Period and Cohort Measures of Migration

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Abstract: Migration is only rarely analyzed from a population perspective, unlike the two other main demographic processes, fertility and mortality. This study shows how standard demographic methodology can be used to study internal migration from both a period and cohort perspective at the population level. I present data and results by calculating the total migration rate (TMigR) on period and cohort data. I use administrative register data for the years from 1970 to 2012 on all inter-parish migration events for the complete population of Sweden. I present both age-specific migration rates as well as TMigR for Sweden. The results overall show an increased concentration of migration events into early adulthood, while total migration frequencies over the life course remained overall stable since 1970 with a small decline in the 1980s. Cohort rates show less fluctuation over time than period rates. The study shows the usefulness of taking a population level approach to migration, and to examine cohort and period trends simultaneously. These methods can easily be extended by decomposing data into different distance thresholds, as well as by migration order given applicable data. All the period and cohort data are available as an online supplement.
1. Introduction

Migration is seldom analyzed from a cohort perspective. In this study I calculate the total migration rate for both period and cohort migration data. I show how the application of standard demographic fertility measures can give important insights into the dynamics of migration, and why they should be more commonly incorporated to the tool kit of migration researchers. I present examples on cohort and period total migration rates as well as age-specific rates using Swedish administrative register data from 1970-2012 for the complete Swedish born population. Individual and regional studies of migration are common but it is less common to use population based measures of migration propensities, in particular those constructed using longitudinal cohort data.

There has been a long awareness of the usefulness of a cohort perspective on migration (Taeuber 1966), and in demography in general (Ryder 1965; Hobcraft, Menken, and Preston 1985). Theories of migration have simultaneously stressed the importance of viewing migration as a life course process (e.g. Rossi 1980; Bailey 2009; Kley 2011). Despite this, migration is almost universally analyzed with period data, and period measures. This is in great contrast to the widespread use of cohort measures in fertility and mortality research. Period perspectives, unlike a cohort perspective, do not directly correspond to the actual life courses of individuals. Instead they are a compound of the experience of different cohorts, and is thus possible that period effects bias measures of the actual life course experience. Event history analyses of migration microdata, common in contemporary research, use longitudinal data on actual birth cohorts, and are as such related to cohort age-specific rates. However, this line of research typically takes an
individual and not a population level perspective (e.g. Kulu 2005; Kulu, Malmberg, and Lundholm 2014; Kolk 2016).

Researchers have also tended to not examine complete populations when examining migration, in sharp contrast to other demographic issues. Unusual exceptions are research which applies modern register data (Westerlund 1998; Lundholm 2007; Bell et al. 2015), an approach also taken in this study. The consequence of such a lack of longitudinal population level period data in migration research is that several standard demographic techniques used in fertility and mortality research are not commonly used. Longitudinal data also makes it possible to study migration propensities based on previous experiences (cf. with parity in fertility research). Another advantage of the use of a complete population for internal migration research is that the population under risk is defined both for in-migration and out-migration.

2. Previous perspectives on migration over the life course

Migration researchers and demographers have been interested in measures of migration propensity over the life course for a long time. The age patterns of internal migration are well understood (Rogers, Raquillet, and Castro 1978; Rogers 1988; Mulder 1993; Mulder 2007), as they are very important for understanding internal migration between different regions within countries. That migration patterns change over the life course, and the association between migration and family formation, housing careers, and other sociodemographic variables, are also central in much theorizing on migration (Rossi
Starting in the 1960s migration researchers began using life table techniques to study migration propensities over the life course (Wilber 1963; Long 1973; Long 1992), similar to the approach used in this manuscript. Much like demographers use period data to create an estimate of life expectancy or fertility levels from a virtual cohort, researchers calculated expected number of migration events over the life course. This approach can be used with cross-sectional data with individuals at different ages from a single region, and from representative survey data, much like mortality and fertility measures. Typically measurements of life course migration range from 5 to 15 depending on country, and definition of migration events. If some information on previous migration patterns are available, it is also possible to calculate migration histories (Kulu et al. 2014).

Researchers have also developed various methods to infer age-specific migration rates, and thus total number of migrations, from sources with incomplete or noisy data (e.g. Rogers and Rajbhandary 1997). An valuable contribution, which partially answers similar questions is the use of age-period-cohort methods applied to migration (Mulder 1993), though this does not directly address research questions about life course migration experiences.

### 3. Population level measures of migration

The number of migration events over the life course can be seen as a direct analog to both the Total Fertility Rate (TFR), and the Cohort Fertility Rate (CFR). It is calculated by
summing up age-specific rates for a given age range. This measure has been given several different names, including migration expectancy (e.g. Wilber 1963; Long 1973), General Migration Rate (e.g. Rogers and Rajbhandary 1997), and total migration rate (e.g. Gődri and Spéder 2010). The terminology “life expectancy” has been criticized by mortality researchers as being misleading (e.g. Wilson and Oeppen 2003), and should in my opinion be avoided also for demographic migration measures. I will refer to the period measure as the total migration rate (Period TMigR) and the cohort measure as the Cohort Migration Rate (Cohort TMigR or CMigR), analogous to fertility measures.

I use the notation below.

\( n_m_x = \frac{nM_x}{nP_x} \)  \( \quad \) \( \text{(2)} \ TMigR = n \sum_x n_m_x \)

\( \quad \) \( \text{(3)} \ 40 \text{TMigR}_20 = n \sum_{x=20}^{40} n_m_x \)

Where: \( x \)=age, \( M \)=number of migrations under risk, \( m \)=migration rate, \( P \)=population at risk, \( n \)=time interval for the exposure (in this manuscript 1). Cohort TMigR is calculated in a similar way, with the difference that the sum of age-specific rates for a cohort is used, instead of rates for different ages at a single time point. Note that the exposure for all migration rates typically is hard to define, this is less of a problem with national numbers of internal migration events, as the exposure is related to a clearly bounded population. In this study (for simplicity of computation) I use the end-year population at a given age as exposure, and assume that all migrations are evenly distributed across the year, though this will slightly overestimate rates at higher ages. This is convenient for comparisons of cohort and period measures. The exception is the first age group \( m_0 \) where I apply the mid-year population (for simplicity assumed to be half of the end-year
population) of the age group. The last step is not always done in studies of migration age patterns, and leads to an underestimation of age-specific migration rates of around 50%. This notation highlights the similarity with period measures, something which will be even more apparent when one introduces order specific migration rates (similar to parity in fertility analysis). The notation also allows simple differentiation among different age intervals, something which is extra important in migration analysis as migration in childhood is not “self-generated”, but rather related to parental migration decisions. The measure is sensitive to the way a “migration event” is defined, as migration is a sociological event which with a less clear binary interpretation (from both a spatial and temporal perspective) than mortality and fertility. In this study I will use the crossing of a parish border as the definition of a migration event. Parish borders have the advantage that they are the most stable administrative grouping over the study period, as well as the smallest administrative unit in size (Sweden had a little more than 2500 parishes for most of the study period). However, the numbers of parishes began to decrease at an increasing rate the final 15 years of the study as parishes were consolidated. A consequence is that the migration rates in the final period to some degree are underestimation relative calculations for earlier periods.

In this manuscript I apply data from Swedish administrative registers from the years 1970-2012 for all Swedish-born men and women registered in Sweden. The data covers the complete population, but is limited to individuals below age 75 for the period before 1990, as well as migration events below age 75 until 2004. I will largely use only this age range for later figures. I attach several tables with all input data structured by cohort,
period, and age, as an online supplement. These files additionally include data for all ages after 2004. As the focus of the study is changes over time and comparisons between cohort and period measures, I will present results for both sexes jointly.

4. Results

In this section, I present results on period and cohort measures of migration. In Figure 1a and 1b I show age-specific period and fertility migration rates for Sweden from 1970 onwards. In Figure 1b, with cohort rates, no cohort has complete migration histories from age 0 to 75 as the data is limited to between 1970 and 2012. The figures show a familiar pattern of internal migration age patterns in which migration is high before children start school, rapidly rises around the end of high school, and peak in the mid 20s, after when it begins to rapidly decline. Migration propensities in the mid 20s are more than 6 times as high as in during adolescence, and even higher compared to late adulthood. Unlike American migration patterns, there is no substantive increase in migration rates associated with retirement decisions. At advanced ages over 85 there is however some evidence of increasing rates (see supplemental tables). There has been an increasing concentration of migration in early adulthood over time, visible in both period and cohort trends. In contrast migrations involving children have decreased over time, while migration propensities in the 20s and 30s have increased. The decrease in migration in childhood ages suggests decreasing migration by more settled individuals and families. These patterns are further shown in Table 1 comparing migration in year 1970 and 2000, examining the age distribution of migration events over the life course by decade. Table 1
show clearly that much migration took place at much earlier ages in 1970 compared to 2000.

**Figure 1a** Interparish migration rates by age and period, men and women born and resident in Sweden

![Graph showing migration rates by age and period]

**Figure 1b** Interparish migration rates by age and cohort, men and women born and resident in Sweden

![Graph showing migration rates by age and cohort]
Table 1: Age thresholds for when cumulative migration events over a life course are reached. Period rates for 1970 and 2000 for all inter-parish migrations in Sweden between ages 0 and 75

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<td>31</td>
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Note: \( T_{MigR_{75}} \) in Sweden for 1970 was 6.04, and for 2000 was 6.42.

Figure 2: Total migration rate \((20\_ TMigR_{40})\) and Cohort migration rate \((20\_ C_{MigR_{40}})\) for ages 20 to 40, inter-parish migrations of Swedish born and resident men and women.

In figure 2, I present comparisons between period and cohort total migration rates between ages 20 and 40 for inter-parish migrations. I also show \(20\_ C_{MigR_{40}}\) lagged by 27 years, the mean age of migration between age 20 and age 40. These are age ranges where most migration occurs, and the age intervals also allow comparisons between cohort and period rates. \(20\_ TMigR_{40}\) and \(20\_ C_{MigR_{40}}\) increases during the 1970s to 2000s from a little over 2.5 to 3.5 interparish migrations over the age span considered. Cohort rates show less variation over time than period measures, a pattern also seen in cohort measures of mortality and fertility. There is a clear increase in the period measures for the early 1990s, a time of economic crisis in Sweden, which also is reflected in a less dramatic form in cohort measures.
Finally, in figure 3 I present TMigR for different age ranges. Overall, the choice of age ranges in this case shows that similar period trends affected migration in all age ranges. The total number of migration across parish borders (the sum of the age-specific rates shown in Figure 1a) decreased from a $\text{0TMigR}_{75}$ of about 7 migrations in the early 1970s, to about 5 in the 1980s after where it has once again increased to 7. Around half of all migration from ages 0-75 took place between ages 20 and 40. After 2004 when data also for ages 76+ are available, shows that $\text{0TMigR}_{100}$ is about 0.8 migrations higher than $\text{0TMigR}_{75}$. Overall, when using a larger age range over the complete life course, there is a clear U-shaped pattern form 1970 to 2012 with a minimum reached in the 1980s, while migration increased in early adulthood over the same period.
5. Possible extensions of population based migration measures

Similar to fertility measures where analyses by parity are common, it is possible to calculate order specific migration rates with longitudinal data. This allows decomposing TMigR into order specific components, and also allow comparisons with conditional age-specific rates (using only the order-specific population under risk as the denominator), the underlying rates in (parity specific) event history analysis, if the population composition by migration order is known (cf. Kolk 2014; Kulu et al. 2014). Another extension is to decompose the data into different kinds of migration events using different distance thresholds (either based on coordinate data, or different levels of hierarchical
administrative geographical organization). It is also straightforward to desegregate data by population sub-group such as educational level, sex, or country of origin.

6. Conclusions

There are many advantages of taking a population level view of migration events using micro-level data. Beyond giving an adequate and representative view of actual migration histories of a population, they are also the appropriate level of analysis to study interactions between migration, housing markets, and the general economy. Longitudinal population level data is also required to translate results from micro-level event-history studies with equivalent standard population level measures. Similarly, examining cohort trends and period trends simultaneously is important to separate the effect of period shocks, and long term secular changes in peoples preferences. While administrative data with migration histories might be comparatively rare, representative longitudinal survey data with migration histories are also adequate for such calculations. It is also possible to use aggregated period data, if there is a sufficiently long time series. The total migration rate is a useful contribution to the toolbox of both demographers and migration researcher.

7. Acknowledgments

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8. References


