Net Cohort Migration in England and Wales: How Past Birth Trends May Influence Net Migration

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Population Review, Volume 46, Number 2, 2007, pp. 51-62 (Article)

Published by Sociological Demography Press
DOI: *https://doi.org/10.1353/prv.2008.0000*

Population Review

Volume 46, Number 2, 2007
Type: Article pp. 51-62

Net Cohort Migration in England and Wales: How Past Birth Trends May Influence Net Migration

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Abstract

An established role for statistical social science is to try to uncover the extent to which aggregate behaviour is conditioned by context as exemplified by the work of Durkheim. A decade prior to Durkheim's seminal work, eleven 'laws' of human migratory behaviour were proposed by Ravenstein. In this paper we suggest an extension to this work, that: *migration balances the relative worth of people to places over the course of human lifetimes; not in days, month or years: people follow the tides of life.* We explore the concept of net cohort migration to demonstrate this for England and Wales, for which long-term quality datasets are available.

Keywords

Migration, England and Wales, net cohort migration, demography, statistical social science, Sweden

Introduction

Ernst Georg Ravenstein's 'Laws of Migration' were published in the Journal of the Royal Statistical Society in 1885 (Ravenstein 1885,1889). Ravenstein, an employee of the Royal Geographical Society was motivated by William Farr, President of the Royal Statistical Society 1871-1873:

"It was a remark of the late Dr. William Farr, to the effect that migration appeared to go on without any definite law, which first directed my attention to [the] subject...." (Ravenstein 1885:167 cited in Tobler1995).

William Farr worked in the Registrar General's Office for England and Wales from 1838 to 1879, and was responsible for the collection of official medical statistics. He established the first system for routinely recording causes of death alongside occupation, and was a Commissioner for the 1871 Census. His observation, that migration appeared to go without almost any definite law, probably related to the apparently random fluctuations in the trend of annual net migration: calculated as the difference between changing counts of births, deaths and population in an area over time. Bearing in mind that Farr would have only observed the first few decades of the 160 year time series shown here in Figure 1, his observation was remarkably apposite.

In response to Farr's remark, Ravenstein developed some eleven 'laws' of migration, outlined by Grigg (Grigg 1977a, 1977b). Whilst none of Ravenstein's laws have been refuted, none of them explain the apparently random fluctuations shown in net migration trends to which Farr was most probably referring. Here we argue that this was unsurprising as neither Farr nor Ravenstein had access to the data needed to understand net migration balances: a time series of good quality data extending over at least 150 years.

In this article we present a method for estimating migration over a birth cohort rather than a time period. We suggest that migration patterns roughly balance births for these cohorts over the course of their lifetimes. The apparent random fluctuations in net migration trends are due to short term events and their aggregate influence, over the lifetime of a cohort, tends to cancel out. We develop and present an analysis of net cohort migration, which is possible with data, or estimates, extending over at least a full lifespan. Here, we focus on England and Wales, but have replicated our work using Swedish data (Appendix B). Most countries of the world do not produce data suitable to replicate this analysis globally.

Existing work on cohort migration tends to have an emphasis on the health or social circumstances of particular groups of migrants (Brimblecombe, Dorling and Shaw 1999, 2000; Harding 2004; MacPherson 2001). Wider, structural issues have been identified in an important body of work by Hatton and Williamson (2002, 2004), who observed cohort influences on migration in many countries with their proposition that 'The birthrate lagged 20 years stands as a proxy for the young adult cohort size. Its effect is positive, and it is large – suggesting that up to half of additional births ultimately spilled over into emigration'(2004:11).

Recently, the issue of whether increased immigration may substitute for lower birth rates in affluent nations has been raised (Rauhut 2004; UNDP 2001). On the general issue of cohort trends, Easterlin (1980) is credited with popularising our knowledge of the importance of the specific year a person is born on his/her future life chances, but the importance of that year for general migration trends has not been widely recognised.

This paper begins with an exploration of birth and migration trends for England and Wales for the years from 1840 to 2000. We suggest that when net cohort migration is considered, the impact of changing birth cohort size on migratory volume and direction becomes very clear.

We then examine possible shifts in the nature of the relationship between cohort size and net migration over the last 150 years, and we use official population projections to estimate future dimensions. Finally, we assess the validity of our findings, comparing our findings with data for Sweden.

Net Cohort Migration

Figure 1 shows the annual counts of births for England and Wales for 1840 to 2000. Details of the methods used to derive all figures can be found in Appendix A.

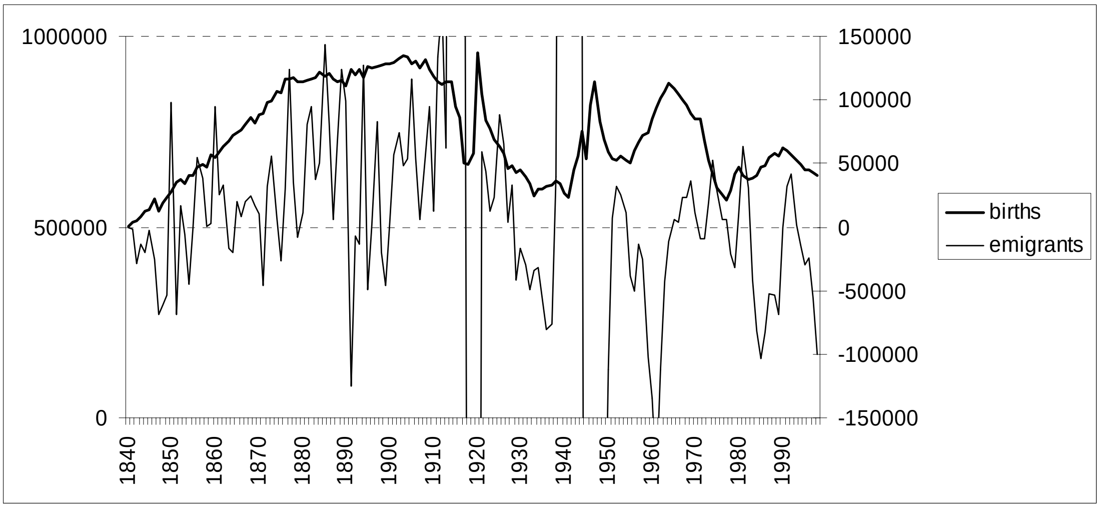

Figure 1. Annual Births and Net Emigration, England and Wales, 1840-2000.
Numbers of births are scaled by the left vertical axis, and net migration by the right-hand vertical axis (labelled emigration as the balance is shown as positive when out-migration is higher than in-migration to aid comparison with the trend in births).

Net emigration, as shown in Figure 1, is the excess of emigrants over immigrants. Scaled by the second axis of the figure, this trend is far less amenable to simple description, occasionally extending beyond the bounds of the graph as it apparently fluctuates wildly. Had Farr lived beyond 1883 he might have detected an upwards trend in the nineteenth century pattern with emigration peaking in the years 1850, 1852, 1856, 1860, 1865, 1873, 1877, 1882, 1885, 1889 and 1897. Net emigration often very quickly became negative between these dates as more people entered the country than left it. The dates themselves are somewhat arbitrary as this trend of net migration has a fractal quality whereby, on closer inspection, between each local maximum and minimum there appear others (Mandelbrot 1982). In only one year in peacetime in the twentieth century are the flows as large, and then of an influx of only 202,000 people in 1961. However, it is particularly timely to note that this record has just been exceeded with a figure of 223,000 for 2004 (Chappell 2005). Note that the most recent peaks in net emigration in 1974, 1981 and 1992 coincide with periods of economic recession.

Figure 2 is similar to Figure 1 but here net migration, labelled on the figure as ‘emigrants’, has not been measured over the course of a single year but over the lifetimes of the people born in each year. Net cohort migration records whether fewer, or more, people die in a place as compared to how many of <u>them</u> were born there. Net cohort migration is most simply calculated by subtracting from births in an area in a year the number of deaths recorded in that area of people born in that particular year over the subsequent century. It is the count of emigration less immigration over the lifetime of a birth cohort. For estimates of net cohort migration after 1900 we rely to increasing extents on official predictions of the population (see Appendix A for methods when a full cohort history is unavailable).

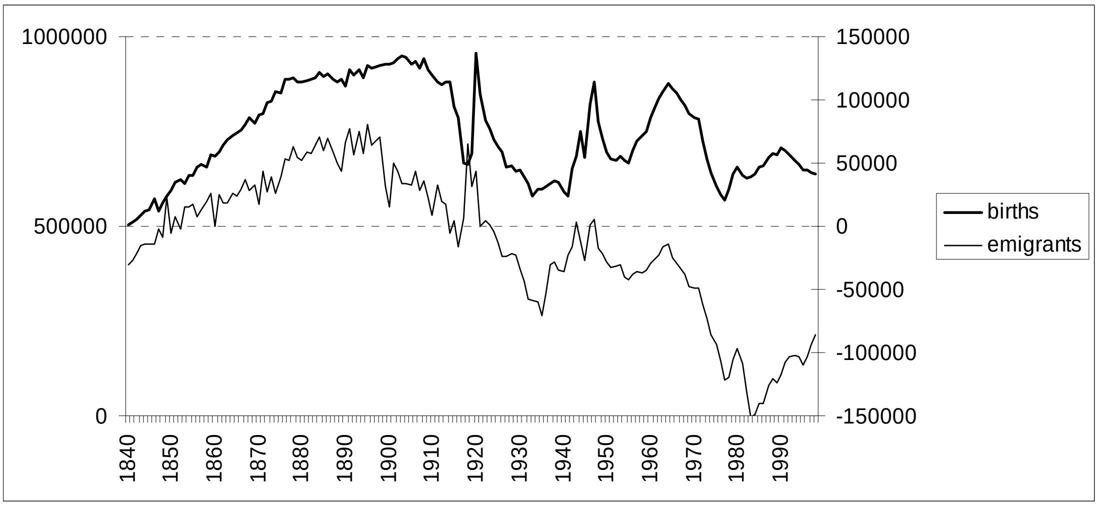

Figure 2. Annual Births and Net Cohort Emigration, England and Wales, 1840-2000
Note: Read as for Figure 1, but with cohort replacing net period migration (here 'emigrants' are net cohort emigrants i.e. emigrants-immigrants).

Looking in more detail at the period since 1850 and the correspondence between the trend in births and net cohort emigration: emigration first peaks at over 50,000 people net leaving per year (born in a given year) for the birth year when the birth increase first stalls: 1876. This coincides with the raising of public awareness of birth control connected with the Bradlaugh-Besant Trial (involving prosecution for the publication of a leaflet on family planning). This causes the break in the slope of the process that Chappell observes 'whereas previously, delayed marriage and non-marriage were the only factors reducing the number of children borne by each woman, by the late 19th and early 20th centuries the use of traditional methods of birth control (abstinence and withdrawal) within marriage had become more widespread' (2005:5).

Like births, net emigration rates then slowly undulate, but reach a maximum of 70,000 of those born in 1898 dying elsewhere. From the last Victorian birth cohorts of the turn of the century, net emigration falls quickly away. The trend mirrors that of births a few years later. For those cohorts there is less impetus to leave as they are replacing the deaths of the First World War and with fewer people a few years younger than them competing for space (at work and at home). England and Wales became net importers of people. With 'windrush' immigration from the Caribbean, a local peak of 70,000 more people born in 1935 died here than were born here. Estimates after 1965 are more problematic as they are based on actual events for only the first 35 years of life and official predictions from ages 35 to just over age 60, with zero net migration assumed after age 60.

In the remainder of this article we continue to use counts of people rather than rates per capita, age-adjusted fertility rates and so on: it is not clear how best these counts could be standardized. However, because we have not standardised either birth or net cohort migration counts, this should be borne in mind when considering Figure 3. This re-projects the information shown in Figure 2. Figure 3 suggests, in general, that when there are more births a higher number of people emigrate (net) and net emigration is more likely than net immigration. It is possible to discern distinct trends within this overall relationship.

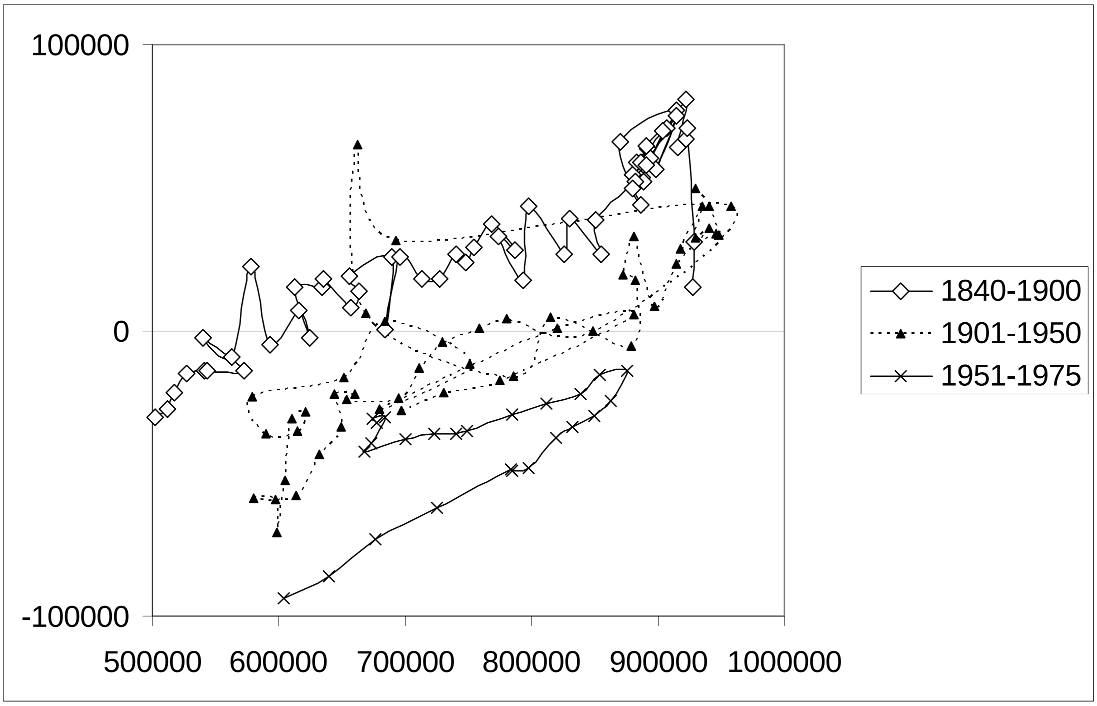

Figure 3. Births in, by net-cohort-emigration from, England and Wales 1840-1975
Source: Figure 2 (births x axis)

The left-most diamond in Figure 3 represents the year 1840 when just over half a million babies were born (x-axis) and a net additional 32,000 people born in that year entered these countries (y-axis). The years 1841, 1842, 1843 and so on are the diamonds progressively to the right of that initial point, connected by lines. In general more babies were born each year and fewer people entered these countries with progressively more emigrating, until around 1898. The last two diamonds in the series represent births in 1899 and 1900. The trend abruptly ends in 1899 because boys born in 1899 were, in general, too young to 'migrate' to France in 1914, from which many did not return (Brittain 1933). This is clear when rates for men and women are compared (results not shown).

The next period shown in the graph, as solid triangles, is of those children born between 1901 and 1950. There are more atypical years in this period (due partly to peaks in births a year after surviving men return from war in 1919 and 1947) but, in general, the solid triangles of births from 1901-1950 lie on a line some 50,000 emigrants below the 1840-1900 trend. Hence it would be possible to create two very simple equations: one which predicted lifetime emigrants from births for the period 1840-1898; and the other from 1899 to 1950. Both would be of the form:

Emigrants = (births – constant) * fraction

Given that the slopes of the lines are so similar, the fraction would stay the same and the constant would vary by about 50,000 people.

Finally, the crosses in Figure 3 show the period from 1950 to 1975. As births rose from 1955 to 1965, net lifetime immigration decreased each year and then as the number of births fell successively each year from 1965, net immigration increased. The most recent trend moves down the y axis to suggest net immigration (over the course of their lifetimes) of almost 100,000 people born in 1975; however this trend becomes heavily dependent upon actuarial estimates of future population numbers and deaths.

Discussion

As yet there are very few countries of the world which have very good quality long time series demographic data, a large population, and detailed future population forecasts to replicate this analysis. However, Sweden does fit these criteria having better registration data than England and Wales, and the replication of trends there is evident (this is demonstrated by Figures 4, 5 and 6 shown in Appendix B, which are the Swedish equivalents of Figures 1, 2 and 3 shown above).

The extent to which this work is predictive can only be ascertained in the future and unfortunately it is going to take a long time to tell. The last cohort that we are at all comfortable to include is of those born in 1975, as shown in Figure 3, simply to illustrate where the trend appear to be heading. Nevertheless, the recent high estimate of net immigration of 223,000 in 2004 (Chappell 2005) is coincident with the trough in births in 1976 (i.e. 28 years earlier, with 28 being a viable representation of the mean age at which many people migrate) and is supportive of this work. It is important to remember that here we are talking of net cohort numbers.

Conclusion

Clearly the research questions reflect more widespread availability of datasets of good quality representing lengthy time spans.

In aggregate terms people's behaviour appears to be very predictable over the course of their lifetimes as a group – if there is space for them, if they are welcomed and in demand, they will come. If they leave they are more likely to return, and so on such that the size of their birth cohort very closely predicts their net migratory behaviour until death. This process is remarkably consistent given that is occurs over a time frame of huge economic growth and change.

From these results it is possible to speculate that the premium and cost of Empire (that England and Wales had from 1840 until the birth cohort of 1898 came of age) was the net export and non-return of roughly 50,000 people additional people per year per birth cohort. This includes emigration to Canada, Australia, New Zealand and the United States (not officially part of the Empire). Speculation over the 1898 turning point can occur with the great statistical advantage that this date was so long ago that the data are virtually complete (i.e. estimates are based on real deaths and not future estimates). These results also add another dimension to arguments of the possibility that current official population projections are incorrect because those projections assume rates of net immigration lower than those needed to replace shrinking cohorts; however this again can only be assessed well into the future (Morris 2004).

Beyond the historical and future demography of England and Wales these results are perhaps of most interest in that they suggest that regularity in lifetime migration patterns might soon become observable worldwide. The graphs shown above have been replicated in Appendix B of this paper for Sweden to give an example. Most affluent nations of the world have established births, deaths and population data series that will soon extend for enough years to allow net cohort migration to be calculated for recent decades. These net cohort migration trends will simultaneously tell us of trends, in the aggregate, of countries not affluent enough to establish and maintain such data series for so long.

Acknowledgements

The authors would like to thank Hans Lundström and Phil Rees for helping with access to and understanding of the Swedish, and English and Welsh data respectively, Eilidh Garrett for advice on historical demography and, for Danny Dorling, the Department of Geography, University of Canterbury at Christchurch, New Zealand for time and space to study these trends. We also thank anonymous reviewers for their helpful comments.

Appendix A: Data and Methods

Data

For England and Wales annual data was collected from 1840 to 2000 by calendar year of births, deaths and population by single year of age (up to age 101+) and sex ,and population, births and deaths projections to 2027 (mid year estimates were projected to start year for the period 1991-2003). For Sweden the same data was collected but for single years of age up to age 111+ extending back to 1750 and forward to 2050.

Net emigration in England and Wales in the year 1990 is set to zero for all age and sex groups as the official series of statistics break their due to the revision of population estimates back to 1991 following the 2001 census. This has a negligible effect on the overall trends.

References

1. Historical Series

Human Mortality Database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de

2. Population Projections

United Kingdom Government Actuary's Department (GAD), http://www.gad.gov.uk/ and Statistika Centralbyrån (Statistics Sweden(http://www.scb.se/)

Methods

Net cohort immigration is the number of people who have entered an area, born in a particular year, less the number of people who have left that area born in that year. It can be estimated from annual births, deaths and population counts.

Given that births (and deaths) are recorded over a time period of usually one year and that population is usually recorded at one time point, usually of age last birthday, the following method allows net cohort immigration to be estimated in such a way that the lack of exact correspondence between groups enumerated at one point in time and entering or leaving the population over a period of time is greatly reduced.

To estimate net cohort immigration between years *t* and *t*+1 and ages 0 and 1 given:

B_t = births occurring in year *t*
B_{t-1} = births occurring in year *t*-1
$D_{0,t}$ = deaths of babies aged 0 in year *t*
$P_{0,t+1}$ = population aged 0 on January 1st of year *t*+1
$P_{1,t+1}$ = population aged 1 on January 1st of year *t* +1

$I_{0,t}$:net migration estimate in year t of children aged 0 is given by:

$$I_{0,t} = (P_{0,t+1} + P_{1,t+1})/2 - (B_t + B_{t-1})/2 + D_{0,t} \qquad (1)$$

For ages 1 and above net migration estimate in year *t* of people aged *a* is given by:

$$I_{a,t} = (P_{a,t+1} + P_{a+1,t+1})/2 – (P_{a-1,t} + P_{a,t})/2 + D_{a,t} \quad (2)$$

Thus net lifetime immigration is approximated by:

$$\begin{aligned} I_t = \; & (P_{0,t+1} + P_{1,t+1})/2 – (B_t + B_{t-1})/2 + D_{0,t} + \\ & \textstyle\sum_{a=1 \text{ to } 100} [\, (P_{a,a+t+1} + P_{a+1,a+t+1})/2 – (P_{a-1,a+t} + P_{a,a+t})/2 + D_{a,a+t}] \quad (3) \end{aligned}$$

$$\begin{aligned} = \; & (P_{0,t+1} + P_{1,t+1})/2 – (B_t + B_{t-1})/2 + D_{0,t} + \\ & (P_{1,t+2} + P_{2,t+2})/2 – (P_{0,t+1} + P_{1,t+1})/2 + D_{1,t+1} + \\ & (P_{2,t+3} + P_{3,t+3})/2 – (P_{1,t+2} + P_{2,t+2})/2 + D_{2,t+2} + \\ \ldots \\ & (P_{100,t+101} + P_{101,t+101})/2 – (P_{99,t+100} + P_{100,t+100})/2 + D_{100,t+100} \end{aligned}$$

$$= \quad (P_{100,t+101} + P_{101,t+101})/2 - (B_t + B_{t-1})/2 + \textstyle\sum_{a=0 \text{ to } 100} D_{a,a+t} \quad (4)$$

$$\cong \quad (\textstyle\sum_{a=0 \text{ to } 100} D_{a,a+t}) - (B_t + B_{t-1})/2 \quad (5)$$

Net lifetime immigration for people born in year *t* is approximated by the sum of number of people of age *t* dying in year *t*+1 for each year from *t* to *t*+100 less the mean number of births in years *t* and *t*-1. When a full cohort of data is not available net lifetime immigration can be approximated by equation 3 above (assuming net immigration from older ages is 0). Instead of summing to age 100 the sum is to the highest age for which data or projected data are available.

[By inserting a subscript for women and men above, net cohort migration by sex can be calculated.]

Net cohort emigration is simply: $- I_t$

Appendix B: Sweden

No commentary is included with these three figures as they are simply presented here to illustrate that the results found in England and Wales are similar to those found elsewhere.

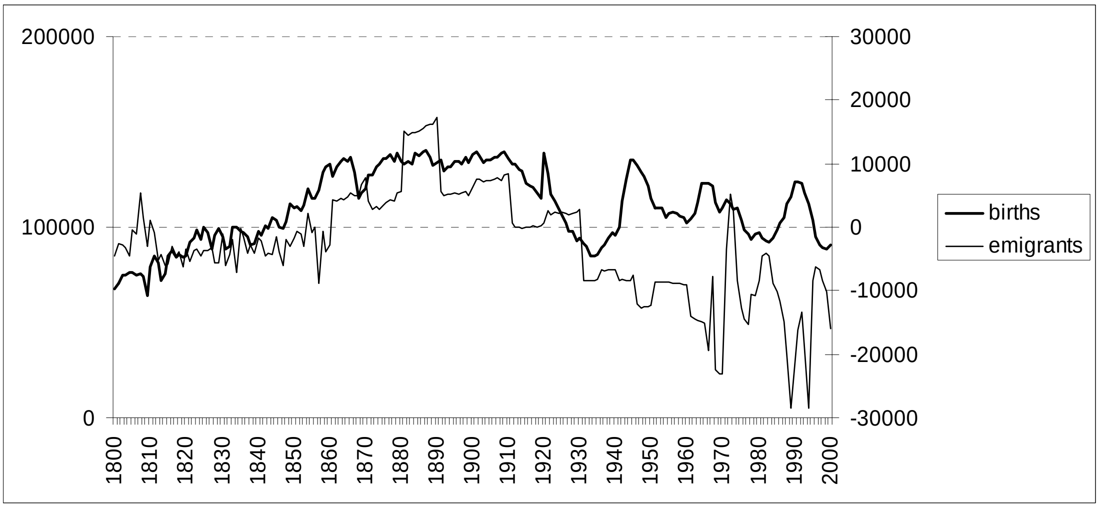

Figure 4. Annual Births and Net Emigration, Sweden, 1800-2000

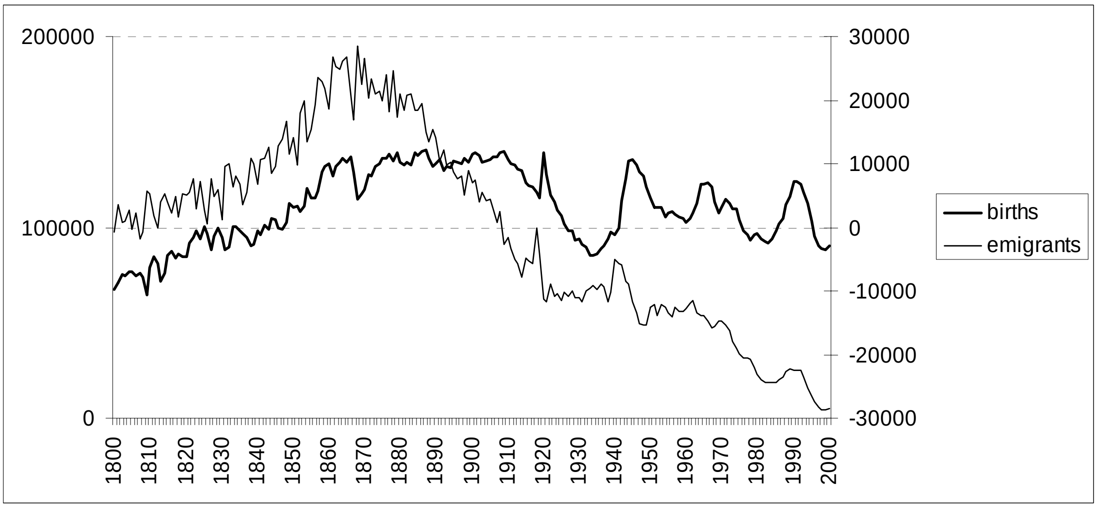

Figure 5. Annual Births and Net Cohort Emigration, Sweden, 1800-2000

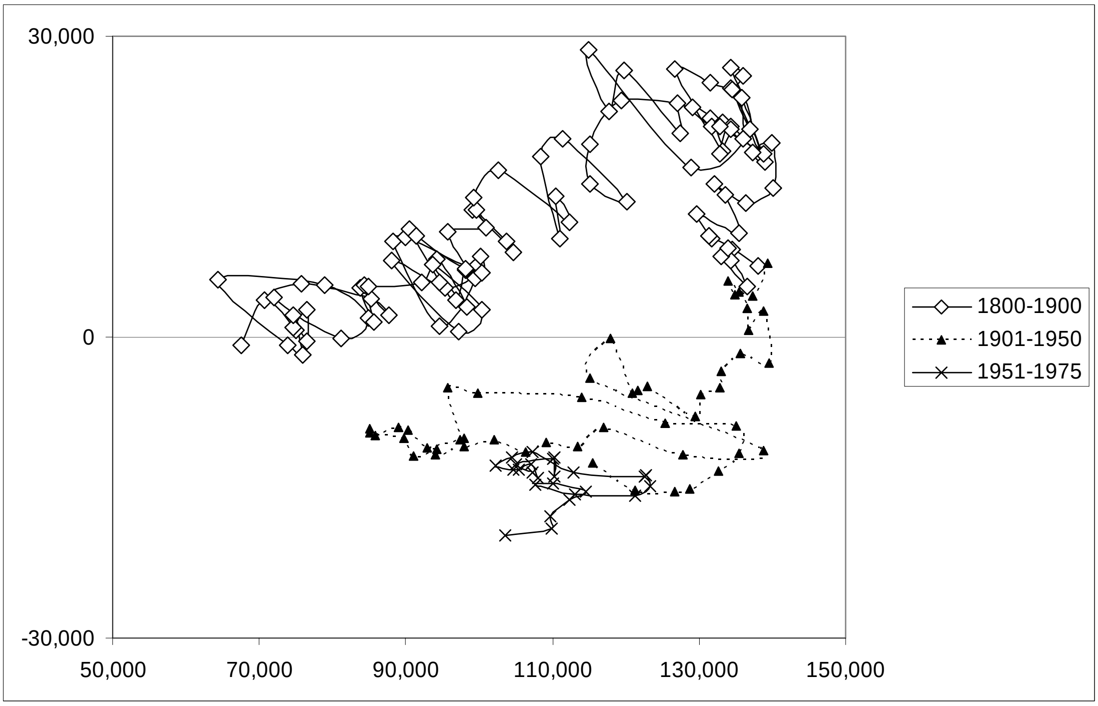

Figure 6. Annual Births verses Net Cohort Emigration, Sweden, 1800-1975

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