.
[10] The unemployment variables are specified as changes not levels, except for the effect in the fourth column where there is a level effect.
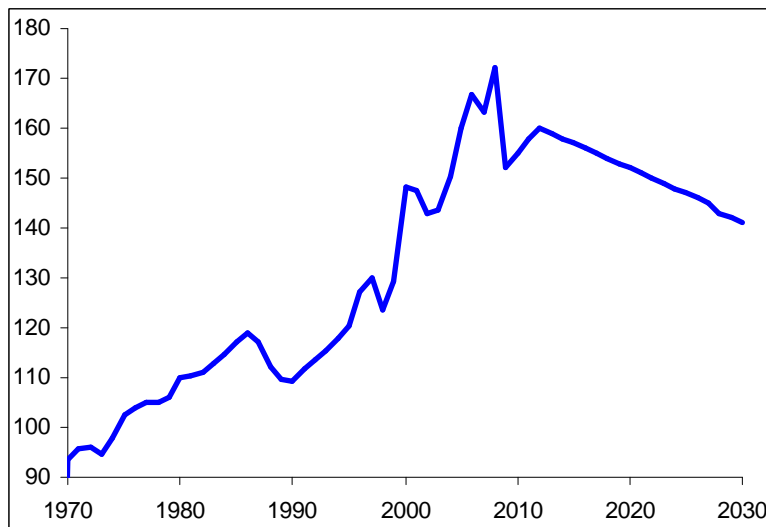
When using the models discussed earlier for forecasting we first of all need a forecast of all the explanatory variables that enter the estimated equations. In our case this is relative income and unemployment. For the latter two variables we have used recent macroeconomic forecast based on Consensus Forecasts (2009) for 2009 and 2010. We have assumed that the current recession gradually disappears and that unemployment rates return to more normal levels as shown in Figure 5.

Figure 5 - Unemployment rates in OECD and in Norway, 1970-2030

The most important variable that we need to forecast is relative income, proxied by GDP per capita using PPPs. Since it is relative income that matters, we focus on how Norwegian income may develop compared to the average OECD level. Norway's current situation is influenced by its petroleum production combined with high oil prices. It is generally expected that petroleum output will continue to decline so that the oil sector gradually will contribute less to GDP. According to the most recent long term projections from the Norwegian government the contribution of the oil sector to GDP will fall from roughly 37 % in 2008 to 10 % in 2030.[11] Most of this decline in output will correspond to a fall in petroleum rents, which is defined as excess profits from exploiting this natural resource. It is not reasonable to assume that Norway will have access to another resource that will provide the country with similar incomes. In the very short run we expect oil prices to pick up somewhat again and more than compensate for the decline in production but this is not reasonable in the long run. For non-oil GDP per capita we assume that there is no change in relative income. This motivates our assumption with regard to the development of relative income between Norway and the OECD average. Historical figures and the forecast are shown in Figure 6 below.

Figure 6 - GDP per capita in PPPs. Norway relative to OECD. Observations 1970-2008 and forecast 2009-2030
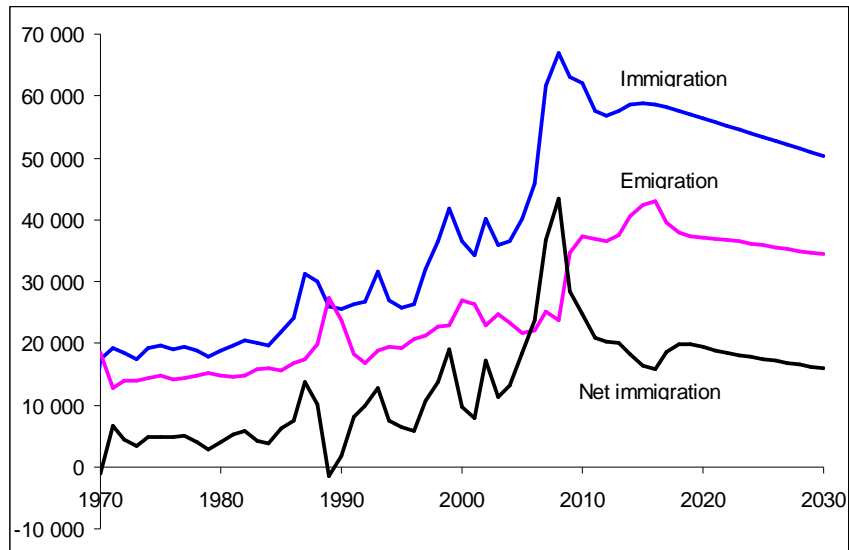

[11] Cf. Figure 7.2 on page 129 of Perspektivmeldingen 2009, St.meld.nr.9 (2008-2009) Ministry of Finance, Oslo, 2009.

Based on these assumptions and no impact of possible changes in migration policies, we can make a forecast for gross migration flows to and from Norway. The forecasting equations used are those presented in the appendix. The results are shown on Figure 7. For gross flow into Norway the decline in the short run is mainly due to the decline in income. As oil prices are expected to grow in the next cyclical upturn, this tells us that migration into Norway should increase again but in the long turn the decline in income due to declining oil and gas production will lead to lower immigration.

The gross emigration from Norway has a hump shape in the near future that is a result of higher unemployment in Norway as well as declining relative income in the short run. In 2010, higher oil prices are assumed to increase relative incomes again and it is only when the volume of petroleum production starts to decline that the long run tendency for declining income becomes strong and net migration also falls.

Figure 7 - Gross and net migration flows to Norway. History and forecasts 1970 to 2030.

One may ask how sensitive this forecast is to the assumption of the development in long term relative income. It is not interesting to study the effect of higher or lower unemployment since these variables mainly have short run effects and it is not reasonable to assume a long lasting trend in unemployment in spite of the fact that such a change can go on at least for a decade, cf. Figure 5. One rather extreme alternative would be to assume that relative incomes would show absolute convergence in the long run, meaning that sometimes in the not very distant future Norway's income relative to the OECD average would be back at its level of the early 1970s, i.e. before oil made a big impact on Norway's incomes. Using the long run solution of the estimated models yields the following striking results. Net immigration from Europe, America and Oceania would be 3 000 persons per year and the immigration from Africa and Asia would be quite similar. Thus, a return to the relative income levels that Norway enjoyed before oil made an impact on the economy would bring net immigration nearly back to the levels of the early 1970s as shown on Figure 7. That this should be the conclusion is, of course, not a surprise. The models we have estimated reproduce the historical development quite well. Assuming that exogenous variables take on values of the early 1970s should by model design reproduce the values for the endogenous variables that were observed at that time.

7. APPLICATION IN OFFICIAL POPULATION PROJECTIONS

When Statistics Norway published population projections for the periods 2009-2060 the assumptions for net immigration were based on a modification of the results of the analysis presented here (Statistics Norway 2009a, b). The reason for this is that it is difficult to explain to the public the various troughs, peaks and inflection points shown in Figure 7. After all, the econometric model is not a perfect model of reality, as many variables have not been included, such as migration flows between other countries, more country-specific data on economic conditions in sending countries, etc. Moreover, the econometric analysis shows that the model does not match the data perfectly. To allow for this we did some smoothing of the model-produced migration flows.

There is substantial uncertainty about the effects of relative income and unemployment on migration flows, and about the future levels of these economic factors. To account for this uncertainty we designed high and low series of net immigration, with the same general shape as the medium series. This was done in a rather *ad hoc* way, taking into account

previous trends and levels in the migration flows and likely future variations in these trends, since no alternative high and low variants of the economic forecasts were available, nor were there any probability distributions of these.

The modified series of net immigration were made separately for the two groups of countries that the analysis was made for:

- **Group 1:** Immigrants from EEA/EFTA, North America, Australia and New Zealand,
- **Group 2:** Immigrants from the rest of Eastern Europe, Africa, Asia (with Turkey), Latin America and the rest of Oceania.

These country groups correspond closely to the analysis presented in this paper, with minor differences. Immigrants from Group1 are mostly labour immigrants whereas immigrants from Group 2 are mostly refuges and family members.

The immigration assumptions are shown in Figures 8, 9 and 10.

Figure 8 - Net immigration to Norway from Group 1 countries. Registered 1990-2008 and projected 2009-2060

Figure 9. Net immigration to Norway from Group 2 countries. Registered 1990-2008 and projected 2009-2060
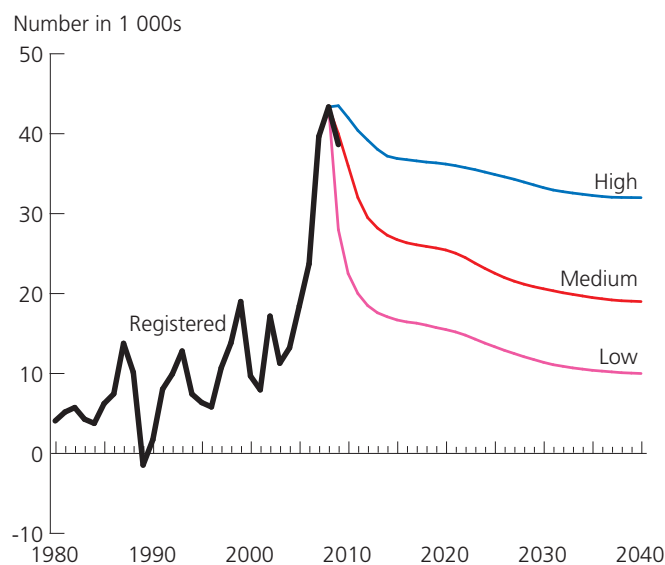
Figure 10. Total Net immigration to Norway. Registered 1990-2009 and projected 2009-2060

Number in 1 000s

The analyses presented here have been the basis for the forecast of net immigration used in the official projections of the Norwegian population, for the whole country as well as for the 430 municipalities (Statistics Norway 2008a, 2009a).[12] They have also been used to make national projections of immigrants and their children born in Norway by country background, i.e. own and parents' country of birth (Statistics Norway 2008b, 2009b).

After the projections were made in published in June 2009 migration data for all of 2009 have become available. They show that our assumption for 2009 was very close to the observed number, as shown in Figure 10.

8. SUMMARY AND CONCLUDING REMARKS

The analysis presented here is novel in several ways:

- An econometric model of migration flows to and from Norway has been estimated.

- The estimation results are used, together with economic forecasts, to project future migration to and from Norway.

- The resulting net migration flow shows a clear picture that cannot be achieved by simple extrapolation: First, a decline from a high level due to the financial and economic crisis, then an increase following the economic recovery, and finally a long-term gradual decline because Norway's advantaged economic position will decline, due to reduced petroleum production.

- It is unusual that a projection model is able to project a complete turn-around of a trend.

The decline in net immigration to Norway due to the current financial crisis and other factors is in line with other studies (Sward 2009; OECD 2009; Statistics Sweden 2009). This is also confirmed by recent migration data, as shown in Figure 10. Gross immigration to Norway peaked in the third quarter of 2008, while outmigration has been increasing.

The predicted decline in future immigration to Norway is consistent with public opinion surveys in several countries that find that the majority of the population wants a more restrictive immigration policy (PEW 2008). However, only a minority of the Norwegian population (38 per cent) support a more restrictive policy towards refugees and asylum seekers, while the majority (53 per cent) is satisfied with the current policy (Blom 2008).

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[12] For each of 19 regions emigration probabilities were estimated on the basis of registered emigration for the previous five years. The sum of these flows for each projection year, which is the total emigration from Norway, was added to the assumed total net immigration, yielding total immigration fro each year. This number was distributed over 94 projection regions by age and sex, according to a distribution based on registered immigration for the previous five years. Finally, the population growth for each projection region was disaggregated to the municipalities in each region (ranging from 1 to 18 municipalities in each projection region). The projections regions are identical to economic regions, NUTS-4 in EU terminology, except that the largest cities are treated as separated projection regions.

9. REFERENCES

Blom, S. (2008): Holdninger til innvandrere og innvandring 2008, Rapport 2008/57, Statistics Norway

Borjas, G.J. (1987): Self-Selection and the Earnings of Immigrants, *American Economic Review* **77** (4): 531-553.

Borjas, G.J., (1994): The economics of immigration, *Journal of Economic Literature*, 32 (December), 1667–1717.

Brunborg, H., I. Texmon and S.V. Pettersen (2008): Nye befolkningsframskrivinger. *Økonomiske analyser* 3/2008: 29-41, http://www.ssb.no/emner/08/05/10/oa/200803/brunborg.pdf

Carrington, W.J., E. Detragiache, and T. Vishwanath (1996): Migration with Endogenous Moving Costs, *American Economic Review* **86** (4): 909- 930.

Consensus Forecasts (2009): Consensus Forecasts, Survey Date February, 10, 2009, Consensus Economics Inc, London, UK.

Doornik, J.A. and H. Hansen (1994): A Practical Test for Univariate and Multivariate Normality, Discussion Paper, Nuffield College, Univ. of Oxford.

Doornik, J.A. and D.F. Hendry (2007): *Empirical Econometric Modelling using PcGive,* Volume I, Timberlake Consultants LTD, London.

Engle, R.F. (1982): Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation, *Econometrica* 50: 987-1007.

Eurostat (2007): Demographic outlook. National reports on the demographic developments in 2006. Methodologies and Working Papers, Eurostat, Luxembourg.

Eurostat (2009a): Demographic outlook. National reports on the demographic developments in 2007. Methodologies and Working Papers, Eurostat, Luxembourg.

Eurostat (2009b): EUROPOP2008 - Convergence scenario, national level.
http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/proj_08c_esms.htm

Gorbey, S., D. James and J. Poot (1999): Population Forecasting with Endogenous Migration: An Application to Trans-Tasman Migration. *International Regional Science Review* **22**(1): 69-101.

Harvey, A.C. (1981): *The Econometric Analysis of Time Series,* Philip Allan, Oxford.

Howe, N. and R. Jackson (2006): Long-Term Immigration Projection Methods: Current Practice and How to Improve it, WP 2006-3, Center for Retirement Research, Boston College

Karemera, D. V.I. Oguledo, and B. Davis (2000): A gravity model analysis of international migration to North America, *Applied Economics* **32:** 1745-1755.

Keilman, N., D. Q. Pham and A. Hetland (2001): Norway's Uncertain Demographic Future, Social and Economic Studies 105, Statistics Norway.

Lanzieri, G. (2009): EUROPOP2008: A set of population projections for the European Union. Paper presented at the IUSSP International Population Conference, Marrakech, 27 Sep.– 2 Oct. 2009.

Mayda, A. M. (2009): International Migration: A Panel Data Analysis of the Determinants of Bilateral Flows, *Journal of Population Economics,* DOI 10.1007/s00148-009-0251-x

Péridy, N. (2008): A generalized model of international migration determinants: An application to European immigration from Southern Mediterranean countries. Paper presented at the European Science Foundation Seminar "Estimation and Projection of International Migration", 17 - 19 September 2008, University of Southampton.

PEW (2007): World Publics Welcome Global Trade -- But Not Immigration. *47-Nation Pew Global Attitudes Survey*, http://pewglobal.org/reports/display.php?ReportID=258

Schrier, D. and D. McRae (2000): An Econometric Model Describing the Movement of the Population Between British Columbia and the Rest of Canada, Population Section, BC Stats, Ministry of Finance and Corporate Relations, Government of British Columbia.

Statistics Norway (2008a): Continued population growth, http://www.ssb.no/english/subjects/02/03/.

Statistics Norway (2008b): Strong growth in immigrant population, http://www.ssb.no/innvfram_en/.

Statistics Norway (2009a): High population growth in the future,
http://www.ssb.no/english/subjects/02/03/folkfram_en/.

Statistics Norway (2009b): High growth in the number of immigrants, http://www.ssb.no/innvfram_en/.

Statistics Norway (2009c): Economic trends for Norway and abroad: Improvement, but slowdown continues, *Economic survey* 3/2009, http://www.ssb.no/kt_en/.

Statistiska centralbyrån (2009): Sveriges framtida befolkning 2009-2060. *Demografiska rapporter* 2009:1, Statistiska centralbyrån, Stockholm.

Sward, J. (2009): Migration and the financial crisis: how will the economic downturn affect migrants? Briefing no. 17 of the Development Research Centre on Migration, Globalisation & Poverty. Sussex Centre for Migration Research. http://www.research4development.info/PDF/ Outputs/MigrationGlobPov/BP17.pdf

White, H. (1980): A Heteroskedasticity Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, *Econometrica* 48: 817-838.

Zhang, L.-C. (2008): Developing methods for determining the number of unauthorized foreigners in Norway, Documents 2008/11, Statistics Norway

APPENDIX - EQUATIONS USED FOR FORECASTING GROSS MIGRATION FLOWS

The estimation results shown in this appendix are those used for forecasting in the paper. Compared to the estimation results shown in the paper these equations have not been specified as migration relative to the population in the origin country or region. Instead we have used a direct level formulation. The reason is mainly to avoid having to forecast population in the origin region in order to be able to forecast gross migration flows to Norway. It proved to be easy to find specifications in levels that are roughly the same as those specified on a rate form. The statistical tests are quite satisfactory.

In general we have chosen a log-linear specification so that each migration flow is the log of the number of migrants. The explanatory variables are usually lagged values of the migration flow with lag of one year denoted by _1, and a lag of two years _2.

The income variable is denoted "LNor gdp per" and is the (natural) logarithm of GDP per capita in Norway compared to the OECD region. Again, it usually enters with a time lag.

The unemployment rate is included in all equations and is usually specified in changes so that Dunempl means changes in the unemployment rate between to consecutive years while D2unempl means changes between year t and year t-2.
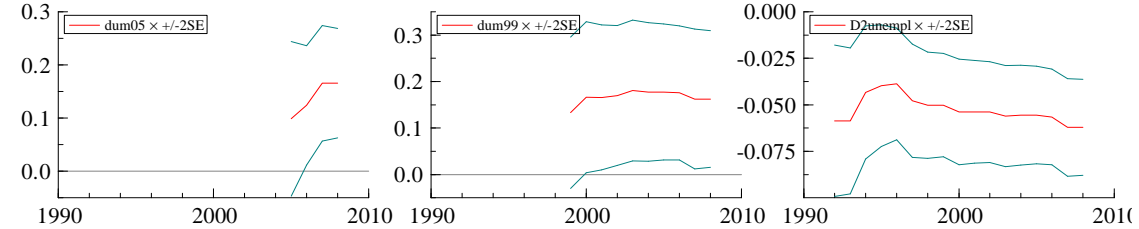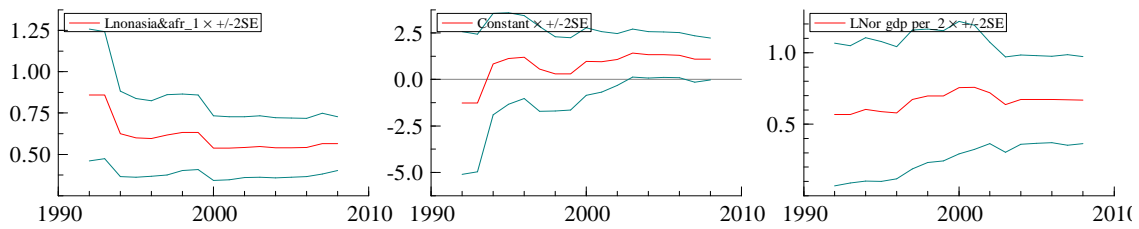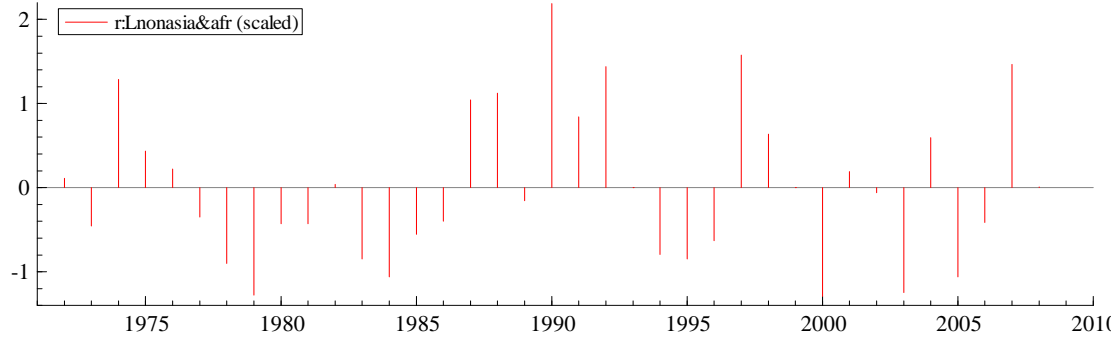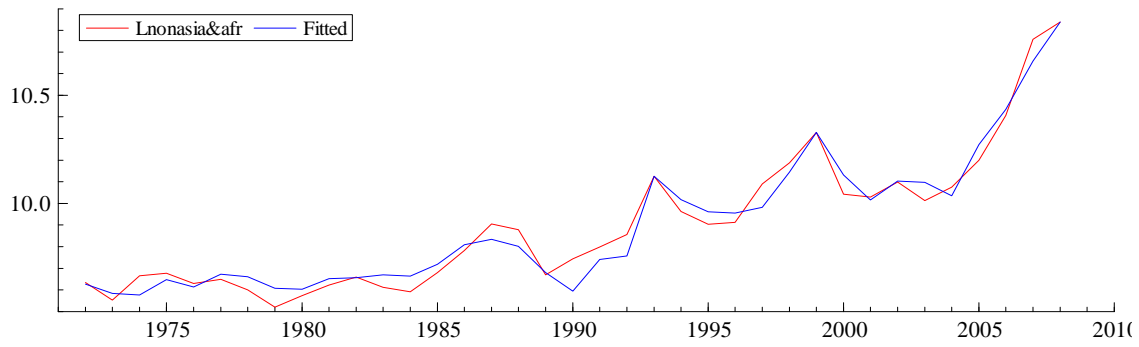
In all cases we need binary variables or dummies in order to arrive at well specified tests (basically only to arrive at normally distributed errors), but these dummies have only minor effects on the estimates of the parameters of interest. The dummies are noted so that the number indicates in what year the variable takes on the value "1" (all others being zero).

Migration to Norway from non-Asian and non-African countries (nonasia&afr)

Immigration from the "OECD-area" to Norway is positively related in the relative income level in the long run. Unemployment in both regions have the expected sign but enter only as changes in levels so for a constant level of unemployment there are no long run effects on migration. There is an important dummy that enters the equation and one that picks up an important change in policies. The dummy "dum05" is not a simple step dummy as all other dummies, but one that picks up a change in the constant level related to the enlargement of the EU in 2004 when several East-European countries entered the common labour market of the EU (which Norway belongs to via the European Economic Area treaty. The other two dummies pick up large immigration flows to Norway related to the conflicts in former Yugoslavia. The model specification is fairly stable, in particular the long run effect of income is quite stable and highly significant.

```
Modelling Lnonasia&afr by OLS. Sample: 1972 to 2008


                 Coefficient  Std.Error  t-value  t-prob Part.R^2
Lnonasia&afr_1      0.565297    0.08101     6.98    0.000   0.6267
Constant            1.10090     0.5659      1.95    0.061   0.1155
dum99               0.162102    0.07341     2.21    0.035   0.1439
dum93               0.312560    0.07012     4.46    0.000   0.4066
dum05               0.165625    0.05163     3.21    0.003   0.2619
D2unemplnor        -0.0621683   0.01289    -4.82    0.000   0.4450
LNor gdp per_2      0.669025    0.1521      4.40    0.000   0.4003
Dunemploecd         0.0342882   0.02300     1.49    0.147   0.0712

sigma               0.0683316  RSS            0.135406988
R^2                 0.963221   F(7,29) =     108.5 [0.000]**
log-likelihood      51.2915    DW                    1.54

AR 1-2 test:     F(2,27)  =   1.8858 [0.1712]
ARCH 1-1 test:   F(1,27)  =   1.9740 [0.1714]
Normality test:  Chi^2(2) =   4.0264 [0.1336]
hetero test:     F(11,17) =   0.3063 [0.9745]
```

Migration from Norway to non-Asian & non-African countries (nonasiaafrout)
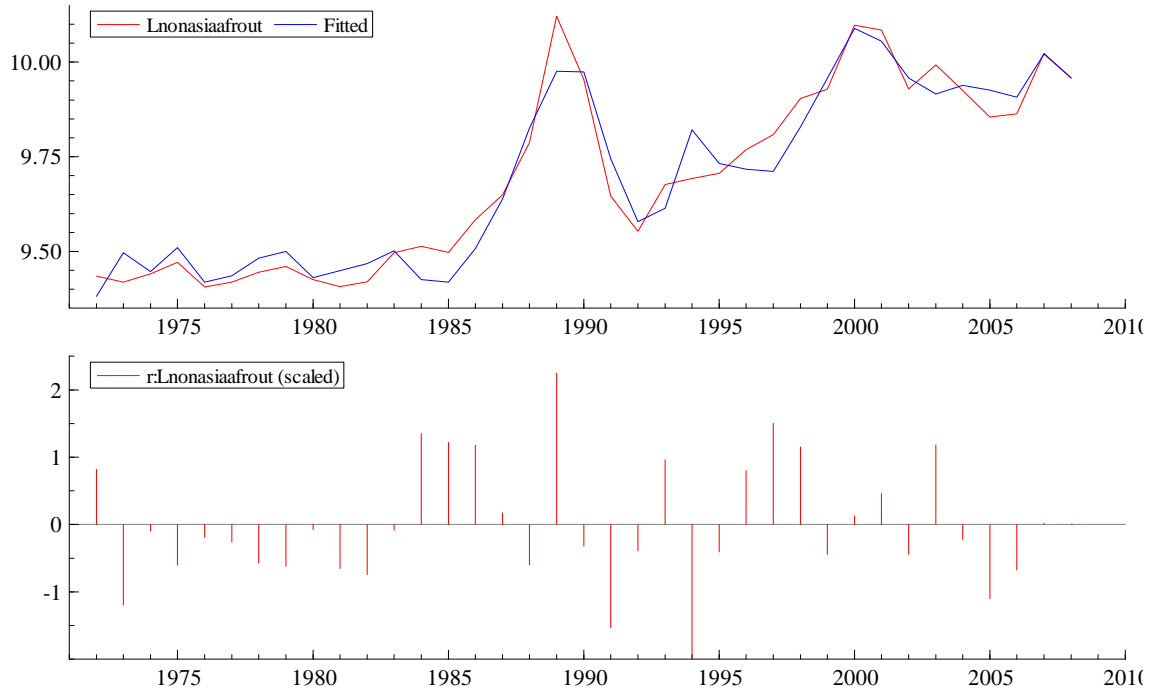
Outward migration depends in the long run only on inward migration. Changes in unemployment both in Norway and in the "OECD-area" have effects but this only matters for cyclical features in the data.
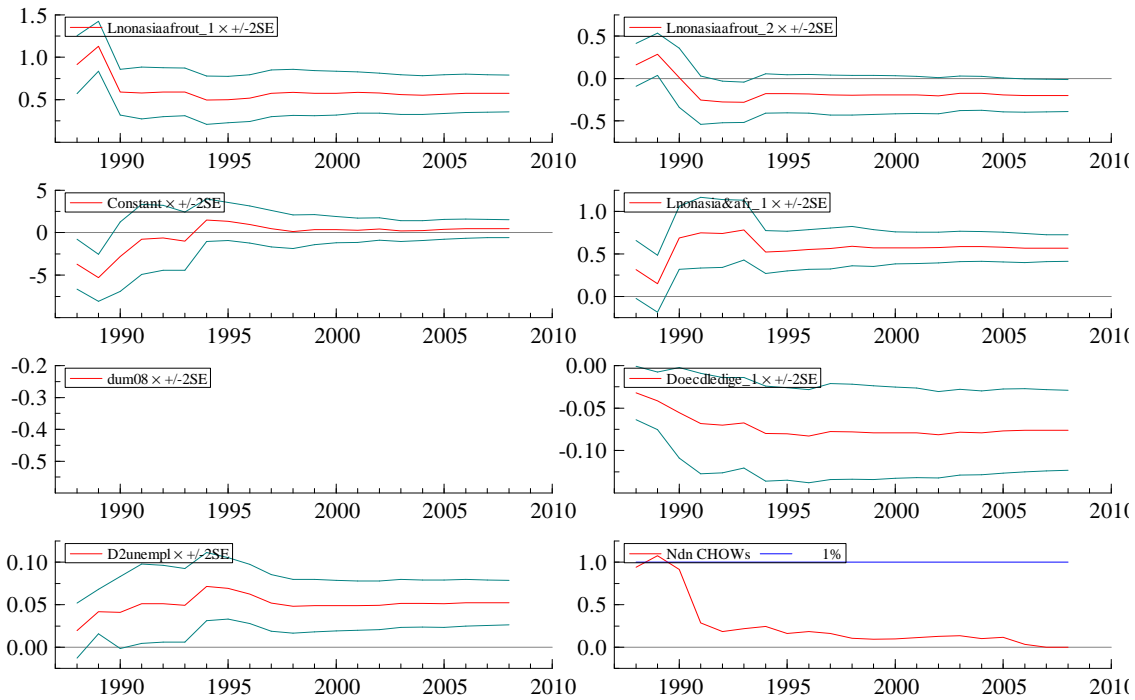
The specification tests are satisfactory and the recursive estimation of the parameters indicates high stability over time or from the early 1990s, to be more precise. There is one fairly large outlier (1989) but the normality test indicates no rejection so additional dummies are not necessary.

```
Modelling Lnonasiaafrout by OLS. Sample: 1972 to 2008

                    Coefficient   Std.Error    t-value   t-prob  Part.R^2
Lnonasiaafrout_1      0.574369       0.1082       5.31    0.000    0.4844
Lnonasiaafrout_2     -0.199912      0.09452      -2.12    0.043    0.1298
Constant              0.474308       0.5252      0.903    0.374    0.0265
Lnonasia&afr_1        0.568525      0.07819       7.27    0.000    0.6380
dum08                -0.409033      0.08377      -4.88    0.000    0.4428
Dunemploecd_1        -0.0761716     0.02350      -3.24    0.003    0.2594
D2unemplnor           0.0523885     0.01311       4.00    0.000    0.3475

sigma                 0.0647174  RSS                  0.125650377
R^2                   0.938042   F(6,30) =        75.7 [0.000]**
log-likelihood        52.6749    DW                         1.76
no. of observations         37  no. of parameters            7
mean(Lnonasiaafrout)    9.69626  var(Lnonasiaafrout)    0.0548107

AR 1-2 test:     F(2,28)  =  0.80098 [0.4589]
ARCH 1-1 test:   F(1,28)  =  0.35840 [0.5542]
Normality test:  Chi^2(2) =  0.95524 [0.6203]
hetero test:     F(11,18) =   1.3032 [0.2984]
```

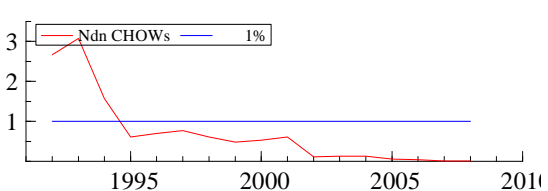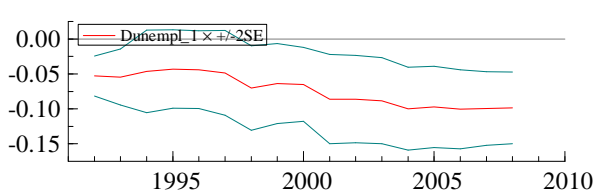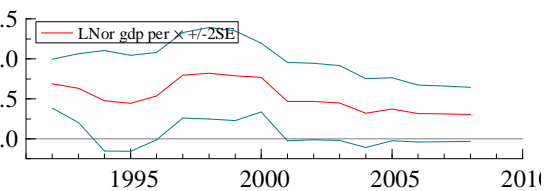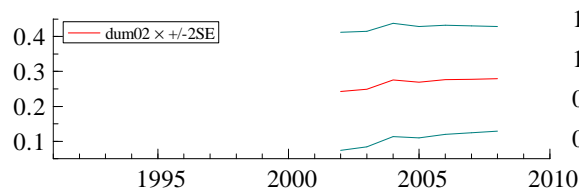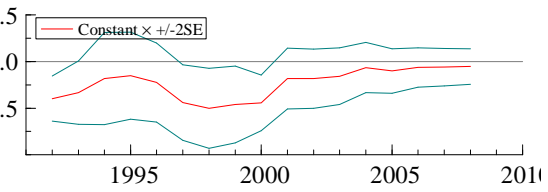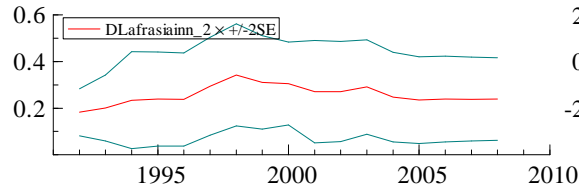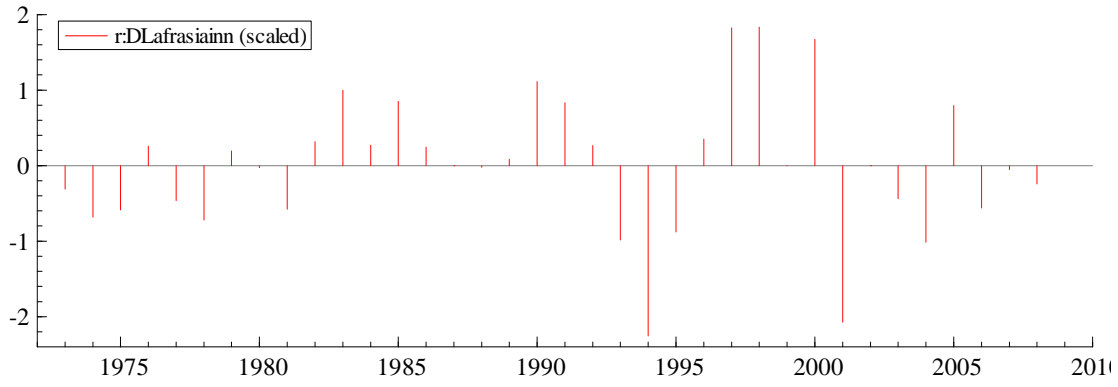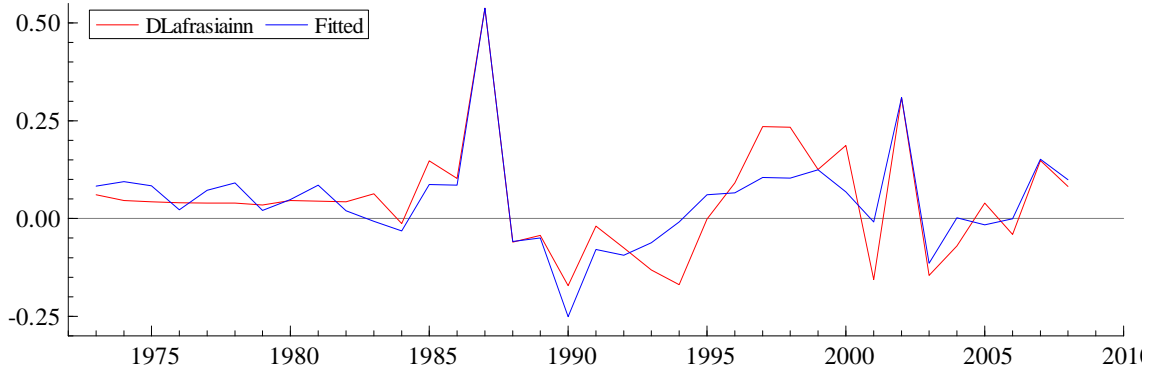## Migration from Africa and Asia (incl. Turkey) to Norway

The main explanatory variable her is relative income. Only changes in unemployment in Norway affect inward migration. Specification tests are generally good but the Chow test indicate instability in the model in the early 1990s and there is a large outlier in 1994 that perhaps should have been "cleaned".

```
Modelling Lafrasiainn by OLS. Sample: 1973 to 2008

                  Coefficient  Std.Error   t-value  t-prob Part.R^2
DLafrasiainn_2       0.239056     0.08845      2.70   0.011   0.2012
Constant            -0.265245      0.4751    -0.558   0.581   0.0106
Lafrasiainn_1        0.865418     0.05051     -2.66   0.012   0.1967
dum87                0.430134     0.07502      5.73   0.000   0.5313
dum02                0.278962     0.07479      3.73   0.001   0.3242
LNor gdp per         0.306458      0.1693      1.81   0.081   0.1015
Dunemplnor_1       -0.0983559     0.02566     -3.83   0.001   0.3363

sigma                0.0711207  RSS               0.146686424
R^2                  0.791874   F(6,29) =    18.39 [0.000]**
log-likelihood        47.9718   DW                       1.58

AR 1-2 test:      F(2,27)  =  0.89151 [0.4218]
ARCH 1-1 test:    F(1,27)  =   1.0704 [0.3100]
Normality test:   Chi^2(2) =   2.7947 [0.2473]
hetero test:      F(10,18) =  0.65272 [0.7517]
```

Migration from Norway to Africa and Asia (incl. Turkey)

In this equation only short and long term effects of unemployment in Norway is the explanatory variable. This is the only equation where the level of unemployment in Norway has a long term effect on migration. Higher unemployment leads to more outward migration. If we impose that only changes in unemployment matter, the specification tests are not passed by standard critical values.

```
Modelling Lafrasiaout by OLS. Sample: 1972 to 2008

                 Coefficient  Std.Error  t-value  t-prob Part.R^2
Lafrasiaout_1       0.723103    0.07965     9.08    0.000   0.7141
Constant            2.07688     0.5837      3.56    0.001   0.2773
unemplnor_1         0.0793444   0.01809     4.39    0.000   0.3683
unemplnor_2        -0.0546121   0.02049    -2.67    0.012   0.1771

sigma               0.0612452  RSS              0.123781959
R^2                 0.90388    F(3,33) =      103.4 [0.000]**
log-likelihood     52.9521     DW                       2.18

AR 1-2 test:      F(2,31)  =    1.6220 [0.2138]
ARCH 1-1 test:    F(1,31)  =   0.98527 [0.3286]
Normality test:   Chi^2(2) =   0.29987 [0.8608]
hetero test:      F(6,26)  =   0.46178 [0.8300]
hetero-X test:    F(9,23)  =   0.36638 [0.9396]
RESET test:       F(1,32)  =    2.0993 [0.1571]
```