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ABSTRACT

Does the Glass Ceiling Exist? A Cross-National Perspective on Gender Income Mobility*

We compare male and female upward labor income mobility in Germany and the United States using the GSOEP-PSID Cross National Equivalent File. Our main interest is to test whether a glass ceiling exists for women. The standard glass ceiling hypothesis highlights the belief that the playing field is level for women and men in the labor market up to a point, after which there is an effective limit on advancement for women. We examine the glass ceiling hypothesis by looking at the dynamics of the income distribution -- the movement of women and men through the distribution of income over time. We find that there is considerable evidence in favor of a glass ceiling both in Germany and the United States. In Germany the glass ceiling is evident in higher incomes while in the United States the glass ceiling is evident at all incomes levels.

JEL Classification: D3, D63, J7

Keywords: glass ceiling, mobility, Markov chain, income distribution dynamics, gender discrimination

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1 Introduction

In 1995 the U.S. Department of Labor's Glass Ceiling Commission issued a report saying: "a glass ceiling exists and that it operates substantially to exclude minorities and women from top levels of management." [*Good for Business: Making Full Sense of the Nation's Human Capital* (1995, page 7)]. The glass ceiling concept is popular in the press, in government circles and in general conversation. The economics literature has hardly touched the topic, though the few articles that have dealt with the issue have found glass ceilings [Duleep and Sanders (1992), McDowell, Larry D. Singell and Ziliak (1999), and Athey, Avery and Zemksy (2000)].[1]

The glass ceiling is generally thought of as the transparent but real barriers which impede qualified women and other minorities from advancing up the job ladder into high level management positions. In the economics literature, the glass ceiling has been variously (and relatedly) defined to be: 1) discrimination at the top [Duleep and Sanders (1992)]; 2) gender differences in promotion opportunities among groups whose labor market attachment is strong and does not differ markedly by gender [McDowell et al. (1999)]; and 3) upper levels of firms remaining homogeneous even when the lower levels are more diverse [Athey et al. (2000)].

Our interpretation is that the glass ceiling hypothesis captures the idea that women and other minorities are less likely to be promoted – they have lower upward mobility, especially at the higher income levels – than their male majority colleagues. Effectively it means that mobility is constrained. The standard glass ceiling hypothesis is that the existence of a glass ceiling implies that the upper level of the employment distribution - and by implication the upper end of the labor income distribution - remains less diverse than the entry level. In terms of labor income mobility we expect to see here similar patterns of upward mobility for

[1] A January 8, 2003 search on Econlit (http://www.econlit.org), an index of professional economics journals, found only 13 references with the term "glass ceiling" in the abstract or title. Only three of these were in what would generally be called mainstream economics journals. A similar search of the SSRN database (http://www.ssrn.com), a repository of discussion papers in economics, came up with 6 references.

women and men within the lower and middle parts of the distribution, but little movement of women relative to men across the upper tail of the distribution.[2]

We examine the labor income mobility of men and women in Germany and the United States using the GSOEP-PSID Cross National Equivalent File. Our main interest is to test whether a glass ceiling exists for women relative to men. The standard glass ceiling hypothesis highlights the belief that the playing field is level for women and men in the labor market up to a point, after which there is an effective limit on advancement for women. We examine the glass ceiling hypothesis by looking at the dynamics of the income distribution – the movement of women and men through the distribution of income over time. A thorough examination of the glass ceiling hypothesis requires a detailed data set that would contain information at the micro level on promotions and salaries. The data that we use does not include all the information needed to study promotions and salary increases at the firm level. However, the existence of a glass ceiling for women, for example, would imply that there would be observed differences in income mobility between men and women. Evidence of significant differences in income mobility for women would be consistent with the glass ceiling hypothesis while evidence of equal mobility between men and women would be evidence against the glass ceiling hypothesis.

We therefore study the income mobility of men and women by modelling the dynamics of the income distribution as a first order Markov chain. Bayesian methods are used to characterize the distribution of all the functions of the transition probability matrix. In particular, we are able to estimate the probabilities of an individual moving from one income classification to another, formally compare and contrast various mobility indices across different subsamples of the data, and formally compare and test various hypotheses on the convergence properties of the income distribution. We are most interested in measuring upward income mobility and testing different hypotheses on the transitional dynamics of the income distribution.

[2]While obviously related, the existence of a glass ceiling does not necessarily imply that there is discrimination. McDowell et al. (1999) find evidence of a glass ceiling in the academic economics profession. However, they indicate that they also find that the publishing profile for female economists is lower throughout their careers relative to men.

In the next section we lay out the basic elements needed in modelling income distribution dynamics. In Section 3 we discusses various income mobility measures and characterize the upward mobility measures we use to examine whether or not there is a glass ceiling. Section 4 discuss our data and priors. Results are discussed in section 5. Section 6 concludes.

2 Modelling Income Distribution Dynamics

The dynamics of labor income is studied in this paper using a first order Markov chain. The use of Markov chain models to study income dynamics has a long history with notable contributions by Champernowne (1953) and Shorrocks (1976).

One of the most appealing aspects of using a Markov chain to model income dynamics across individuals is the ability to investigate issues such as differences in income mobility over time, among subgroups of the population. The Markov assumption is a natural way of thinking about income dynamics while imposing only minimal theoretical structure. Gang, Landon-Lane and Yun (2003) formally develop measures of upward and downward mobility and show how these can be aggregated into standard Markov chain mobility measures. Here we offer a discussion of the modelling and estimation strategy.

Let there be C income classifications where C is a finite number and let π represent the income distribution over these C income classes. The distribution across the C classes where π_{jt} is the proportion of the total population that is in class j at time t is $\pi_t = (\pi_{1t}, \ldots, \pi_{Ct})'$. Therefore the variable π_t defines the "state" of the world at time t. The first order Markov assumption implies that the state of the world today is only dependent on π_{t-1}. That is,

$$P(\pi_t|\pi_{t-1}, \pi_{t-2}, \ldots, \pi_{t-j}) = P(\pi_t|\pi_{t-1}) \quad \forall \ j = 2, 3, \ldots, \tag{1}$$

where $P(.)$ represents the conditional probability distribution of π. Define the probability of transiting from class i in period *t-1* to class j in period t to be $p(\pi_t = j|\pi_{t-1} = i) \equiv p_{ij}$

so that the Markov transition matrix, $\mathbf{P}$, can be defined as $\mathbf{P} = [p_{ij}]$. Then the first order Markov chain model is

$$\pi_t' = \pi_{t-1}'\mathbf{P}. \tag{2}$$

It is simple to show that $\pi_t' = \pi_0'\mathbf{P}^t$, where π_0 is the initial income distribution. The invariant or limiting income distribution, $\overline{\pi}$, is any distribution that satisfies

$$\overline{\pi}' = \overline{\pi}'\mathbf{P}. \tag{3}$$

The invariant distribution is unique if there is only one eigenvalue of $\mathbf{P}$ with modulus one.[3]

This paper uses Bayesian methods to estimate and make inferences from the Markov chain model outlined above. One important benefit of using Bayesian methods is that it is simple to characterize the distribution of any function of the primal parameters, π_0 and $\mathbf{P}$, of the model. For example, we are able to characterize the distribution of the invariant distribution, $\overline{\pi}$; a highly non-linear function of $\mathbf{P}$. Other functions of $\mathbf{P}$ that are of interest include various mobility indices such as the probability of moving to a higher income class. In Section 3 below we provide more detail about the particular mobility indices in which we are interested.

Before discussing in detail the measure of mobility and the tests used in this paper, we first discuss our sampling scheme. We observe N individuals over T time periods and place them into C classifications. Let $i \in \{1, 2, \ldots, C\}$, $n \in \{1, 2, \ldots, N\}$, and let $t \in \{1, 2, \ldots, T\}$. For each individual, n, define

$$\delta_{nit} = \begin{cases} 1 & \text{if individual } n \text{ is in class } i \text{ for time period } t \\ 0 & \text{else} \end{cases}. \tag{4}$$

For each individual, n, and for each time period t we observe the individuals' income class

[3]Implicitly we are assuming that the eigenvalues have been ordered from highest to lowest in terms of magnitude. As $\mathbf{P}$ is row stochastic we know that the highest eigenvalue, in terms of magnitude, is 1. If the magnitude of the second eigenvalue is strictly less than 1 then we know that the invariant distribution is unique.

$s_{nt} \in \{1, 2, 3, \ldots, C\}$. Let $S_{NT} = \{\{s_{nt}\}_{n=1}^{N}\}_{t=1}^{T}$ be the information set at time T. Define $k_{i0} = \sum_{n=1}^{N} \delta_{ni0}$ as the number of individuals that are in class i in the initial period and define $k_{ij} = \sum_{n=1}^{N} \sum_{t=1}^{T} \delta_{ni(t-1)} \delta_{njt}$ as the total number of transitions from class i in time period *t-1* to class j in time period t across all time periods. The matrix $\mathbf{K} = [k_{ij}]$ is the observed sample transition matrix. Note that if T is greater than two it is implicitly assumed that $\mathbf{P}$ is the same for all *T-1* transition periods.[4]

The data density, or likelihood function, for the model defined in (2) is

$$p(S_{NT}|\pi_0, \mathbf{P}) \propto \prod_{i=1}^{C} \pi_{i0}^{k_{i0}} \prod_{j=1}^{C} p_{ij}^{k_{ij}} \tag{5}$$

which is the kernel of the product of two independent multivariate Dirichlet (Beta) distributions. Natural conjugate priors for π_0 and $\mathbf{P}$ are also independent Dirichlet distributions defined as

$$p(\pi_0) = \left[\frac{\Gamma(\sum_{i=1}^{C} a_{i0})}{\prod_{i=1}^{C} \Gamma(a_{i0})} \right] \prod_{i=1}^{C} \pi_{i0}^{(a_{i0}-1)} \tag{6}$$

and

$$p(\mathbf{P}) = \prod_{i=1}^{C} \left[\frac{\Gamma(\sum_{j=1}^{C} a_{ij})}{\prod_{j=1}^{C} \Gamma(a_{ij})} \right] \prod_{j=1}^{C} \pi_{ij}^{(a_{ij}-1)}. \tag{7}$$

Here the priors are parameterized by the vector $a_0 = (a_{10}, \ldots, a_{C0})'$ and $\mathbf{A} = [a_{ij}]$. The priors have a notional sample interpretation. We can think of $a_{i0} - 1$ as the number of individuals in the i^{th} class of the initial relative income distribution of a notional sample and $a_{ij} - 1$ can be interpreted as the total number of transitions from class i in period *t-1* to class j in period t for the notional sample. Assuming that the priors are independent then the posterior distribution for (2) is

$$p(\pi_0, \mathbf{P}|S_{NT}) \propto \left[\frac{\Gamma(\sum_{i=1}^{C} a_{i0})}{\prod_{i=1}^{C} \Gamma(a_{i0})} \right] \prod_{i=1}^{C} \pi_{i0}^{(k_{i0}+a_{i0}-1)} \prod_{i=1}^{C} \left\{ \left[\frac{\Gamma(\sum_{j=1}^{C} a_{ij})}{\prod_{j=1}^{C} \Gamma(a_{ij})} \right] \prod_{j=1}^{C} \pi_{ij}^{(k_{ij}+a_{ij}-1)} \right\}. \tag{8}$$

[4]The observed initial distribution, k_0 and the observed data transition matrix, $\mathbf{K}$, are both functions of the information set, S_{NT}. Hence S_{NT} and $(k_0, \mathbf{K})$ are interchangeable in the definitions of the data density. For brevity we use S_{NT}.

The joint posterior density kernel in (8) is the kernel for the product of two Dirichlet distributions. The posterior distribution for π_0, the initial income distribution, is Dirichlet with parameters $(k_{10} + a_{10}, \ldots, k_{C0} + a_{C0})'$. The posterior distribution for $\mathbf{P}$ is the product of C independent Dirichlet distributions with parameters $(k_{i1}+a_{i1}, \ldots, k_{iC}+a_{iC})'$ for $i = 1, \ldots, C$ (Geweke 1998).

We are interested in calculating conditional expectations, $E(g(\pi_0, \mathbf{P})|S_{NT})$, for any well defined function, $g(\pi_0, \mathbf{P})$, of the parameters of the Markov chain. Examples include the invariant income distribution and measures of upward mobility, which we define in Section 3. It is a simple matter to make identical and independent draws from these independent Dirichlet distributions using the method described in Devroye (1986). Let $\pi_0^M = \{\pi_0^{(m)}\}_{m=1}^M$, and $\mathbf{P}^M = \{\mathbf{P}^{(m)}\}_{m=1}^M$ be the i.i.d. samples from the posterior distribution, $p(\pi_0, \mathbf{P}|S_{NT})$. By the law of large numbers the conditional expectation, $E(g(\pi_0, \mathbf{P})|S_{NT})$, can be approximated by the simple arithmetic average, $\overline{g}_M = M^{-1} \sum_{m=1}^M g(\pi_0^{(m)}, \mathbf{P}^{(m)})$. This simple result allows us to characterize all functions, g(.), of the primal parameters for which g(.) is well defined. Particular functions of interest to us are defined in the next section.

3 Mobility and the Glass Ceiling

Testing for a glass ceiling involves measuring the mobility of males and females in the population. There are many measures of overall income mobility that can be defined (Shorrocks (1978) and Geweke, Marshall and Zarkin (1986)). A measure of overall income mobility that is commonly reported in the literature is the measure due to Shorrocks (1978),

$$\mathcal{M}_s(\mathbf{P}) = \frac{C - tr(\mathbf{P})}{C - 1}, \tag{9}$$

which is the inverse of the harmonic mean of the expected length of stay in an income class, scaled by a factor of $C/(C-1)$. This index satisfies the monotonicity, immobility and strong immobility persistence criteria and hence is internally consistent.[5]

Gang et al. (2003) show how this measure can be decomposed into its upward and downward income mobility components. We also show that these upward and downward income mobility indices are internally consistent with respect to the persistence criteria noted above. The measure of upward mobility that we use in this paper is

$$\mathcal{M}_U(\mathbf{P}) = \frac{1}{C-1}\sum_{k=1}^{C-1}\mathcal{M}_{U|k}(\mathbf{P}), \tag{10}$$

where

$$\mathcal{M}_{U|i}(\mathbf{P}) = \sum_{k=i+1}^{C} p_{ik}. \tag{11}$$

Here, $\mathcal{M}_{U|i}$ measures the probability of moving up from income class i to an income class above i, and $\mathcal{M}_U$ is the average probability of moving to a higher income class. These measures allow us to characterize any differences between males and females in terms of ability of moving to a higher income class.

In order to determine whether there is any evidence in support of the glass ceiling hypothesis we propose to test whether males have more upward mobility than females. The general format of the test is as follows. Let $\mathcal{S}$ be any particular statistic that we are interested in. Let

$$d_k = \begin{cases} 1 & \text{if } \mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}} \\ 0 & \text{else} \end{cases}.$$

Our function of interest, $g(\pi_0, \mathbf{P})$, is the posterior probability that the statistic, $\mathcal{S}$, is bigger for males than for females, and is given by

$$g(\pi_0, \mathbf{P}) = p(\mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}}) = \int_{\Theta_1} p(\pi_0, \mathbf{P}|S_{NT})dp(\pi_0, \mathbf{P}|S_{NT}) \tag{12}$$

[5]See Geweke et al. (1986) for a complete discussion on the properties of these mobility indices.

where Θ_1 is the region of the support of the posterior in which $\mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}}$. An estimator of $p(\mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}})$ is

$$M^{-1} \sum_{m=1}^{M} d_m$$

for some sample $\{d_m\}_{m=1}^{M}$. In practice we have i.i.d. draws $\left\{\pi_0^{(m)}, \mathbf{P}^{(m)}\right\}_{m=1}^{M}$ from the posterior distribution $p(\pi_0, \mathbf{P}|S_{NT})$ for males and for females. Then for each of these draws we can calculate, for example, $\mathcal{M}_U$ for males and females and calculate whether $\mathcal{M}_U(males) > \mathcal{M}_U(females)$.

A value of $p(\mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}}) = 1$ can be interpreted as the distribution of $\mathcal{S}_{\text{male}}$ being completely to the right of the distribution of $\mathcal{S}_{\text{female}}$. Conversely, a value of 0 implies that the distribution of $\mathcal{S}_{\text{male}}$ is completely to the left of distribution of $\mathcal{S}_{\text{female}}$. Therefore, the closer the value of $p(\mathcal{S}_{\text{male}} > \mathcal{S}_{\text{female}})$ is to 1 the further to the right is the distribution of $\mathcal{S}_{\text{male}}$ relative to the distribution of $\mathcal{S}_{\text{female}}$.

4 Data and Prior Distribution

4.1 Data

In order to study gender differences in upward mobility of labor income, we use samples drawn from two panel data sets, the Panel Study of Income Dynamics (PSID) from the USA and the German Socio-Economic Panel (GSOEP). The study is facilitated by using PSID and GSEOP files from the Cross National Equivalent File (CNEF), which makes the information in PSID and GSOEP directly comparable.[6] The PSID-CNEF and GSOEP-CNEF contain information regarding not only demographic characteristics but also labor market activities including labor income. Our variable of interest is real labor income, which we calculate using

[6]PSID-CNEF and GSOEP-CNEF are available thanks to efforts of researchers and staff in Cornell University and the German Institute for Economic Research (DIW). For details of making equivalent files across countries, see the homepage of this project, http://www.human.cornell.edu/pam/gsoep/equivfil.cfm.

data from the CNEF. We deflate labor income using the consumer price index (base year: 1991) and convert German Marks to US dollars using a purchasing power parity exchange rate (PPP) in 1991.[7] We convert Marks to dollars at purchasing power parity to facilitate comparison between the United States and Germany. so we can assign the class of workers based on "absolute" amount of labor income, not "relative" position in the distribution of labor income, and to make our comparisons of upward mobility in the U.S. and in Germany more transparent.

We exclude the over-sample of low-income families from PSID and utilize the West German sample from the GSOEP (sample A). We also excluded those who work in agriculture. In order to study only workers who have strong attachment to labor market and to focus on the glass ceiling among "career" workers, we restrict the sample to those who work in full-time jobs in both starting and ending years.[8] Full-time workers are those who work 35 hours or more per week on average. We study only workers not younger than 25 years in the beginning year and not older than 60 years in the ending year of the period. For example, we select people from age 25 to 47 in 1984 when we study the 13 year transition between 1984 and 1997.

Table 1 shows mean labor income in the U.S. and Germany for 1984 and 1997, the first and last year for which we have data in both the GSOEP and PSID. To gain some perspective on the sample we use in our analysis, Table 1 shows for both the U.S. and Germany the incomes and sample sizes of all workers (including part-time), full time workers in the unbalanced panel, and full time workers appearing in both the 1984 and 1997 samples. The sample we are using, "career-workers", i.e., those who are full time workers both in the beginning and ending periods, have the highest incomes. Among our sample, U.S. men in 1984 enjoy an

[7] The PPP in 1991 is 2.09 DM per one US dollar, while the exchange rate in the same year is 1.66 DM per a dollar.

[8] For example, we choose people who were full-time job workers in both year 1984 and 1997 when we study the 13 year transition, the longest period for which both USA and German data are available. When we study sub-periods, we choose people who worked in full-time jobs in the starting and ending years of the sub-period. Hence the sample size is not fixed when we study transition in different periods. Also, the fact that they worked in full-time job in both years does not necessarily mean that they worked in a full-time job throughout the period.

annual labor income premium of 51.42 percent over women. For 1997 this premium is 45.55 percent. In Germany the wage gap is 46.71 percent in 1984 and 31.38 percent in 1997.

4.2 Prior Distributions

This paper uses Bayesian methods to estimate and make inferences from the Markov chain model outlined in section 3. One important benefit of using Bayesian methods is that it is simple to characterize the distribution of any function of the primal parameters, π_0 and $\mathbf{P}$, of the model and any, possibly non-linear, function of these primal parameters. In this paper, the functions of the primal parameters that we are interested in are the various mobility measures described above.

As we use a Bayesian estimation strategy, we need to construct priors for the unknown parameters of our model. The unknown parameters of the first order Markov chain model are π_0 and $\mathbf{P}$. We propose conjugate Dirichlet priors for π_0 and $\mathbf{P}$ parameterized by the vector a_0 and the matrix $\mathbf{A}$ respectively. These priors have a notional data interpretation in that $a_{i0} - 1$ can be interpreted as the number of individuals initially contained in income class i, while $\mathbf{A}_{ij} - 1$ can be interpreted as the number of individuals transiting from income class i to income class j in the notional prior data set.

We take a neutral stance with our priors in that we want the data to tell the story. Noting that the prior has a notional data interpretation, we propose priors that are generated from a notional data set that is one tenth the size of the observed sample. For example, if the sample that we are using contains one thousand individuals then the prior would be parameterized so that it could be interpreted as coming from a notional sample of 100 individuals.[9]

The information contained in the posterior distribution is a weighted average of information contained in the data and the information contained in the prior. Therefore we set the

[9]It should be noted, however, that there is a positive externality in including prior information in that if the prior is suitably defined, none of the parameters defining the Dirichlet distribution in the posterior will be zero. This allows for easy sampling from the posterior.

Table 1: Mean Income Level (constant US$, base year = 1991)

	U.S.			
	1984		1997	
	Male	Female	Male	Female
	Full-time workers in both years			
mean	26849	17731	33103	22743
std. dev.	(13016)	(7882)	(17661)	(12039)
sample size	150	82	150	82
	Full-time workers in respective year			
mean	28246	18391	30150	20783
std. dev.	(16737)	(8908)	(17633)	(11986)
sample size	899	557	208	197
	Workers in respective year			
mean	23324	13610	26967	17430
std. dev.	(17295)	(9692)	(17973)	(12202)
sample size	1297	1203	256	335

	Germany			
	1984		1997	
	Male	Female	Male	Female
	Full-time workers in both years			
mean	26553	18099	32377	24644
std. dev.	(23694)	(8214)	(16569)	(10051)
sample size	643	132	643	132
	Full-time workers in respective year			
mean	25507	17028	32618	22952
std. dev.	(21857)	(12012)	(16565)	(12396)
sample size	1480	503	748	241
	Workers in respective year			
mean	24276	12198	31363	15716
std. dev.	(21450)	(10367)	(16546)	(11891)
sample size	1657	1035	824	566

Note 1: Workers are restricted to working in non-agriculture and aged 25 to 47 years old in 1984.

Note 2: German Marks are converted to U.S. dollars using PPP in 1991 (2.09DM/US$)

weights to be 0.9 and 0.1 respectively. The prior distributions for all data sets used in this paper are scalar multiples of the following prior distributions. Table 2 contains the values for a_0, the parameter that defines the Dirichlet prior for π_0. In this analysis we define ten income classes that are equal in log length, following Champernowne (1953).

The notional sample size is 100 with each individual having equal prior probability of being a member of any particular income class. The prior for the transition matrix, **P**, is similarly defined. Table 3 contains the prior parameters, **A** that define the prior for **P**.

Table 2: Initial Distribution Prior: a_0

Income Class	1	2	3	4	5	6	7	8	9	10
a_{i0}	11	11	11	11	11	11	11	11	11	11

Table 3: Transition Matrix Prior: **A**

Income Class	1	2	3	4	5	6	7	8	9	10
A_{1j}	6.21	3.60	2.30	1.65	1.13	1.06	1.01	1.01	1.01	1.01
A_{2j}	3.06	5.13	3.06	2.03	1.51	1.10	1.05	1.01	1.01	1.01
A_{3j}	1.93	2.87	4.75	2.87	1.93	1.46	1.09	1.04	1.01	1.01
A_{4j}	1.44	1.89	2.79	4.58	2.79	1.89	1.44	1.08	1.04	1.01
A_{5j}	1.08	1.44	1.88	2.77	4.55	2.77	1.88	1.44	1.08	1.04
A_{6j}	1.04	1.08	1.44	1.88	2.77	4.55	2.77	1.88	1.44	1.08
A_{7j}	1.01	1.04	1.08	1.44	1.89	2.79	4.58	2.79	1.89	1.44
A_{8j}	1.01	1.01	1.04	1.09	1.46	1.93	2.87	4.75	2.87	1.93
A_{9j}	1.01	1.01	1.01	1.05	1.10	1.51	2.03	3.06	5.13	3.06
A_{10j}	1.01	1.01	1.01	1.01	1.06	1.13	1.65	2.30	3.60	6.21

The prior for **P** has the characteristic, in order to be consistent with a_0, that there are ten individuals initially in each income class. We have designed the matrix **A** so that the highest prior probability is given to an individual staying in the same income class that she started in with decreasing probability given to moves further away from the starting income class. This prior is neutral in the sense that there is equal prior probability assigned to all individuals of attaining any income class in the invariant distribution.

5 Results

We report a Shorrocks measure of overall income mobility, $\mathcal{M}_s(\mathbf{P})$ (see (9)), which is an average, across all income classes, of the probabilities of an individual moving out of their current income class. This measure is a measure of upward and downward mobility combined. We also report our measure of upward mobility, $\mathcal{M}_U$. We report both measures for the full sample and we report $\mathcal{M}_U$ for low, middle and high sub-groups of the income classes.

As mentioned earlier, real incomes for the U.S. and Germany were divided up into ten income classes. The income class definitions are given in Table 4 below. The lowest and highest income classes were designed to contain the bottom five percent and top five percent of the income distribution respectively. The other thresholds divide the intervening distribution into eight income ranges equal in log length. Movement from one category to the next can entail large increases in income. For example, someone at the bottom of an internal income class (classes 2 to 9) would need a increase of 23% to move to the next income class.

For each country a number of different models were estimated. When modelling income mobility there is always uncertainty over the appropriate definition of the transition period. In this paper we first estimate a Markov chain model for a 13 year transition period.[10] For this estimation, we include in our sample only those individuals, age from 25 to 47 in the initial year, which in this case is 1984, who were full time employees in both the initial period and the final period of the transition. One benefit of defining the transition period to be thirteen years is that there is enough time to allow workers to progress in their chosen careers, hence allowing for the greatest chance of a transition out of their initial income class. However, defining such a large transition period comes at a price of reducing the number of individuals that we observe.

In order to check the robustness of the results to the definition of the transition period we also estimate a Markov chain with a five year transition using data from the beginning, middle

[10]This is the maximum time period for which we can define a transition period as our data on both countries only covers the period from 1984 to 1997.

Table 4: Income Class Definitions: 1991 US$

Income Class	Income Range	Sub-Group
1	[0, 10000)	Low
2	[10000, 12375)	Low
3	[12375, 15314)	Low
4	[15314, 18951)	Middle
5	[18951, 23452)	Middle
6	[23452, 29022)	Middle
7	[29022, 35915)	High
8	[35915, 44444)	High
9	[44444, 55000)	High
10	[55000, ∞)	High

and end of the sample. For the five year transitions we only use full-time non-agricultural workers between the ages of 25 and 55 in the initial year of the transition.

Tables A.1 through B.8 in Appendices A and B contain the posterior means and standard deviations for π_0, $\mathbf{P}$, and $\overline{\pi}$ for males and females in both countries and for all transition periods. The estimates can be characterized in the following way: Males in both the US and Germany have an initial income distribution that has more weight in the upper five income classes than the corresponding initial distribution for females. This result is robust to definition of the transition period. Moreover, the estimated transitions matrices are such that the invariant distributions for males, in both the US and Germany, also have more mass in the upper income classes than the corresponding invariant distributions for females.

The mobility measures for both the United States and Germany can be found in Table 5. For the United States we see the following patterns. In terms of overall mobility, males in the United States have a higher income mobility, as evidenced by the result that $p(\mathcal{M}_s(males) > \mathcal{M}_s(females)) = 0.725$.

Males also have a higher upward income mobility in both the full measure and in the sub-class measures. There is no evidence suggesting we should reject the glass ceiling hypothesis in all income classes. This result is stronger than the standard statement of the glass ceiling hypothesis in that we cannot reject the glass ceiling hypothesis in low incomes as well.

Table 5: Mobility Measures for 13 year transition

Mobility Measure	Transition Period	Group	Male	Female	Prob[Male > Female]
United States					
$\mathcal{M}_s$	1984-1997	All	0.949	0.925	0.725
			(0.025)	(0.030)	
$\mathcal{M}_U$	1984-1997	All	0.595	0.512	0.973
			(0.027)	(0.033)	
$\mathcal{M}_{U\|low}$	1984-1997	Low	0.827	0.687	0.977
			(0.047)	(0.054)	
$\mathcal{M}_{U\|middle}$	1984-1997	Middle	0.598	0.593	0.533
			(0.046)	(0.056)	
$\mathcal{M}_{U\|high}$	1984-1997	High	0.361	0.255	0.897
			(0.051)	(0.063)	
Germany					
$\mathcal{M}_s$	1984-1997	All	0.918	0.940	0.250
			(0.019)	(0.028)	
$\mathcal{M}_U$	1984-1997	All	0.655	0.584	0.974
			(0.021)	(0.029)	
$\mathcal{M}_{U\|low}$	1984-1997	Low	0.771	0.812	0.253
			(0.045)	(0.042)	
$\mathcal{M}_{U\|middle}$	1984-1997	Middle	0.722	0.703	0.641
			(0.021)	(0.044)	
$\mathcal{M}_{U\|high}$	1984-1997	High	0.473	0.236	0.998
			(0.038)	(0.064)	

To check the robustness of this result with respect to the transition period we report the results for five year transitions. These can be found in Table C.1. In all but the highest income group in the middle transition, 1988-1993, we see that males have a significantly higher probability of moving to a higher income class than do females. It is only in this middle transition that females have a similar upward mobility index for the highest income group, High. This result disappears in the last 5 year sample period.

Overall, however, we see that males tend to have a uniformly higher probability of moving to a higher income class. There does not appear to be anything special about the highest income group. It would appear that a glass ceiling affects females of all incomes in the United

States and not just those in higher initial income classes.

The results for Germany are much starker. We see that females in the German sample have greater overall income mobility. That is, $p(\mathcal{M}_s(males) > \mathcal{M}_s(females) = 0.25$. However, when we look at our upward mobility measures a different story emerges. First, males in Germany have an higher average probability of moving up to a higher income class, 0.655 for men, 0.584 for women, the posterior probability that $\mathcal{M}_U(male) > \mathcal{M}_U(female))$ being 0.974. When broken down over subclasses, we see that females have higher upward mobility in the lowest income group, Low, whereas males and females have similar upward income mobility in the middle income group, Middle. However, in the highest income group we see males totally dominating females in terms of the probability of moving to a higher income class. This pattern can also be found in the mobility measures for the five year transitions given in Table C.2. Therefore, we find that while females have higher overall mobility than males, men have higher upward mobility. While females have higher upward mobility than men in the lower income classes, females have a significantly lower upward income mobility than males in the highest income classes. These results are consistent with the standard glass ceiling hypothesis. Moreover, this result is robust to when the initial income is measured. The results for the five year transitions we examine have initial years of 1984, 1988 and 1992.

6 Conclusion

In this paper, we modelled the dynamics of the income distribution of a country as a finite state first order Markov chain, using data from Germany and the United States. We estimated this model for each country using Bayesian methods with a neutral prior that was designed to reflect relative uncertainty on behalf of the researcher. Once estimated we then were able to analyze the income mobility properties of the data. In particular, we analyzed the upward income mobility characteristics of the data with respect to males and females.

We are particularly interested in whether or not a glass ceiling exists in Germany and the

United States. The idea of the glass ceiling is that women become trapped; women's upward mobility is limited in comparison to men's. This is especially so at high income levels. The existence of a glass ceiling implies that the upper level of the employment distribution - and by implication the upper end of the labor income distribution - remains less diverse than the entry level. The glass ceiling is often discussed as an economy-wide phenomenon. However, most glass ceiling stories arise among discussions of "career-oriented" women. We defined the concept of the "career-oriented" women, contrasted their movements with similar "career-oriented" men. We studied where women and men are located in the labor income distribution and the change in this position over time. Our study of the labor income mobility of men and women in Germany and the United States employed the Cross National Equivalent File, drawn from the PSID for the United States and the German Socio-Economic Panel.

We found strong evidence in favor of a classic glass ceiling in the case of Germany. Overall, while females in Germany enjoy greater overall income mobility, we find that males have a significantly higher upward income mobility for the higher initial income classes. This result is robust to the definition of the transition period. This result is also robust to the year in which the initial income is measured.

The evidence for the United States is somewhat different than for Germany. We find in almost all cases that women have a significantly lower probability of moving to a higher income class for all income groupings. Unlike in Germany, where females' upward income mobility measures compare favorably with males in the lower income classes and is comparable in the middle income classes, females in the United States are uniformly worse off then their male counterparts. Therefore we cannot reject the glass ceiling hypothesis for all income classes in the United States.

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A Posterior Estimates for U.S. Data

Table A.1: Posterior Estimates: US Males (1984-1997)

Initial Distribution: π_0

0.077	0.037	0.117	0.101	0.128	0.192	0.099	0.146	0.059	0.043
(0.019)	(0.014)	(0.023)	(0.023)	(0.025)	(0.029)	(0.022)	(0.027)	(0.018)	(0.015)

Transition Matrix: **P**

0.169	0.063	0.142	0.139	0.046	0.045	0.129	0.179	0.044	0.045
(0.079)	(0.051)	(0.073)	(0.072)	(0.042)	(0.045)	(0.070)	(0.079)	(0.043)	(0.043)
0.083	0.101	0.085	0.204	0.201	0.068	0.068	0.064	0.064	0.062
(0.070)	(0.075)	(0.066)	(0.099)	(0.100)	(0.063)	(0.064)	(0.061)	(0.059)	(0.060)
0.037	0.076	0.053	0.218	0.344	0.102	0.068	0.033	0.033	0.036
(0.035)	(0.047)	(0.041)	(0.075)	(0.085)	(0.053)	(0.046)	(0.032)	(0.032)	(0.036)
0.042	0.044	0.122	0.172	0.125	0.151	0.153	0.039	0.115	0.037
(0.038)	(0.039)	(0.061)	(0.070)	(0.065)	(0.067)	(0.068)	(0.038)	(0.062)	(0.036)
0.032	0.034	0.035	0.071	0.114	0.323	0.100	0.165	0.095	0.033
(0.030)	(0.032)	(0.032)	(0.045)	(0.057)	(0.083)	(0.053)	(0.066)	(0.051)	(0.032)
0.073	0.024	0.025	0.144	0.123	0.153	0.193	0.097	0.097	0.071
(0.040)	(0.022)	(0.024)	(0.054)	(0.049)	(0.056)	(0.058)	(0.047)	(0.045)	(0.039)
0.037	0.040	0.038	0.041	0.154	0.086	0.170	0.198	0.119	0.117
(0.035)	(0.038)	(0.038)	(0.037)	(0.069)	(0.056)	(0.072)	(0.077)	(0.063)	(0.062)
0.029	0.059	0.030	0.029	0.089	0.092	0.126	0.221	0.149	0.177
(0.028)	(0.041)	(0.030)	(0.026)	(0.050)	(0.049)	(0.055)	(0.070)	(0.059)	(0.064)
0.053	0.051	0.052	0.105	0.050	0.054	0.112	0.070	0.133	0.321
(0.052)	(0.048)	(0.050)	(0.067)	(0.050)	(0.049)	(0.067)	(0.054)	(0.072)	(0.103)
0.061	0.061	0.060	0.062	0.059	0.123	0.066	0.131	0.206	0.173
(0.058)	(0.056)	(0.054)	(0.060)	(0.056)	(0.077)	(0.060)	(0.080)	(0.101)	(0.094)

Invariant Distribution: $\overline{\pi}$

0.055	0.050	0.056	0.103	0.117	0.128	0.125	0.128	0.117	0.121
(0.017)	(0.015)	(0.015)	(0.021)	(0.020)	(0.023)	(0.023)	(0.024)	(0.023)	(0.025)

Sample Size

150

Table A.2: Posterior Estimates: US Females (1984-1997)

Initial Distribution: π_0

0.149	0.109	0.156	0.176	0.119	0.149	0.068	0.028	0.028	0.019
(0.036)	(0.031)	(0.036)	(0.038)	(0.031)	(0.036)	(0.025)	(0.016)	(0.016)	(0.013)

Transition Matrix: **P**

0.266	0.179	0.129	0.088	0.088	0.082	0.044	0.041	0.041	0.042
(0.087)	(0.079)	(0.065)	(0.059)	(0.058)	(0.055)	(0.043)	(0.038)	(0.039)	(0.041)
0.112	0.265	0.163	0.154	0.052	0.053	0.052	0.048	0.051	0.051
(0.070)	(0.095)	(0.080)	(0.078)	(0.049)	(0.050)	(0.048)	(0.047)	(0.049)	(0.049)
0.044	0.083	0.171	0.211	0.205	0.082	0.041	0.042	0.039	0.082
(0.040)	(0.055)	(0.075)	(0.084)	(0.077)	(0.052)	(0.039)	(0.041)	(0.038)	(0.052)
0.074	0.041	0.082	0.120	0.265	0.193	0.077	0.076	0.037	0.036
(0.048)	(0.039)	(0.050)	(0.062)	(0.086)	(0.073)	(0.052)	(0.052)	(0.036)	(0.033)
0.050	0.050	0.097	0.056	0.210	0.245	0.101	0.094	0.049	0.049
(0.048)	(0.046)	(0.063)	(0.051)	(0.089)	(0.092)	(0.067)	(0.064)	(0.045)	(0.045)
0.040	0.042	0.047	0.044	0.135	0.136	0.301	0.128	0.084	0.043
(0.038)	(0.040)	(0.044)	(0.039)	(0.073)	(0.066)	(0.093)	(0.070)	(0.054)	(0.041)
0.062	0.065	0.062	0.064	0.132	0.068	0.147	0.260	0.070	0.070
(0.060)	(0.060)	(0.059)	(0.055)	(0.084)	(0.060)	(0.088)	(0.109)	(0.064)	(0.063)
0.086	0.085	0.087	0.082	0.088	0.095	0.096	0.112	0.095	0.174
(0.079)	(0.079)	(0.079)	(0.077)	(0.083)	(0.082)	(0.082)	(0.087)	(0.077)	(0.103)
0.084	0.084	0.088	0.084	0.088	0.089	0.177	0.096	0.114	0.096
(0.079)	(0.078)	(0.082)	(0.077)	(0.079)	(0.083)	(0.111)	(0.081)	(0.089)	(0.080)
0.096	0.092	0.090	0.091	0.094	0.095	0.096	0.101	0.111	0.135
(0.086)	(0.084)	(0.084)	(0.081)	(0.084)	(0.086)	(0.088)	(0.086)	(0.091)	(0.100)

Invariant Distribution: $\overline{\pi}$

0.086	0.093	0.099	0.096	0.142	0.120	0.117	0.105	0.067	0.075
(0.026)	(0.027)	(0.024)	(0.021)	(0.029)	(0.024)	(0.027)	(0.025)	(0.021)	(0.023)

Sample Size

82

Table A.3: Posterior Estimates: US Males (1984-1989)

Initial Distribution: π_0

0.047	0.044	0.083	0.128	0.120	0.180	0.135	0.116	0.077	0.073
(0.008)	(0.008)	(0.010)	(0.012)	(0.013)	(0.014)	(0.013)	(0.012)	(0.010)	(0.010)

Transition Matrix: **P**

0.219	0.158	0.209	0.152	0.096	0.049	0.023	0.046	0.024	0.024
(0.062)	(0.054)	(0.062)	(0.057)	(0.045)	(0.033)	(0.023)	(0.031)	(0.023)	(0.023)
0.183	0.163	0.081	0.264	0.131	0.051	0.025	0.025	0.051	0.025
(0.061)	(0.056)	(0.043)	(0.067)	(0.050)	(0.034)	(0.025)	(0.026)	(0.034)	(0.024)
0.053	0.076	0.167	0.237	0.200	0.107	0.087	0.029	0.029	0.015
(0.028)	(0.034)	(0.044)	(0.050)	(0.049)	(0.036)	(0.033)	(0.020)	(0.021)	(0.015)
0.072	0.016	0.101	0.221	0.293	0.115	0.112	0.040	0.020	0.010
(0.024)	(0.012)	(0.030)	(0.042)	(0.045)	(0.033)	(0.031)	(0.020)	(0.014)	(0.010)
0.022	0.024	0.047	0.136	0.227	0.288	0.134	0.068	0.011	0.044
(0.015)	(0.016)	(0.021)	(0.036)	(0.043)	(0.047)	(0.036)	(0.026)	(0.011)	(0.022)
0.015	0.015	0.039	0.048	0.139	0.221	0.285	0.142	0.060	0.037
(0.011)	(0.010)	(0.016)	(0.019)	(0.030)	(0.036)	(0.039)	(0.030)	(0.020)	(0.016)
0.010	0.038	0.010	0.041	0.043	0.172	0.298	0.210	0.130	0.050
(0.010)	(0.019)	(0.009)	(0.019)	(0.020)	(0.036)	(0.044)	(0.039)	(0.032)	(0.022)
0.011	0.022	0.011	0.012	0.048	0.083	0.156	0.341	0.178	0.138
(0.011)	(0.016)	(0.010)	(0.011)	(0.022)	(0.029)	(0.038)	(0.052)	(0.041)	(0.035)
0.016	0.016	0.016	0.031	0.033	0.051	0.087	0.226	0.231	0.292
(0.016)	(0.016)	(0.015)	(0.022)	(0.024)	(0.026)	(0.035)	(0.052)	(0.051)	(0.058)
0.016	0.016	0.017	0.017	0.033	0.034	0.023	0.096	0.188	0.561
(0.015)	(0.016)	(0.016)	(0.017)	(0.022)	(0.023)	(0.019)	(0.037)	(0.047)	(0.061)

Invariant Distribution: $\overline{\pi}$

0.033	0.033	0.041	0.073	0.100	0.121	0.143	0.159	0.121	0.176
(0.008)	(0.008)	(0.008)	(0.012)	(0.013)	(0.014)	(0.016)	(0.019)	(0.016)	(0.030)

Sample Size

641

Table A.4: Posterior Estimates: US Females (1984-1989)

Initial Distribution: π_0

0.107	0.121	0.137	0.222	0.127	0.144	0.069	0.030	0.025	0.018
(0.015)	(0.016)	(0.017)	(0.021)	(0.016)	(0.017)	(0.012)	(0.008)	(0.008)	(0.007)

Transition Matrix: **P**

0.439	0.165	0.119	0.096	0.038	0.038	0.018	0.035	0.018	0.036
(0.065)	(0.048)	(0.040)	(0.041)	(0.027)	(0.026)	(0.018)	(0.024)	(0.017)	(0.025)
0.144	0.239	0.308	0.121	0.070	0.051	0.017	0.017	0.017	0.016
(0.044)	(0.053)	(0.058)	(0.041)	(0.033)	(0.030)	(0.015)	(0.016)	(0.016)	(0.016)
0.050	0.083	0.258	0.320	0.109	0.046	0.045	0.030	0.016	0.045
(0.026)	(0.033)	(0.054)	(0.057)	(0.037)	(0.024)	(0.024)	(0.020)	(0.016)	(0.026)
0.068	0.041	0.150	0.262	0.255	0.079	0.087	0.030	0.010	0.019
(0.024)	(0.018)	(0.035)	(0.042)	(0.043)	(0.027)	(0.028)	(0.017)	(0.010)	(0.013)
0.079	0.035	0.036	0.121	0.178	0.292	0.175	0.035	0.031	0.017
(0.035)	(0.024)	(0.024)	(0.039)	(0.048)	(0.055)	(0.047)	(0.024)	(0.022)	(0.015)
0.014	0.015	0.045	0.047	0.051	0.459	0.205	0.117	0.032	0.015
(0.013)	(0.014)	(0.024)	(0.024)	(0.027)	(0.058)	(0.047)	(0.038)	(0.022)	(0.016)
0.025	0.025	0.052	0.030	0.060	0.123	0.420	0.098	0.137	0.030
(0.025)	(0.025)	(0.034)	(0.026)	(0.038)	(0.050)	(0.077)	(0.045)	(0.053)	(0.027)
0.045	0.048	0.048	0.048	0.056	0.061	0.303	0.204	0.125	0.061
(0.042)	(0.045)	(0.046)	(0.047)	(0.049)	(0.052)	(0.097)	(0.084)	(0.067)	(0.052)
0.051	0.052	0.050	0.049	0.052	0.062	0.118	0.141	0.229	0.196
(0.048)	(0.051)	(0.048)	(0.047)	(0.049)	(0.056)	(0.070)	(0.077)	(0.091)	(0.087)
0.059	0.059	0.061	0.060	0.060	0.065	0.075	0.153	0.118	0.291
(0.056)	(0.055)	(0.057)	(0.056)	(0.058)	(0.057)	(0.063)	(0.087)	(0.072)	(0.106)

Invariant Distribution: $\overline{\pi}$

0.084	0.063	0.103	0.112	0.094	0.153	0.179	0.085	0.071	0.056
(0.020)	(0.014)	(0.017)	(0.017)	(0.015)	(0.026)	(0.030)	(0.019)	(0.018)	(0.017)

Sample Size

382

Table A.5: Posterior Estimates: US Males (1988-1993)

Initial Distribution: π_0

0.048	0.034	0.087	0.105	0.152	0.154	0.138	0.124	0.079	0.079
(0.007)	(0.006)	(0.009)	(0.010)	(0.012)	(0.013)	(0.011)	(0.012)	(0.009)	(0.010)

Transition Matrix: **P**

0.417	0.138	0.117	0.108	0.081	0.041	0.039	0.019	0.019	0.020
(0.070)	(0.046)	(0.044)	(0.043)	(0.036)	(0.027)	(0.027)	(0.018)	(0.020)	(0.019)
0.143	0.136	0.222	0.176	0.115	0.079	0.025	0.051	0.027	0.026
(0.054)	(0.054)	(0.063)	(0.061)	(0.050)	(0.042)	(0.025)	(0.034)	(0.025)	(0.026)
0.138	0.112	0.189	0.228	0.186	0.040	0.061	0.024	0.012	0.012
(0.037)	(0.035)	(0.043)	(0.046)	(0.040)	(0.021)	(0.027)	(0.016)	(0.012)	(0.012)
0.063	0.047	0.153	0.229	0.240	0.116	0.093	0.021	0.029	0.010
(0.024)	(0.021)	(0.035)	(0.043)	(0.042)	(0.032)	(0.030)	(0.014)	(0.016)	(0.010)
0.014	0.038	0.033	0.171	0.274	0.265	0.139	0.031	0.022	0.014
(0.009)	(0.016)	(0.015)	(0.032)	(0.037)	(0.036)	(0.030)	(0.015)	(0.012)	(0.010)
0.007	0.028	0.030	0.074	0.108	0.303	0.259	0.117	0.052	0.021
(0.007)	(0.014)	(0.014)	(0.022)	(0.026)	(0.039)	(0.036)	(0.028)	(0.019)	(0.012)
0.031	0.016	0.023	0.026	0.085	0.111	0.352	0.265	0.074	0.018
(0.015)	(0.011)	(0.014)	(0.014)	(0.024)	(0.028)	(0.042)	(0.039)	(0.023)	(0.012)
0.009	0.025	0.009	0.018	0.012	0.032	0.209	0.382	0.231	0.075
(0.009)	(0.014)	(0.008)	(0.012)	(0.011)	(0.016)	(0.038)	(0.045)	(0.039)	(0.024)
0.013	0.013	0.012	0.013	0.014	0.031	0.099	0.237	0.358	0.211
(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.019)	(0.034)	(0.048)	(0.053)	(0.047)
0.026	0.013	0.014	0.026	0.013	0.040	0.097	0.078	0.197	0.497
(0.018)	(0.013)	(0.013)	(0.018)	(0.013)	(0.021)	(0.034)	(0.031)	(0.045)	(0.055)

Invariant Distribution: $\overline{\pi}$

0.053	0.038	0.051	0.077	0.094	0.106	0.174	0.172	0.133	0.102
(0.012)	(0.007)	(0.009)	(0.011)	(0.013)	(0.013)	(0.017)	(0.019)	(0.018)	(0.019)

Sample Size

787

Table A.6: Posterior Estimates: US Females (1988-1993)

Initial Distribution: π_0

0.106	0.096	0.159	0.141	0.177	0.141	0.087	0.046	0.028	0.020
(0.013)	(0.013)	(0.016)	(0.013)	(0.016)	(0.015)	(0.012)	(0.009)	(0.007)	(0.006)

Transition Matrix: **P**

0.418	0.205	0.096	0.136	0.072	0.015	0.014	0.015	0.015	0.014
(0.059)	(0.049)	(0.036)	(0.040)	(0.031)	(0.015)	(0.014)	(0.015)	(0.014)	(0.014)
0.237	0.160	0.225	0.167	0.083	0.017	0.048	0.033	0.016	0.015
(0.053)	(0.045)	(0.052)	(0.046)	(0.034)	(0.016)	(0.026)	(0.023)	(0.016)	(0.015)
0.076	0.100	0.241	0.251	0.157	0.114	0.031	0.011	0.010	0.009
(0.026)	(0.030)	(0.043)	(0.042)	(0.036)	(0.030)	(0.017)	(0.011)	(0.010)	(0.009)
0.082	0.061	0.167	0.266	0.248	0.071	0.071	0.012	0.012	0.011
(0.029)	(0.025)	(0.039)	(0.047)	(0.046)	(0.028)	(0.028)	(0.012)	(0.012)	(0.011)
0.009	0.030	0.032	0.156	0.362	0.238	0.134	0.021	0.010	0.010
(0.009)	(0.016)	(0.017)	(0.033)	(0.045)	(0.040)	(0.033)	(0.014)	(0.009)	(0.009)
0.035	0.011	0.025	0.028	0.143	0.335	0.292	0.084	0.036	0.011
(0.019)	(0.011)	(0.017)	(0.017)	(0.037)	(0.049)	(0.047)	(0.029)	(0.019)	(0.011)
0.016	0.018	0.018	0.021	0.076	0.101	0.396	0.254	0.078	0.022
(0.016)	(0.017)	(0.019)	(0.018)	(0.035)	(0.040)	(0.063)	(0.055)	(0.034)	(0.019)
0.029	0.029	0.028	0.030	0.034	0.100	0.145	0.311	0.198	0.096
(0.028)	(0.028)	(0.028)	(0.031)	(0.030)	(0.049)	(0.060)	(0.077)	(0.067)	(0.049)
0.041	0.041	0.041	0.041	0.042	0.051	0.062	0.161	0.277	0.245
(0.041)	(0.040)	(0.039)	(0.040)	(0.038)	(0.043)	(0.048)	(0.074)	(0.090)	(0.086)
0.052	0.048	0.049	0.053	0.050	0.104	0.116	0.131	0.115	0.281
(0.051)	(0.047)	(0.045)	(0.050)	(0.048)	(0.066)	(0.067)	(0.072)	(0.066)	(0.098)

Invariant Distribution: $\overline{\pi}$

0.079	0.056	0.076	0.105	0.140	0.134	0.165	0.117	0.073	0.055
(0.016)	(0.011)	(0.013)	(0.015)	(0.019)	(0.019)	(0.024)	(0.022)	(0.018)	(0.016)

Sample Size

506

Table A.7: Posterior Estimates: US Males (1992-1997)

Initial Distribution: π_0

0.056	0.065	0.068	0.126	0.169	0.145	0.147	0.118	0.055	0.052
(0.013)	(0.013)	(0.014)	(0.018)	(0.020)	(0.019)	(0.019)	(0.018)	(0.013)	(0.012)

Transition Matrix: **P**

0.237	0.171	0.118	0.151	0.072	0.070	0.035	0.073	0.037	0.036
(0.081)	(0.068)	(0.058)	(0.067)	(0.047)	(0.048)	(0.033)	(0.048)	(0.035)	(0.034)
0.053	0.107	0.215	0.236	0.165	0.033	0.065	0.031	0.063	0.033
(0.041)	(0.054)	(0.074)	(0.073)	(0.065)	(0.030)	(0.042)	(0.031)	(0.041)	(0.031)
0.105	0.081	0.190	0.203	0.071	0.128	0.067	0.063	0.031	0.062
(0.055)	(0.049)	(0.065)	(0.073)	(0.046)	(0.057)	(0.044)	(0.042)	(0.031)	(0.042)
0.042	0.081	0.087	0.193	0.244	0.080	0.100	0.097	0.038	0.038
(0.028)	(0.038)	(0.039)	(0.055)	(0.060)	(0.037)	(0.042)	(0.041)	(0.025)	(0.027)
0.030	0.017	0.079	0.112	0.271	0.291	0.153	0.017	0.015	0.016
(0.020)	(0.015)	(0.031)	(0.037)	(0.053)	(0.053)	(0.042)	(0.016)	(0.015)	(0.015)
0.036	0.018	0.019	0.109	0.198	0.194	0.248	0.090	0.035	0.053
(0.024)	(0.017)	(0.017)	(0.042)	(0.052)	(0.052)	(0.057)	(0.038)	(0.024)	(0.030)
0.017	0.035	0.051	0.036	0.087	0.146	0.257	0.231	0.105	0.035
(0.017)	(0.024)	(0.028)	(0.023)	(0.036)	(0.045)	(0.057)	(0.055)	(0.039)	(0.023)
0.021	0.019	0.020	0.062	0.043	0.110	0.154	0.268	0.195	0.108
(0.021)	(0.019)	(0.020)	(0.035)	(0.027)	(0.046)	(0.050)	(0.065)	(0.056)	(0.042)
0.036	0.036	0.036	0.038	0.037	0.075	0.116	0.130	0.186	0.309
(0.035)	(0.035)	(0.034)	(0.035)	(0.037)	(0.048)	(0.063)	(0.061)	(0.073)	(0.087)
0.037	0.040	0.037	0.037	0.074	0.038	0.082	0.087	0.102	0.465
(0.036)	(0.039)	(0.035)	(0.035)	(0.051)	(0.034)	(0.054)	(0.056)	(0.057)	(0.095)

Invariant Distribution: $\overline{\pi}$

0.046	0.046	0.067	0.100	0.132	0.131	0.148	0.121	0.085	0.123
(0.012)	(0.011)	(0.014)	(0.016)	(0.020)	(0.019)	(0.021)	(0.021)	(0.017)	(0.029)

Sample Size

301

Table A.8: Posterior Estimates: US Females (1992-1997)

Initial Distribution: π_0

0.152	0.109	0.150	0.170	0.146	0.100	0.089	0.051	0.017	0.017
(0.022)	(0.019)	(0.022)	(0.023)	(0.023)	(0.018)	(0.018)	(0.014)	(0.008)	(0.008)

Transition Matrix: **P**

0.349	0.155	0.189	0.124	0.063	0.039	0.021	0.019	0.021	0.021
(0.069)	(0.050)	(0.054)	(0.047)	(0.035)	(0.027)	(0.020)	(0.018)	(0.021)	(0.021)
0.094	0.214	0.329	0.114	0.082	0.055	0.028	0.028	0.028	0.028
(0.048)	(0.066)	(0.076)	(0.050)	(0.044)	(0.036)	(0.027)	(0.025)	(0.027)	(0.028)
0.067	0.155	0.183	0.343	0.086	0.063	0.043	0.020	0.020	0.021
(0.035)	(0.051)	(0.056)	(0.069)	(0.040)	(0.034)	(0.030)	(0.020)	(0.020)	(0.020)
0.020	0.061	0.065	0.314	0.271	0.135	0.059	0.018	0.020	0.038
(0.019)	(0.032)	(0.033)	(0.063)	(0.062)	(0.044)	(0.030)	(0.017)	(0.020)	(0.026)
0.065	0.023	0.067	0.028	0.359	0.217	0.154	0.045	0.021	0.022
(0.035)	(0.021)	(0.035)	(0.023)	(0.068)	(0.061)	(0.051)	(0.029)	(0.020)	(0.022)
0.029	0.029	0.033	0.062	0.182	0.279	0.234	0.063	0.060	0.029
(0.029)	(0.027)	(0.029)	(0.039)	(0.065)	(0.073)	(0.072)	(0.040)	(0.041)	(0.029)
0.062	0.030	0.033	0.033	0.037	0.139	0.305	0.261	0.066	0.034
(0.043)	(0.032)	(0.031)	(0.029)	(0.033)	(0.060)	(0.082)	(0.077)	(0.042)	(0.030)
0.045	0.045	0.044	0.045	0.049	0.193	0.106	0.216	0.157	0.099
(0.043)	(0.045)	(0.041)	(0.042)	(0.045)	(0.081)	(0.066)	(0.086)	(0.076)	(0.063)
0.078	0.076	0.074	0.076	0.077	0.085	0.171	0.107	0.149	0.109
(0.071)	(0.069)	(0.069)	(0.072)	(0.070)	(0.074)	(0.103)	(0.079)	(0.093)	(0.083)
0.076	0.076	0.075	0.076	0.079	0.078	0.084	0.097	0.121	0.239
(0.071)	(0.073)	(0.067)	(0.071)	(0.072)	(0.070)	(0.072)	(0.079)	(0.085)	(0.109)

Invariant Distribution: $\overline{\pi}$

0.078	0.074	0.095	0.118	0.150	0.148	0.139	0.091	0.058	0.050
(0.020)	(0.017)	(0.017)	(0.021)	(0.026)	(0.025)	(0.028)	(0.021)	(0.016)	(0.016)

Sample Size

229

B Posterior Estimates for German Data

Table B.1: Posterior Estimates: GERMAN Males (1984-1997)

Initial Distribution: π_0

0.023	0.022	0.070	0.201	0.233	0.197	0.130	0.055	0.031	0.038
(0.006)	(0.006)	(0.009)	(0.015)	(0.016)	(0.015)	(0.012)	(0.009)	(0.007)	(0.007)

Transition Matrix : **P**

0.172	0.106	0.072	0.136	0.080	0.161	0.077	0.078	0.040	0.079
(0.075)	(0.059)	(0.052)	(0.068)	(0.052)	(0.071)	(0.050)	(0.051)	(0.039)	(0.049)
0.176	0.150	0.094	0.110	0.139	0.087	0.042	0.121	0.042	0.040
(0.077)	(0.072)	(0.060)	(0.062)	(0.071)	(0.056)	(0.040)	(0.063)	(0.040)	(0.040)
0.061	0.053	0.073	0.207	0.260	0.141	0.103	0.051	0.033	0.018
(0.031)	(0.029)	(0.033)	(0.052)	(0.057)	(0.044)	(0.040)	(0.029)	(0.023)	(0.017)
0.021	0.023	0.027	0.137	0.271	0.323	0.140	0.039	0.013	0.007
(0.011)	(0.011)	(0.013)	(0.027)	(0.035)	(0.039)	(0.028)	(0.016)	(0.010)	(0.007)
0.012	0.013	0.020	0.080	0.174	0.372	0.225	0.047	0.045	0.011
(0.008)	(0.009)	(0.010)	(0.020)	(0.029)	(0.036)	(0.030)	(0.016)	(0.016)	(0.008)
0.014	0.013	0.015	0.023	0.082	0.180	0.367	0.211	0.068	0.028
(0.010)	(0.010)	(0.010)	(0.012)	(0.022)	(0.031)	(0.039)	(0.033)	(0.020)	(0.013)
0.010	0.010	0.031	0.013	0.034	0.089	0.130	0.342	0.203	0.138
(0.010)	(0.010)	(0.017)	(0.011)	(0.018)	(0.027)	(0.034)	(0.047)	(0.040)	(0.035)
0.020	0.043	0.021	0.023	0.070	0.076	0.106	0.173	0.229	0.240
(0.020)	(0.029)	(0.019)	(0.023)	(0.038)	(0.037)	(0.041)	(0.054)	(0.061)	(0.058)
0.032	0.032	0.062	0.034	0.034	0.042	0.117	0.171	0.212	0.265
(0.030)	(0.031)	(0.040)	(0.032)	(0.030)	(0.034)	(0.057)	(0.066)	(0.070)	(0.077)
0.029	0.055	0.028	0.026	0.113	0.059	0.147	0.078	0.127	0.340
(0.027)	(0.037)	(0.027)	(0.026)	(0.050)	(0.038)	(0.058)	(0.044)	(0.054)	(0.077)

Invariant Distribution: $\overline{\pi}$

0.032	0.037	0.035	0.047	0.096	0.129	0.161	0.162	0.138	0.164
(0.010)	(0.011)	(0.009)	(0.010)	(0.014)	(0.015)	(0.016)	(0.019)	(0.021)	(0.027)

Sample Size

643

Table B.2: Posterior Estimates: GERMAN Females (1984-1997)

Initial Distribution: π_0

0.093	0.087	0.197	0.202	0.206	0.124	0.028	0.021	0.022	0.022
(0.023)	(0.022)	(0.032)	(0.033)	(0.031)	(0.027)	(0.013)	(0.012)	(0.012)	(0.012)

Transition Matrix : **P**

0.198	0.146	0.224	0.133	0.043	0.040	0.045	0.087	0.043	0.041
(0.081)	(0.073)	(0.084)	(0.071)	(0.041)	(0.040)	(0.042)	(0.058)	(0.043)	(0.040)
0.102	0.069	0.188	0.323	0.048	0.089	0.046	0.046	0.045	0.043
(0.061)	(0.053)	(0.082)	(0.095)	(0.044)	(0.059)	(0.042)	(0.045)	(0.043)	(0.042)
0.028	0.032	0.135	0.266	0.283	0.103	0.051	0.050	0.025	0.026
(0.027)	(0.028)	(0.053)	(0.070)	(0.070)	(0.047)	(0.036)	(0.034)	(0.023)	(0.025)
0.026	0.028	0.032	0.136	0.354	0.223	0.099	0.051	0.025	0.025
(0.025)	(0.026)	(0.027)	(0.052)	(0.075)	(0.065)	(0.047)	(0.036)	(0.026)	(0.024)
0.049	0.025	0.027	0.030	0.156	0.248	0.320	0.075	0.023	0.049
(0.035)	(0.023)	(0.026)	(0.026)	(0.056)	(0.069)	(0.070)	(0.041)	(0.022)	(0.033)
0.034	0.036	0.037	0.039	0.043	0.194	0.395	0.110	0.073	0.038
(0.032)	(0.034)	(0.035)	(0.036)	(0.037)	(0.071)	(0.088)	(0.058)	(0.048)	(0.037)
0.073	0.070	0.081	0.075	0.085	0.096	0.188	0.168	0.083	0.081
(0.070)	(0.065)	(0.073)	(0.067)	(0.075)	(0.081)	(0.104)	(0.098)	(0.070)	(0.072)
0.081	0.082	0.077	0.083	0.090	0.093	0.107	0.199	0.100	0.089
(0.073)	(0.075)	(0.073)	(0.075)	(0.077)	(0.078)	(0.082)	(0.110)	(0.080)	(0.078)
0.082	0.080	0.079	0.079	0.085	0.089	0.093	0.103	0.122	0.188
(0.076)	(0.076)	(0.073)	(0.074)	(0.074)	(0.080)	(0.085)	(0.088)	(0.090)	(0.106)
0.082	0.081	0.079	0.080	0.082	0.080	0.085	0.177	0.108	0.146
(0.076)	(0.073)	(0.071)	(0.074)	(0.074)	(0.076)	(0.074)	(0.105)	(0.085)	(0.101)

Invariant Distribution: $\overline{\pi}$

0.068	0.059	0.082	0.106	0.128	0.137	0.174	0.114	0.064	0.068
(0.022)	(0.018)	(0.020)	(0.021)	(0.024)	(0.027)	(0.031)	(0.029)	(0.021)	(0.023)

Sample Size

132

Table B.3: Posterior Estimates: GERMAN Males (1984-1989)

Initial Distribution: π_0

0.019	0.023	0.073	0.207	0.240	0.191	0.127	0.051	0.032	0.037
(0.004)	(0.004)	(0.007)	(0.011)	(0.012)	(0.011)	(0.009)	(0.006)	(0.005)	(0.005)

Transition Matrix : **P**

0.267	0.148	0.104	0.080	0.090	0.142	0.029	0.084	0.028	0.028
(0.070)	(0.060)	(0.051)	(0.047)	(0.048)	(0.056)	(0.027)	(0.046)	(0.028)	(0.027)
0.108	0.203	0.107	0.248	0.113	0.051	0.098	0.024	0.024	0.024
(0.046)	(0.059)	(0.048)	(0.065)	(0.047)	(0.036)	(0.045)	(0.023)	(0.023)	(0.024)
0.029	0.031	0.170	0.356	0.256	0.104	0.028	0.010	0.009	0.009
(0.015)	(0.017)	(0.035)	(0.044)	(0.043)	(0.028)	(0.015)	(0.010)	(0.009)	(0.008)
0.005	0.014	0.035	0.283	0.443	0.139	0.053	0.017	0.007	0.004
(0.004)	(0.007)	(0.011)	(0.025)	(0.029)	(0.021)	(0.014)	(0.008)	(0.005)	(0.003)
0.009	0.028	0.018	0.062	0.387	0.361	0.091	0.028	0.012	0.006
(0.005)	(0.009)	(0.007)	(0.013)	(0.027)	(0.026)	(0.016)	(0.009)	(0.006)	(0.004)
0.007	0.008	0.013	0.040	0.117	0.344	0.340	0.102	0.021	0.008
(0.005)	(0.005)	(0.007)	(0.012)	(0.020)	(0.027)	(0.028)	(0.019)	(0.009)	(0.005)
0.011	0.017	0.011	0.025	0.027	0.087	0.296	0.341	0.130	0.057
(0.008)	(0.009)	(0.008)	(0.011)	(0.011)	(0.020)	(0.034)	(0.034)	(0.024)	(0.017)
0.026	0.024	0.013	0.027	0.033	0.066	0.130	0.309	0.243	0.129
(0.017)	(0.017)	(0.013)	(0.018)	(0.021)	(0.027)	(0.037)	(0.050)	(0.045)	(0.037)
0.018	0.018	0.019	0.020	0.021	0.049	0.062	0.142	0.360	0.292
(0.017)	(0.017)	(0.019)	(0.019)	(0.020)	(0.028)	(0.032)	(0.047)	(0.067)	(0.062)
0.017	0.017	0.034	0.065	0.018	0.068	0.065	0.061	0.203	0.455
(0.016)	(0.016)	(0.024)	(0.030)	(0.016)	(0.031)	(0.032)	(0.031)	(0.053)	(0.064)

Invariant Distribution: $\overline{\pi}$

0.022	0.026	0.027	0.071	0.123	0.153	0.153	0.150	0.141	0.134
(0.007)	(0.007)	(0.006)	(0.010)	(0.013)	(0.014)	(0.015)	(0.016)	(0.021)	(0.024)

Sample Size

1255

Table B.4: Posterior Estimates: GERMAN Females (1984-1989)

Initial Distribution: π_0

0.097	0.076	0.183	0.231	0.187	0.121	0.042	0.024	0.021	0.018
(0.016)	(0.015)	(0.021)	(0.023)	(0.021)	(0.018)	(0.011)	(0.009)	(0.008)	(0.007)

Transition Matrix : **P**

0.257	0.166	0.207	0.174	0.074	0.025	0.024	0.025	0.024	0.025
(0.068)	(0.060)	(0.063)	(0.059)	(0.041)	(0.025)	(0.023)	(0.024)	(0.023)	(0.023)
0.104	0.180	0.286	0.187	0.094	0.032	0.029	0.030	0.028	0.031
(0.051)	(0.067)	(0.078)	(0.063)	(0.049)	(0.030)	(0.028)	(0.029)	(0.027)	(0.030)
0.048	0.050	0.192	0.399	0.162	0.089	0.015	0.015	0.014	0.015
(0.024)	(0.026)	(0.045)	(0.059)	(0.044)	(0.034)	(0.015)	(0.015)	(0.014)	(0.014)
0.014	0.015	0.042	0.282	0.499	0.098	0.014	0.013	0.012	0.012
(0.013)	(0.013)	(0.021)	(0.050)	(0.054)	(0.032)	(0.012)	(0.012)	(0.012)	(0.011)
0.029	0.045	0.031	0.050	0.254	0.456	0.061	0.030	0.015	0.029
(0.020)	(0.026)	(0.021)	(0.026)	(0.051)	(0.059)	(0.028)	(0.020)	(0.016)	(0.019)
0.022	0.022	0.024	0.025	0.113	0.290	0.415	0.047	0.023	0.020
(0.022)	(0.022)	(0.022)	(0.022)	(0.045)	(0.066)	(0.072)	(0.031)	(0.021)	(0.019)
0.091	0.048	0.046	0.136	0.052	0.065	0.130	0.201	0.138	0.093
(0.061)	(0.043)	(0.043)	(0.068)	(0.045)	(0.050)	(0.069)	(0.079)	(0.072)	(0.062)
0.061	0.059	0.056	0.060	0.068	0.076	0.091	0.302	0.151	0.077
(0.055)	(0.056)	(0.052)	(0.055)	(0.062)	(0.062)	(0.065)	(0.106)	(0.088)	(0.063)
0.062	0.065	0.060	0.061	0.067	0.071	0.083	0.167	0.269	0.095
(0.057)	(0.061)	(0.055)	(0.058)	(0.061)	(0.065)	(0.067)	(0.092)	(0.105)	(0.068)
0.066	0.067	0.067	0.068	0.134	0.068	0.081	0.094	0.121	0.234
(0.065)	(0.062)	(0.063)	(0.062)	(0.086)	(0.064)	(0.070)	(0.074)	(0.081)	(0.110)

Invariant Distribution: $\overline{\pi}$

0.059	0.056	0.075	0.130	0.174	0.176	0.123	0.088	0.068	0.052
(0.016)	(0.014)	(0.015)	(0.019)	(0.021)	(0.023)	(0.018)	(0.024)	(0.020)	(0.018)

Sample Size

290

Table B.5: Posterior Estimates: GERMAN Males (1988-1993)

Initial Distribution: π_0

0.018	0.024	0.044	0.167	0.252	0.202	0.132	0.080	0.042	0.038
(0.004)	(0.004)	(0.006)	(0.010)	(0.012)	(0.011)	(0.009)	(0.007)	(0.006)	(0.005)

Transition Matrix : P

0.250	0.154	0.169	0.118	0.124	0.033	0.061	0.033	0.030	0.029
(0.075)	(0.061)	(0.065)	(0.055)	(0.057)	(0.032)	(0.040)	(0.032)	(0.027)	(0.028)
0.084	0.214	0.156	0.125	0.225	0.074	0.050	0.024	0.023	0.023
(0.043)	(0.061)	(0.056)	(0.050)	(0.061)	(0.041)	(0.033)	(0.024)	(0.022)	(0.023)
0.030	0.048	0.170	0.307	0.232	0.096	0.075	0.014	0.014	0.014
(0.020)	(0.025)	(0.045)	(0.054)	(0.051)	(0.036)	(0.032)	(0.013)	(0.014)	(0.015)
0.007	0.018	0.038	0.299	0.443	0.143	0.036	0.005	0.009	0.004
(0.006)	(0.009)	(0.013)	(0.030)	(0.031)	(0.022)	(0.012)	(0.004)	(0.006)	(0.004)
0.003	0.007	0.009	0.074	0.380	0.380	0.102	0.033	0.006	0.006
(0.003)	(0.004)	(0.005)	(0.014)	(0.025)	(0.026)	(0.015)	(0.010)	(0.004)	(0.004)
0.007	0.004	0.009	0.025	0.122	0.415	0.297	0.091	0.019	0.011
(0.005)	(0.004)	(0.006)	(0.009)	(0.019)	(0.030)	(0.027)	(0.017)	(0.008)	(0.006)
0.005	0.006	0.006	0.019	0.032	0.074	0.490	0.270	0.069	0.030
(0.006)	(0.005)	(0.005)	(0.010)	(0.012)	(0.019)	(0.035)	(0.032)	(0.018)	(0.012)
0.008	0.008	0.009	0.019	0.022	0.035	0.136	0.485	0.169	0.110
(0.009)	(0.008)	(0.008)	(0.012)	(0.013)	(0.016)	(0.031)	(0.047)	(0.034)	(0.029)
0.015	0.016	0.016	0.015	0.018	0.041	0.064	0.143	0.347	0.325
(0.014)	(0.016)	(0.016)	(0.014)	(0.017)	(0.025)	(0.030)	(0.042)	(0.057)	(0.055)
0.016	0.016	0.016	0.017	0.018	0.018	0.097	0.059	0.070	0.674
(0.015)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.037)	(0.029)	(0.031)	(0.061)

Invariant Distribution: $\overline{\pi}$

0.014	0.016	0.019	0.045	0.098	0.130	0.202	0.187	0.097	0.192
(0.005)	(0.005)	(0.005)	(0.009)	(0.013)	(0.016)	(0.021)	(0.021)	(0.016)	(0.039)

Sample Size

1239

Table B.6: Posterior Estimates: GERMAN Females (1988-1993)

Initial Distribution: π_0

0.068	0.086	0.153	0.207	0.226	0.151	0.054	0.023	0.011	0.020
(0.014)	(0.015)	(0.019)	(0.022)	(0.022)	(0.019)	(0.012)	(0.008)	(0.006)	(0.007)

Transition Matrix : **P**

0.408	0.146	0.074	0.096	0.062	0.062	0.030	0.031	0.061	0.032
(0.085)	(0.060)	(0.046)	(0.048)	(0.041)	(0.040)	(0.031)	(0.030)	(0.042)	(0.032)
0.120	0.186	0.348	0.139	0.055	0.051	0.025	0.024	0.026	0.027
(0.051)	(0.063)	(0.075)	(0.055)	(0.036)	(0.034)	(0.023)	(0.024)	(0.025)	(0.026)
0.068	0.089	0.304	0.229	0.194	0.035	0.032	0.016	0.016	0.017
(0.031)	(0.035)	(0.058)	(0.052)	(0.048)	(0.023)	(0.023)	(0.016)	(0.016)	(0.016)
0.050	0.041	0.092	0.271	0.372	0.089	0.050	0.012	0.013	0.012
(0.026)	(0.022)	(0.032)	(0.047)	(0.052)	(0.033)	(0.024)	(0.011)	(0.013)	(0.012)
0.012	0.013	0.037	0.129	0.360	0.310	0.094	0.024	0.012	0.012
(0.012)	(0.012)	(0.020)	(0.034)	(0.050)	(0.047)	(0.031)	(0.016)	(0.011)	(0.011)
0.016	0.016	0.019	0.021	0.104	0.403	0.333	0.036	0.035	0.017
(0.015)	(0.016)	(0.018)	(0.020)	(0.039)	(0.062)	(0.058)	(0.024)	(0.024)	(0.017)
0.036	0.037	0.036	0.076	0.045	0.160	0.288	0.165	0.082	0.078
(0.034)	(0.035)	(0.034)	(0.048)	(0.038)	(0.066)	(0.082)	(0.069)	(0.052)	(0.050)
0.057	0.060	0.060	0.061	0.066	0.133	0.090	0.185	0.154	0.135
(0.053)	(0.056)	(0.058)	(0.056)	(0.055)	(0.081)	(0.066)	(0.092)	(0.083)	(0.081)
0.076	0.073	0.076	0.080	0.081	0.092	0.100	0.128	0.176	0.119
(0.070)	(0.067)	(0.072)	(0.074)	(0.073)	(0.079)	(0.081)	(0.088)	(0.103)	(0.087)
0.062	0.062	0.125	0.060	0.063	0.064	0.075	0.087	0.114	0.288
(0.060)	(0.059)	(0.081)	(0.055)	(0.062)	(0.059)	(0.061)	(0.070)	(0.076)	(0.107)

Invariant Distribution: $\overline{\pi}$

0.067	0.054	0.092	0.113	0.164	0.188	0.148	0.065	0.055	0.055
(0.019)	(0.014)	(0.019)	(0.019)	(0.023)	(0.029)	(0.025)	(0.018)	(0.016)	(0.019)

Sample Size

312

Table B.7: Posterior Estimates: GERMAN Males (1992-1997)

Initial Distribution: π_0

0.014	0.015	0.028	0.111	0.219	0.219	0.187	0.111	0.046	0.051
(0.003)	(0.004)	(0.005)	(0.009)	(0.012)	(0.012)	(0.011)	(0.009)	(0.006)	(0.006)

Transition Matrix : **P**

0.407	0.150	0.094	0.068	0.043	0.079	0.041	0.038	0.040	0.040
(0.095)	(0.072)	(0.056)	(0.050)	(0.039)	(0.050)	(0.039)	(0.036)	(0.039)	(0.038)
0.158	0.202	0.121	0.119	0.136	0.118	0.038	0.037	0.036	0.036
(0.069)	(0.074)	(0.062)	(0.063)	(0.064)	(0.062)	(0.037)	(0.036)	(0.035)	(0.035)
0.050	0.117	0.195	0.239	0.168	0.109	0.049	0.025	0.025	0.024
(0.035)	(0.047)	(0.061)	(0.065)	(0.054)	(0.047)	(0.033)	(0.023)	(0.025)	(0.024)
0.032	0.020	0.064	0.270	0.418	0.135	0.038	0.008	0.008	0.007
(0.014)	(0.011)	(0.022)	(0.036)	(0.041)	(0.028)	(0.016)	(0.007)	(0.007)	(0.007)
0.011	0.016	0.019	0.128	0.372	0.325	0.090	0.020	0.008	0.011
(0.007)	(0.008)	(0.008)	(0.019)	(0.029)	(0.028)	(0.017)	(0.008)	(0.005)	(0.007)
0.008	0.022	0.009	0.036	0.108	0.461	0.276	0.055	0.021	0.004
(0.005)	(0.009)	(0.006)	(0.011)	(0.018)	(0.030)	(0.027)	(0.013)	(0.009)	(0.004)
0.009	0.009	0.009	0.019	0.048	0.175	0.416	0.219	0.065	0.032
(0.006)	(0.007)	(0.007)	(0.009)	(0.014)	(0.025)	(0.032)	(0.026)	(0.016)	(0.012)
0.008	0.007	0.015	0.008	0.018	0.043	0.191	0.428	0.220	0.064
(0.007)	(0.007)	(0.010)	(0.008)	(0.011)	(0.017)	(0.033)	(0.042)	(0.034)	(0.020)
0.016	0.031	0.015	0.046	0.018	0.024	0.032	0.204	0.352	0.264
(0.016)	(0.020)	(0.014)	(0.027)	(0.016)	(0.019)	(0.021)	(0.050)	(0.058)	(0.054)
0.015	0.014	0.029	0.015	0.015	0.016	0.053	0.091	0.198	0.555
(0.015)	(0.014)	(0.020)	(0.014)	(0.014)	(0.015)	(0.027)	(0.034)	(0.048)	(0.062)

Invariant Distribution: $\overline{\pi}$

0.029	0.028	0.028	0.060	0.109	0.175	0.177	0.155	0.119	0.119
(0.009)	(0.007)	(0.006)	(0.009)	(0.013)	(0.018)	(0.016)	(0.018)	(0.017)	(0.024)

Sample Size

1077

Table B.8: Posterior Estimates: GERMAN Females (1992-1997)

Initial Distribution: π_0

0.056	0.040	0.139	0.185	0.234	0.175	0.107	0.028	0.018	0.018
(0.013)	(0.011)	(0.019)	(0.023)	(0.024)	(0.022)	(0.017)	(0.009)	(0.008)	(0.008)

Transition Matrix : P

0.320	0.102	0.124	0.158	0.076	0.038	0.037	0.037	0.073	0.037
(0.090)	(0.059)	(0.064)	(0.068)	(0.051)	(0.037)	(0.037)	(0.036)	(0.048)	(0.036)
0.163	0.148	0.208	0.151	0.096	0.048	0.046	0.047	0.045	0.046
(0.076)	(0.072)	(0.082)	(0.075)	(0.061)	(0.045)	(0.040)	(0.043)	(0.043)	(0.044)
0.040	0.101	0.226	0.361	0.155	0.042	0.019	0.019	0.018	0.019
(0.026)	(0.041)	(0.056)	(0.065)	(0.050)	(0.027)	(0.019)	(0.019)	(0.017)	(0.018)
0.075	0.018	0.081	0.362	0.255	0.135	0.031	0.015	0.015	0.014
(0.032)	(0.015)	(0.032)	(0.058)	(0.051)	(0.042)	(0.020)	(0.014)	(0.015)	(0.015)
0.012	0.025	0.027	0.122	0.448	0.265	0.051	0.026	0.012	0.012
(0.012)	(0.017)	(0.018)	(0.035)	(0.056)	(0.049)	(0.024)	(0.017)	(0.012)	(0.012)
0.031	0.015	0.017	0.020	0.098	0.430	0.293	0.064	0.017	0.015
(0.021)	(0.014)	(0.017)	(0.016)	(0.035)	(0.060)	(0.056)	(0.029)	(0.015)	(0.015)
0.023	0.022	0.023	0.095	0.051	0.147	0.435	0.127	0.052	0.026
(0.021)	(0.022)	(0.022)	(0.044)	(0.033)	(0.052)	(0.073)	(0.048)	(0.033)	(0.024)
0.054	0.054	0.055	0.058	0.060	0.071	0.143	0.288	0.141	0.075
(0.052)	(0.051)	(0.052)	(0.054)	(0.051)	(0.058)	(0.084)	(0.105)	(0.078)	(0.065)
0.067	0.067	0.070	0.067	0.069	0.076	0.090	0.175	0.147	0.172
(0.062)	(0.063)	(0.065)	(0.062)	(0.066)	(0.066)	(0.072)	(0.094)	(0.087)	(0.093)
0.069	0.062	0.066	0.069	0.070	0.068	0.079	0.090	0.119	0.307
(0.062)	(0.057)	(0.063)	(0.064)	(0.066)	(0.059)	(0.068)	(0.072)	(0.085)	(0.113)

Invariant Distribution: $\overline{\pi}$

0.062	0.043	0.064	0.140	0.167	0.187	0.164	0.081	0.047	0.045
(0.017)	(0.012)	(0.014)	(0.022)	(0.027)	(0.028)	(0.030)	(0.022)	(0.014)	(0.017)

Sample Size

285

C Mobility Indices for 5 year transitions

Table C.1: Mobility Measures for 5 year transition: United States

Mobility Measure	Group	Male	Female	Prob[Male > Female]
Transition from 1984 to 1989				
$\mathcal{M}_s$	All	0.817	0.780	0.896
		(0.018)	(0.025)	
$\mathcal{M}_U$	All	0.533	0.426	0.999
		(0.018)	(0.023)	
$\mathcal{M}_{U\|low}$	Low	0.713	0.596	0.990
		(0.038)	(0.036)	
$\mathcal{M}_{U\|middle}$	Middle	0.553	0.466	0.979
		(0.029)	(0.033)	
$\mathcal{M}_{U\|high}$	High	0.333	0.216	0.984
		(0.030)	(0.046)	
Transition from 1988 to 1993				
$\mathcal{M}_s$	All	0.763	0.773	0.344
		(0.018)	(0.022)	
$\mathcal{M}_U$	All	0.463	0.435	0.854
		(0.018)	(0.020)	
$\mathcal{M}_{U\|low}$	Low	0.622	0.589	0.735
		(0.038)	(0.032)	
$\mathcal{M}_{U\|middle}$	Middle	0.476	0.420	0.925
		(0.026)	(0.029)	
$\mathcal{M}_{U\|high}$	High	0.291	0.297	0.451
		(0.025)	(0.044)	
Transition from 1992 to 1997				
$\mathcal{M}_s$	All	0.848	0.822	0.776
		(0.023)	(0.028)	
$\mathcal{M}_U$	All	0.525	0.450	0.977
		(0.023)	(0.026)	
$\mathcal{M}_{U\|low}$	Low	0.743	0.646	0.936
		(0.047)	(0.041)	
$\mathcal{M}_{U\|middle}$	Middle	0.505	0.462	0.784
		(0.037)	(0.044)	
$\mathcal{M}_{U\|high}$	High	0.328	0.242	0.891
		(0.041)	(0.050)	

Table C.2: Mobility Measures for 5 year transition: Germany

Mobility Measure	Group	Male	Female	Prob[Male > Female]
Transition from 1984 to 1989				
$\mathcal{M}_s$	All	0.770	0.846	0.007
		(0.017)	(0.027)	
$\mathcal{M}_U$	All	0.557	0.519	0.912
		(0.016)	(0.025)	
$\mathcal{M}_{U\|low}$	Low	0.731	0.723	0.555
		(0.035)	(0.038)	
$\mathcal{M}_{U\|middle}$	Middle	0.544	0.581	0.185
		(0.016)	(0.037)	
$\mathcal{M}_{U\|high}$	High	0.397	0.252	0.984
		(0.029)	(0.053)	
Transition from 1988 to 1993				
$\mathcal{M}_s$	All	0.697	0.793	0.001
		(0.017)	(0.027)	
$\mathcal{M}_U$	All	0.529	0.442	0.999
		(0.016)	(0.026)	
$\mathcal{M}_{U\|low}$	Low	0.735	0.609	0.990
		(0.037)	(0.044)	
$\mathcal{M}_{U\|middle}$	Middle	0.528	0.472	0.942
		(0.017)	(0.031)	
$\mathcal{M}_{U\|high}$	High	0.324	0.244	0.913
		(0.026)	(0.054)	
Transition from 1992 to 1997				
$\mathcal{M}_s$	All	0.705	0.766	0.031
		(0.019)	(0.027)	
$\mathcal{M}_U$	All	0.462	0.424	0.871
		(0.019)	(0.026)	
$\mathcal{M}_{U\|low}$	Low	0.624	0.667	0.255
		(0.048)	(0.049)	
$\mathcal{M}_{U\|middle}$	Middle	0.474	0.407	0.962
		(0.018)	(0.033)	
$\mathcal{M}_{U\|high}$	High	0.288	0.198	0.937
		(0.024)	(0.048)	

IZA Discussion Papers

No.	Author(s)	Title	Area	Date
697	R. Schettkat	Differences in US-German Time-Allocation: Why Do Americans Work Longer Hours than Germans?	5	01/03
698	T. M. Andersen J. R. Skaksen	Product Market Integration, Comparative Advantages and Labour Market Performance	2	01/03
699	D. Margolis V. Simonnet	Educational Track, Networks and Labor Market Outcomes	2	01/03
700	T. K. Bauer	Flexible Workplace Practices and Labor Productivity	1	01/03
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