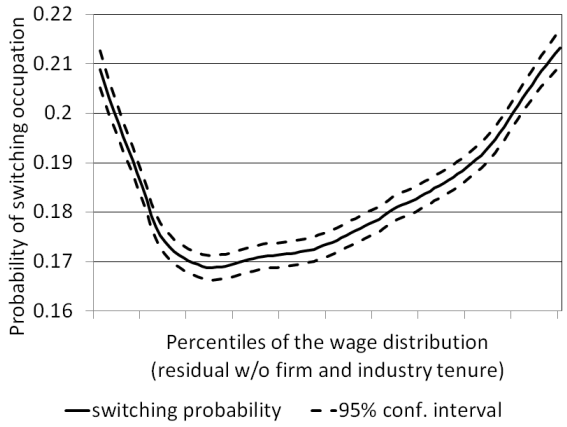
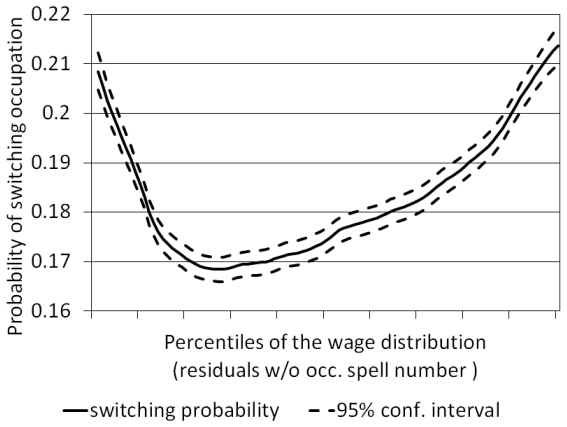
ONLINE APPENDIX to
"The U-Shapes of Occupational Mobility"
by Fane Groes, Philipp Kircher, and Iourii Manovskii

OA1 Alternative Wage Regression Specifications



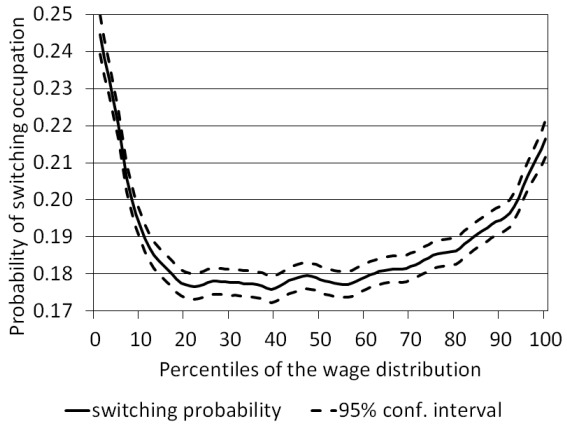
(a) Wage regression excluding firm and industry tenure.



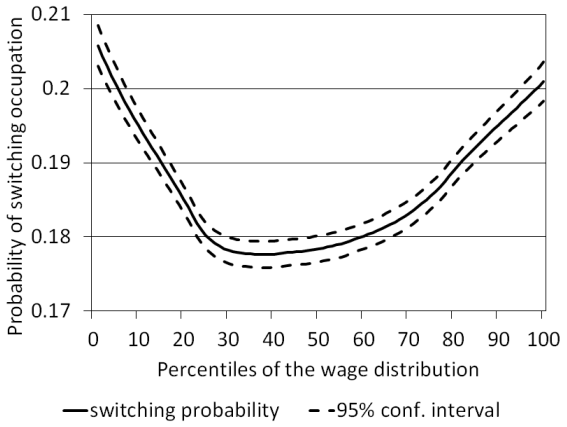
(b) Wage regression excluding occupational spell number.

Figure OA-1: Non-parametric plot of probability of switching occupation by worker's percentile in residual distributions from alternative wage regression specifications.

OA2 Sensitivity to Bandwidth Choice

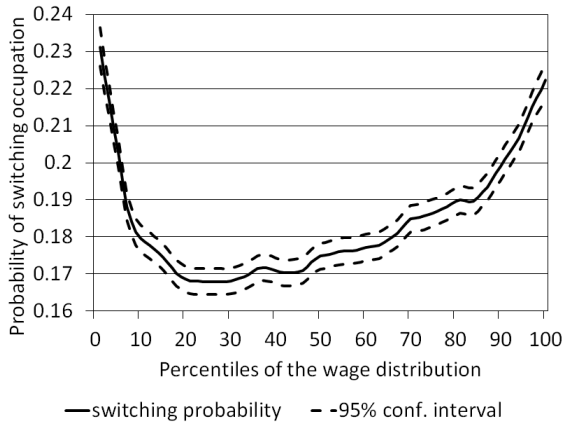


(a) Half bandwidth.

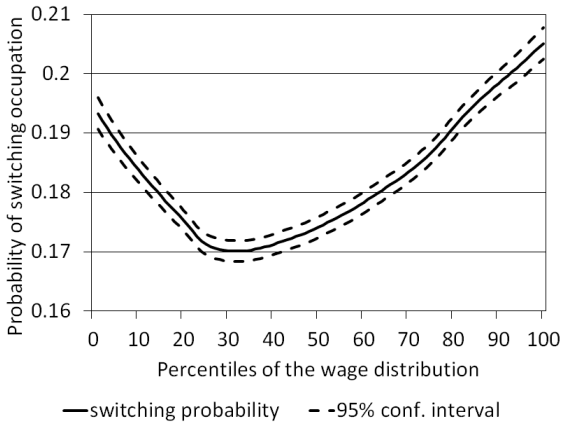


(b) Double bandwidth.

Figure OA-2: Non-parametric plot of probability of switching occupation by worker's percentile in the wage distribution within occupation and year for half and double bandwidth.

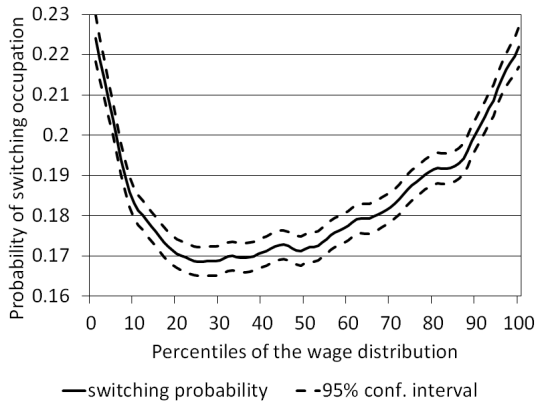


(a) Half bandwidth.

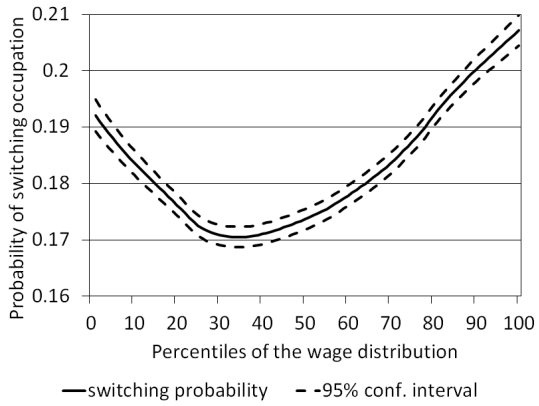


(b) Double bandwidth.

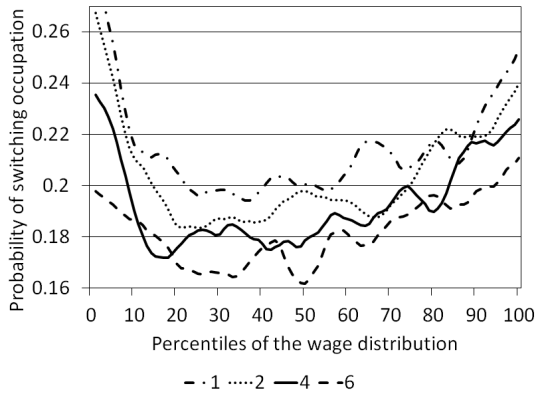
Figure OA-3: Non-parametric plot of probability of switching occupation by worker's percentile in the distribution of wage residuals for half and double bandwidth.



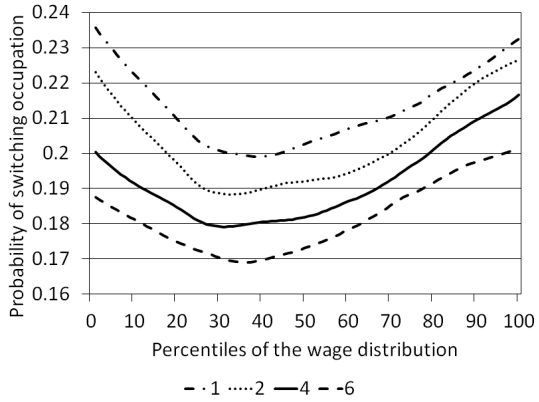
(a) Overall. Half bandwidth.



(b) Overall. Double bandwidth.



(c) For various years after graduation. Half bandwidth.



(d) For various years after graduation. Double bandwidth.

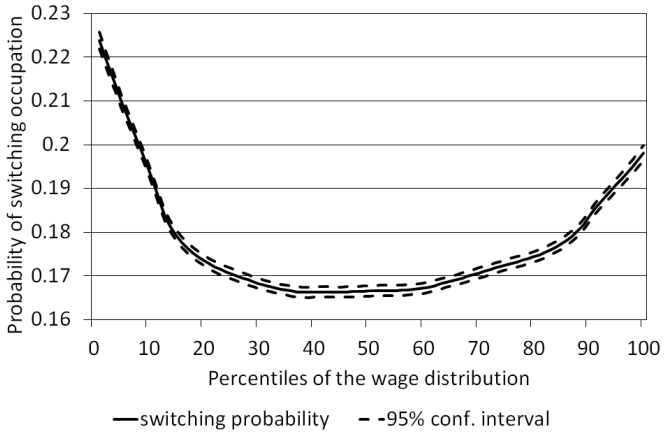
Figure OA-4: Non-parametric plot of probability of switching occupation by worker's percentile in the wage distribution within occupation, year, and years after graduation for half and double bandwidth.

OA3 Results on the Small Sample Including more Experienced Workers

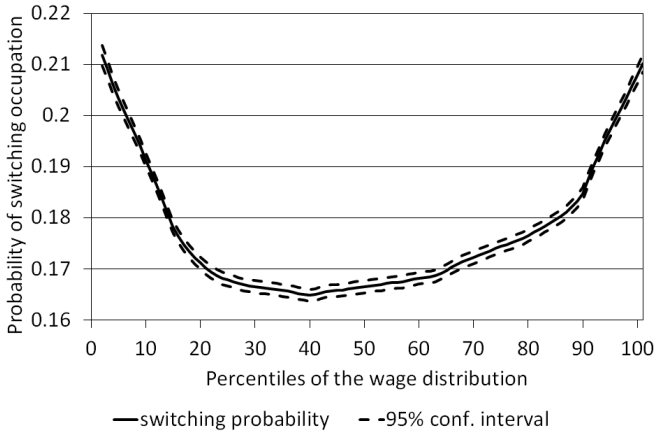
The U-shape pattern holds true for all years of experience and/or years after graduation. In the Online Appendix OA4 we show occupational mobility for up to 15 years after graduation for our Large Sample that includes individuals working in either the private or public sector. In that analysis we have included at most 15 years after graduation because this is the longest duration we can follow workers for in our data while observing their entire work history. Observing entire work history is necessary to create occupation, industry, and firm tenure for each worker, which are used as controls in the wage regression that delivers the wage residuals.

However, if we only consider raw wages, the data allow us to look at workers for up to 25 years after they graduate from school. To accommodate this, we create a sample of workers who completed their education and work in the private sector for at least two consecutive years (the latter restriction is just to be able to define occupational switchers between two consecutive years). For these workers we compute their wage percentiles (location in the within year and occupation wage distribution) in the same two ways as we do for workers' raw wages in the paper, i.e., unconditional and conditional on years since graduation. Figure OA-5(a) shows the workers' switching probability when we calculate wage percentiles within year and occupation. Even on this population sample, where the worker's wage percentile is not conditioned on year after graduation, the switching probability is U-shaped. The U-shape in Figure OA-5(a) indicates a higher switching probability for low wage worker than for high wage workers, which may be affected by the possibility that more experienced and less mobile workers are concentrated in the upper part of the within-occupation wage distribution. This is why we also report the results that control for worker's years after graduation when constructing wage percentiles within occupation. In Figures OA-5(b) and OA-5(c) we calculate wage percentiles of the full population sample within year, occupation, AND years after graduation. These figures show that conditioning on years after graduation yields symmetric U-shapes overall as well as for all years after graduation up to 25 years.

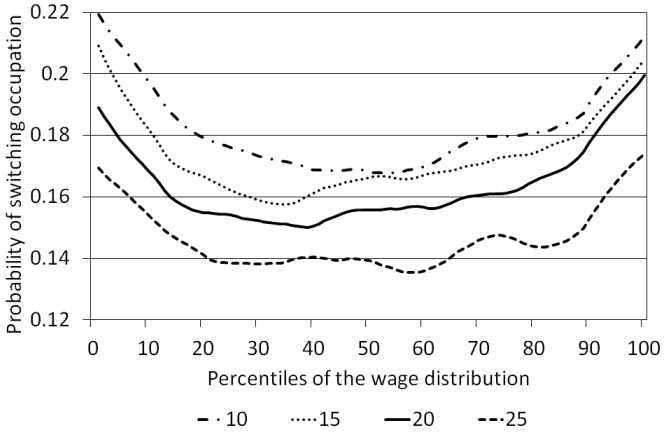
Figures OA-6(a), OA-6(b), and OA-6(c) show that our findings on the direction of mobility also remain robust for the population sample that includes experienced workers both when we find workers' wage percentiles within year and occupation and also when we calculate wage percentiles within year, occupation, and year after graduation. The directional mobility patterns follow those of Figures 3(a), 4(a), and 4(b) in the body of the paper.



(a) Distribution of raw wages within occupation and year, population.

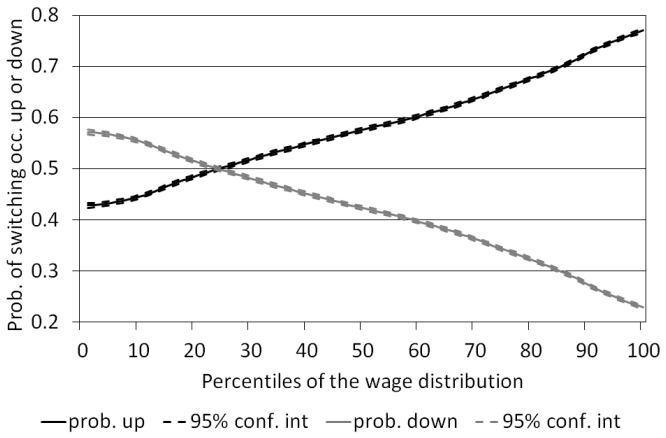


(b) Distribution of raw wages within occupation and year and year after graduation, population.

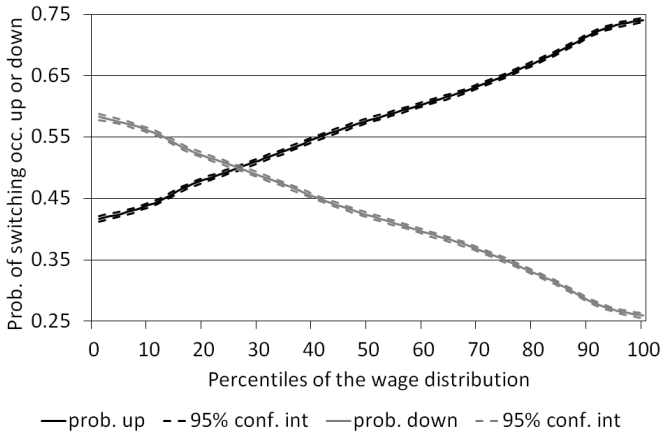


(c) Distribution of raw wages within occupation, year and 10, 15, 20, and 25 years after graduation, population.

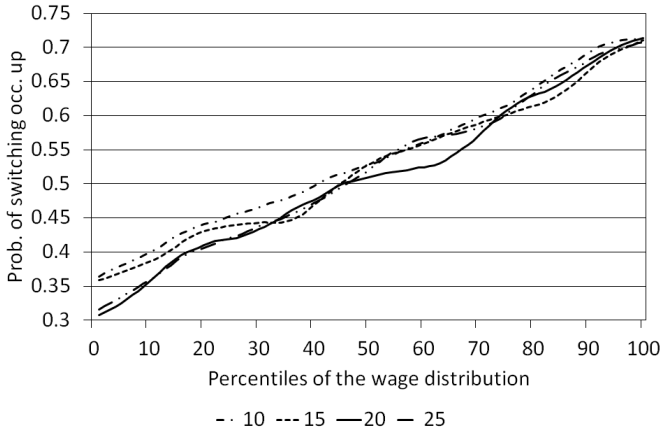
Figure OA-5: Occupation switching by worker's percentile in the relevant wage distribution before the switch for the population of workers in the private sector.



(a) Distribution of raw wages within occupation and year, population.



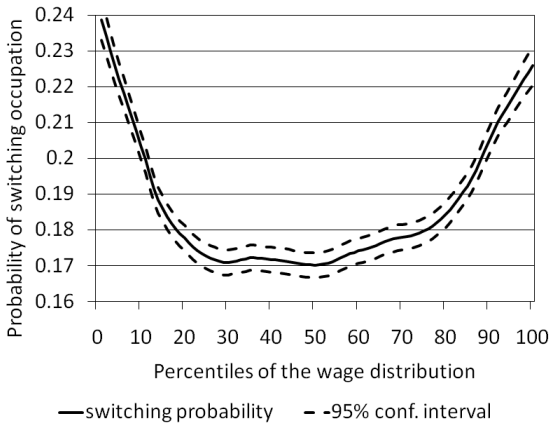
(b) Distribution of raw wages within occupation and year and year after graduation, population.



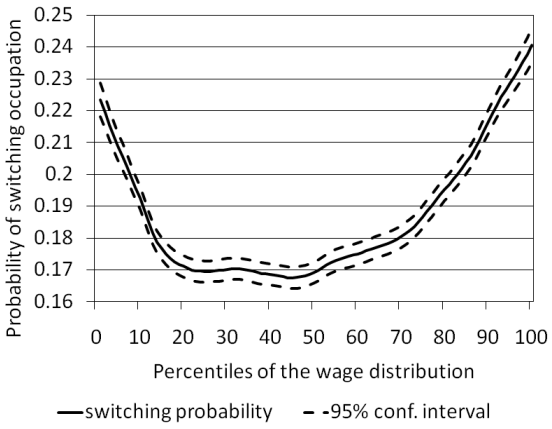
(c) Distribution of raw wages within occupation, year and 10, 15, 20, and 25 years after graduation, population.

Figure OA-6: Direction of occupational mobility, conditional on switching occupation, by worker's percentile in the relevant wage distribution before the switch for the population of workers in the private sector.

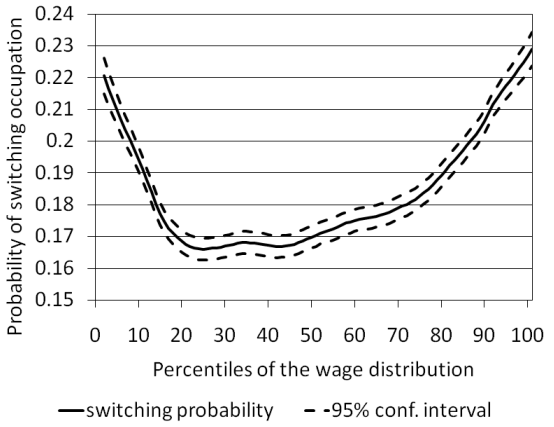
OA4 Results on the Large Sample



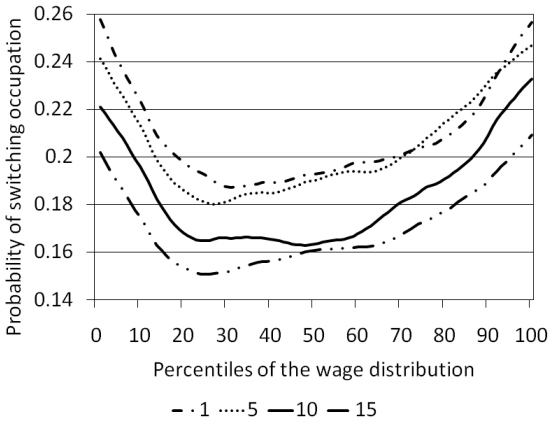
(a) Distribution of raw wages within occupation and year.



(b) Distribution of wages residuals.

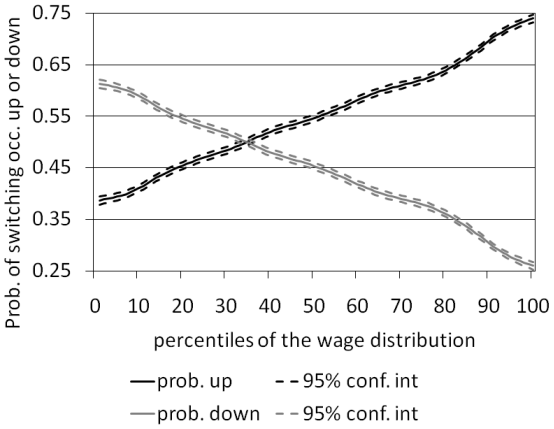


(c) Distribution of raw wages within occupation, year, and year after graduation.

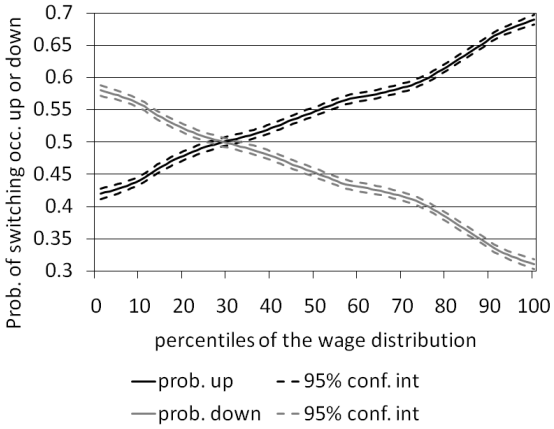


(d) Distribution of raw wages within occupation, year, and year after graduation for various years after graduation.

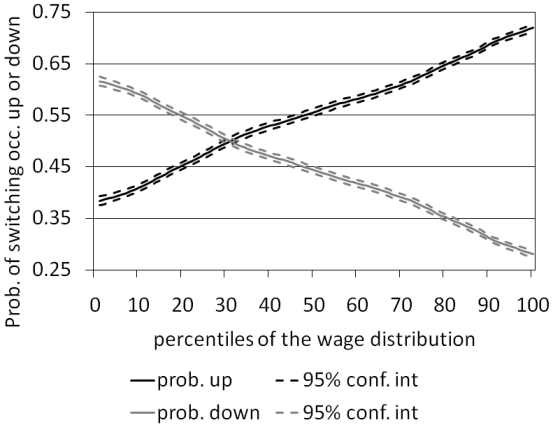
Figure OA-7: Non-parametric plot of probability of switching occupation by worker's percentile in the relevant wage distribution. Large Sample.



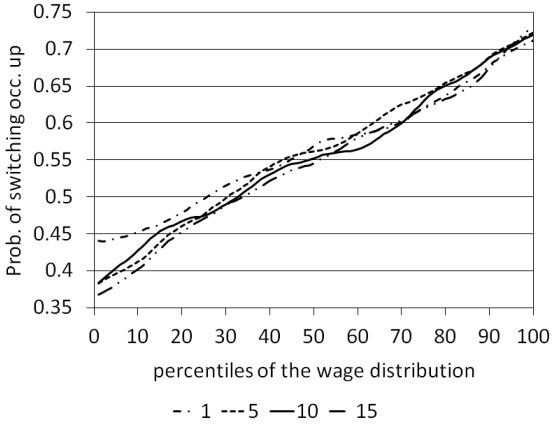
(a) Distribution of raw wages within occupation and year. Average wage in occupation from population.



(b) Distribution of wages residuals. Average wage in occupation from time constants in wage regression.

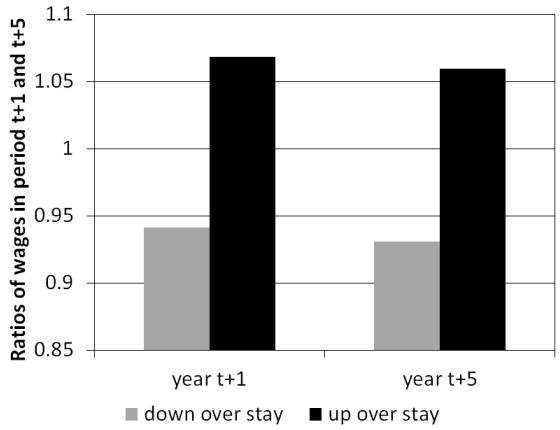


(c) Distribution of raw wages within occupation, year, and year after graduation. Average wage in occupation from population.

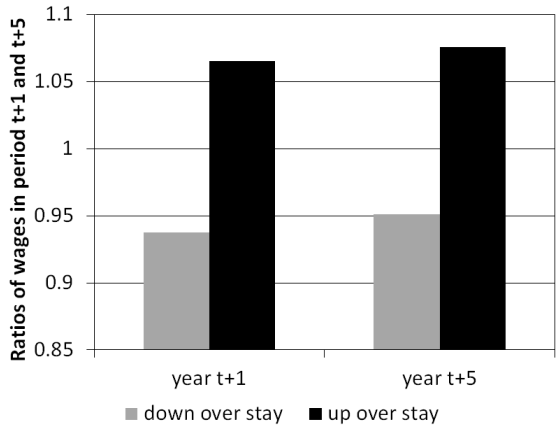


(d) Distribution of raw wages within occupation, year, and year after graduation for different years after graduation. Average wage in occupation from population.

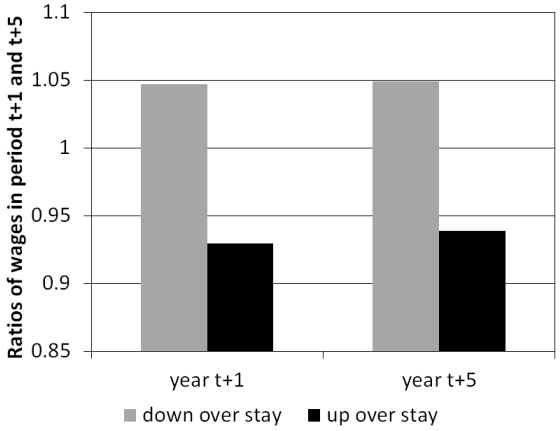
Figure OA-8: Non-parametric plot of direction of occupational mobility, conditional on switching occupation, by worker's percentile in the relevant wage distribution before the switch. Large Sample.



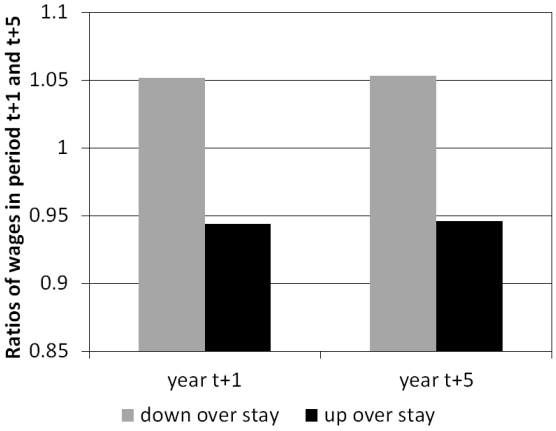
(a) Unconditional.



(b) Conditional on the number of years after graduation.

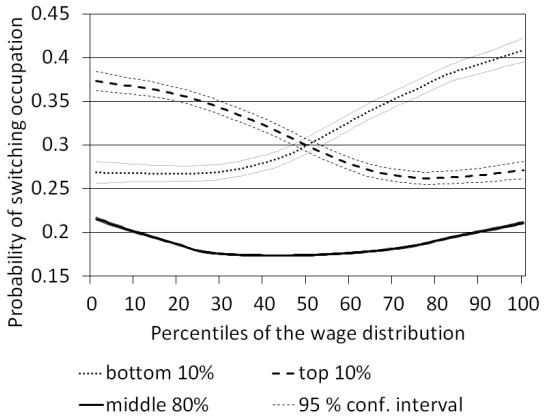


(c) Unconditional.

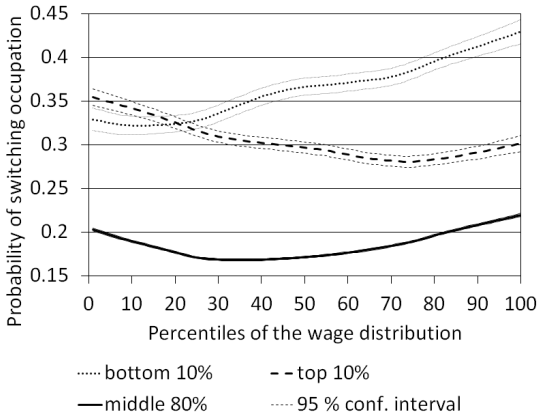


(d) Conditional on the number of years after graduation.

Figure OA-9: Weighted average of year $t+1$ or $t+5$ ratios of real wages of workers who switch occupations between years t and $t+1$ over (1) workers who stay in the same *original* occupation in years t and $t+1$ (Panels 9(a) and 9(b)) or (2) workers who stay in the same *destination* occupation in years t and $t+1$ (Panels 9(c) and 9(d)) by direction of the switch (i.e., whether the switch involves moving to an occupation that pays more or less on average than the source occupation). Large Sample.

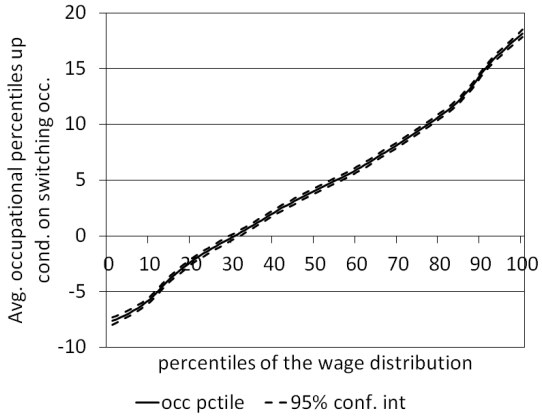


(a) Distribution of raw wages within occupation and year. Growth rates of average wage in occupation from population.

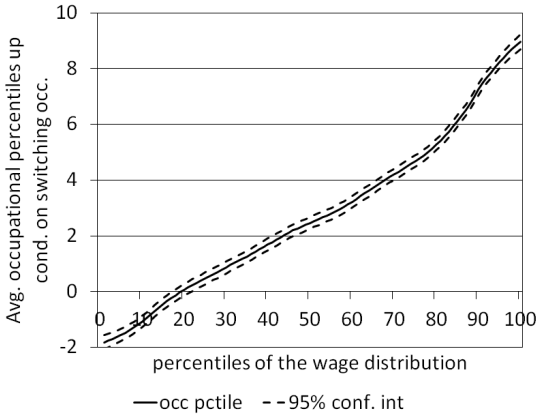


(b) Distribution of wage residuals. Growth rates of average wage in occupation from time constants in wage regression.

Figure OA-10: Non-parametric plot of probability of switching occupation by worker's percentile in the relevant wage distribution. For the fastest growing 10% of occupations, the slowest growing 10% of occupations, and the remaining 80% of occupations. Large Sample.



(a) Distribution of raw wages within occupation and year.



(b) Distribution of wage residuals.

Figure OA-11: Non-parametric plot of direction of occupational mobility in terms of change of occupational percentiles, conditional on switching occupation, by worker's percentile in the relevant wage distribution. Large Sample.

OA5 Patterns of Occupational Mobility Within and Across Firms Conditional on Worker's Position in the Distribution of Wage Residuals

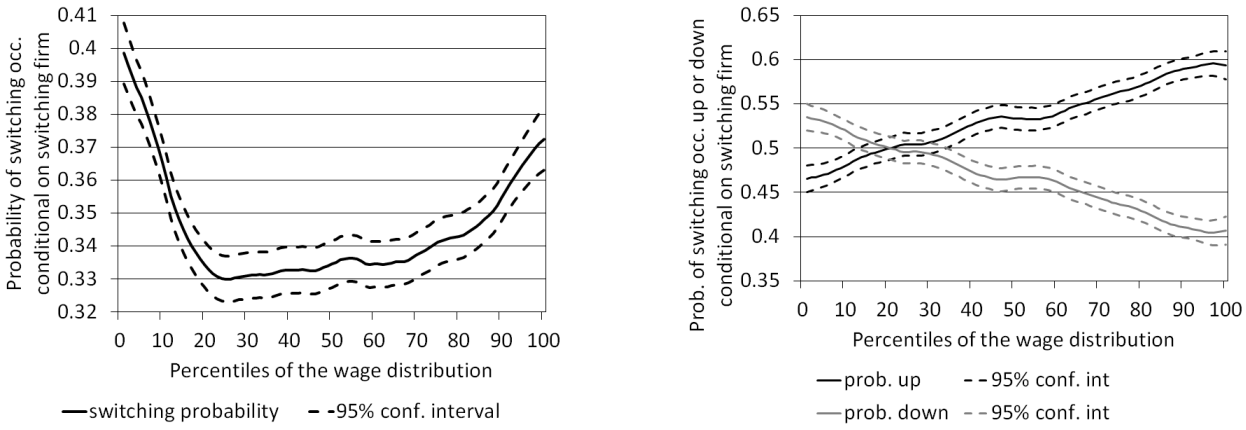


Figure OA-12: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on switching firms* by worker's percentile in the distribution residual wages.

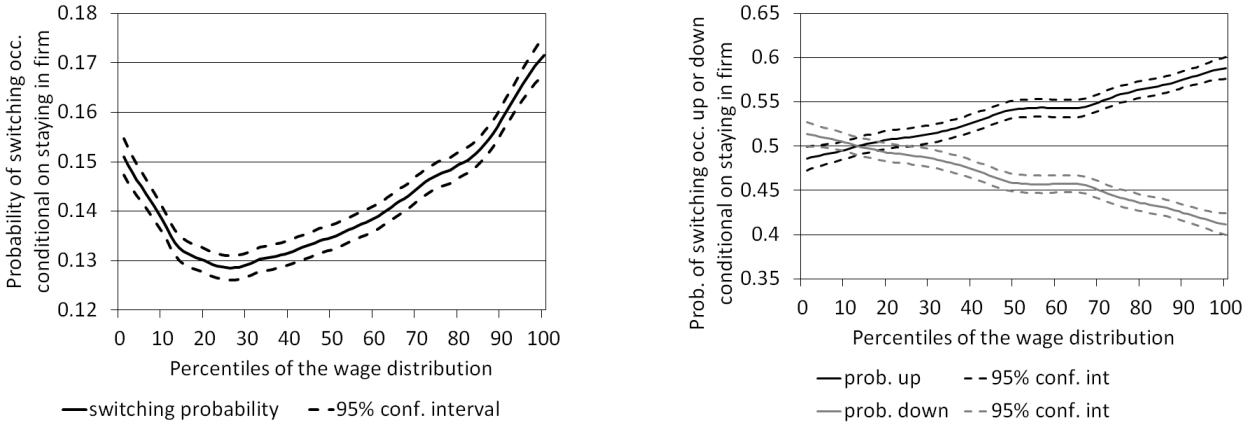


Figure OA-13: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on staying with the firm* by worker's percentile in the distribution of residual wages.

OA6 Assessing the Role of Measurement Error

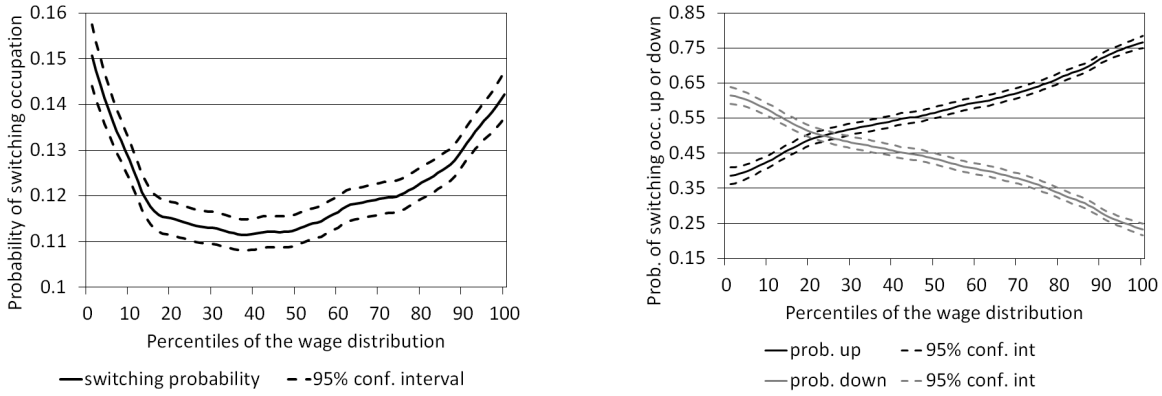


Figure OA-14: Non-parametric plots of probability of switching occupation between years t and $t+1$ and of direction of occupational mobility conditional on staying in the same occupation in years $t-1$ and t and staying the same occupation in years $t+1$ and $t+2$ by worker's percentile in the distribution of raw wages.

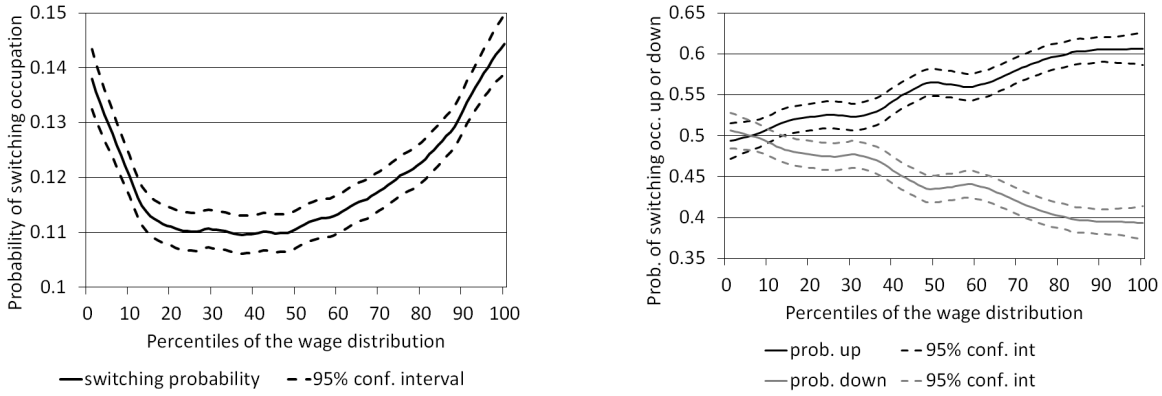


Figure OA-15: Non-parametric plots of probability of switching occupation between years t and $t+1$ and of direction of occupational mobility conditional on staying in the same occupation in years $t-1$ and t and staying the same occupation in years $t+1$ and $t+2$ by worker's percentile in the distribution of residual wages.

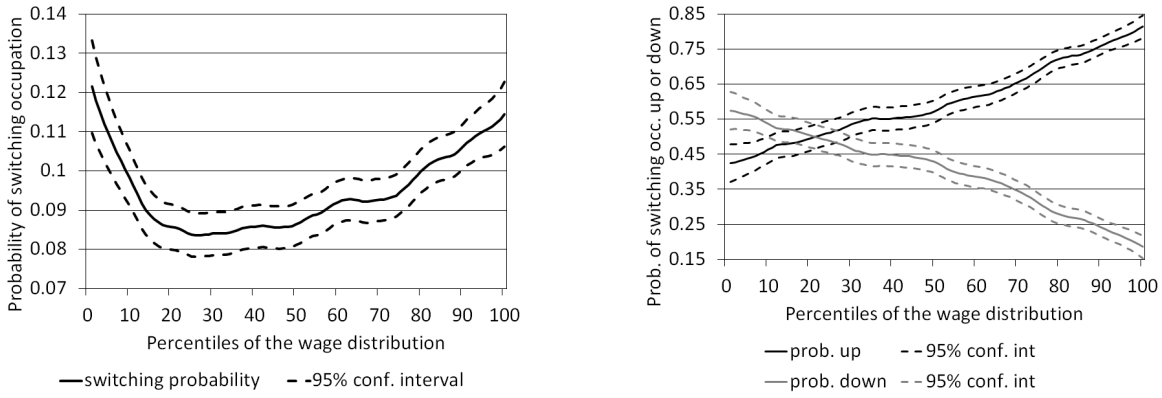


Figure OA-16: Non-parametric plots of probability of switching occupation between years t and $t+1$ and of direction of occupational mobility conditional on staying in the same occupation in years $t-2$, $t-1$, and t and staying the same occupation in years $t+1$, $t+2$, and $t+3$ by worker's percentile in the distribution of raw wages.

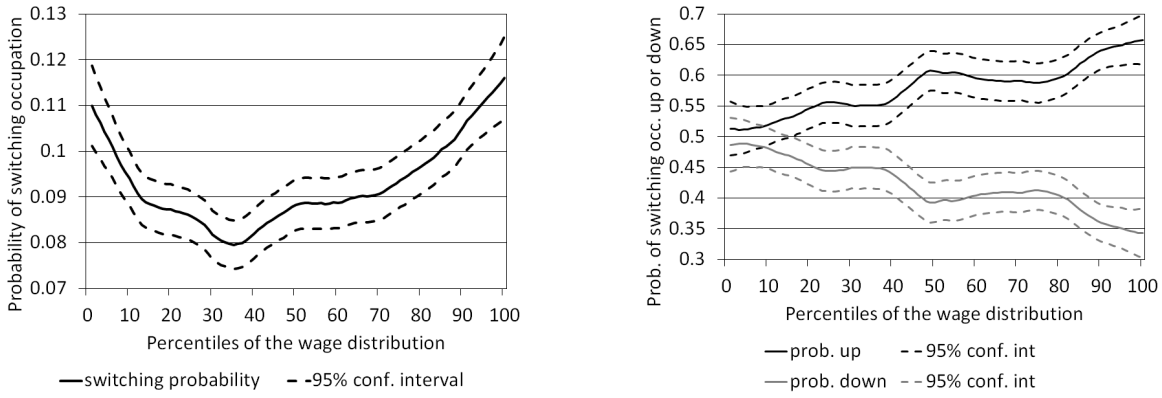
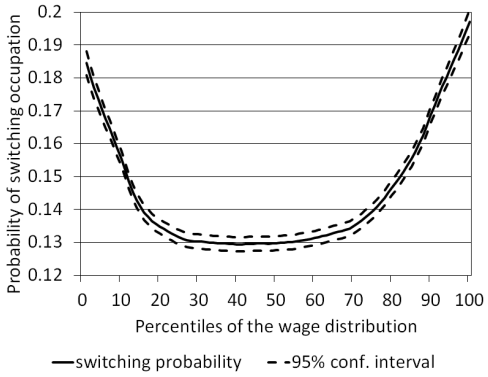
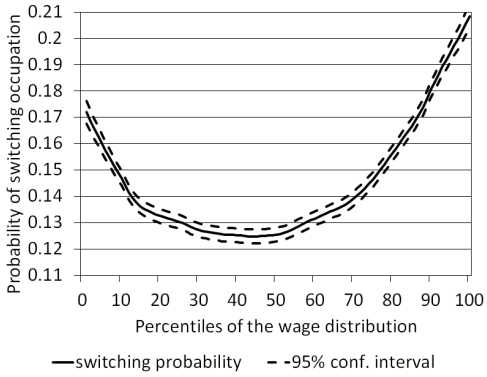


Figure OA-17: Non-parametric plots of probability of switching occupation between years t and $t+1$ and of direction of occupational mobility conditional on staying in the same occupation in years $t-2$, $t-1$, and t and staying the same occupation in years $t+1$, $t+2$, and $t+3$ by worker's percentile in the distribution of residual wages.

OA7 The U-shapes of Occupational Mobility: Females

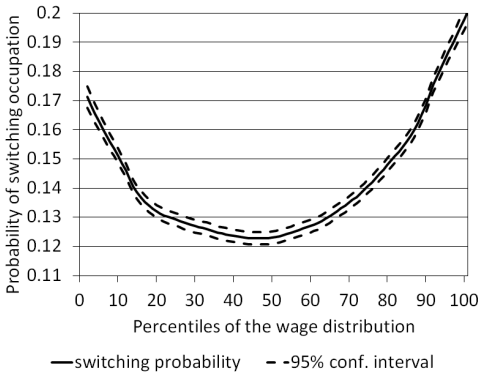


(a) Distribution of raw wages within occupation and year.

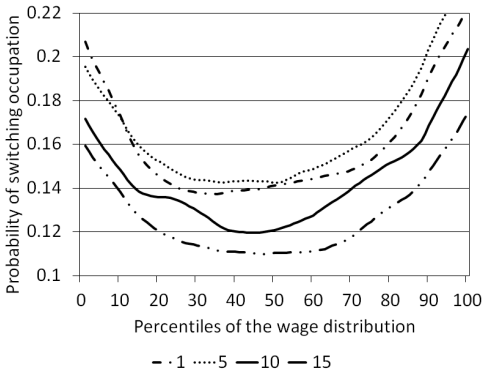


(b) Distribution of wage residuals.

Figure OA-18: Non-parametric plot of probability of switching occupation by worker's percentile in the relevant wage distribution. Women.

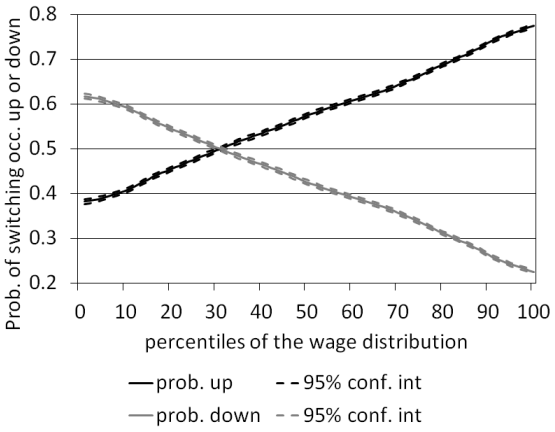


(a) Overall.

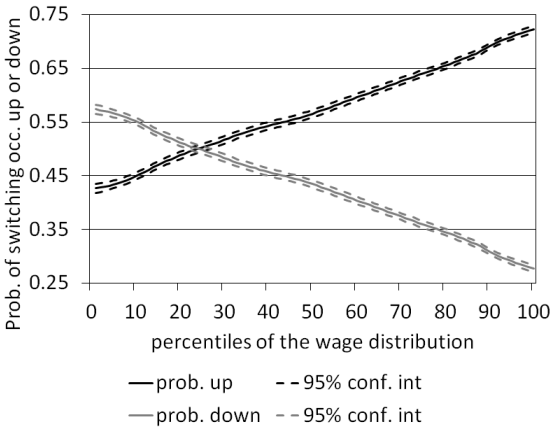


(b) For different years after graduation.

Figure OA-19: Non-parametric plot of probability of switching occupation by worker's percentile in the distribution of raw wages within occupation, year, and years after graduation. Women.

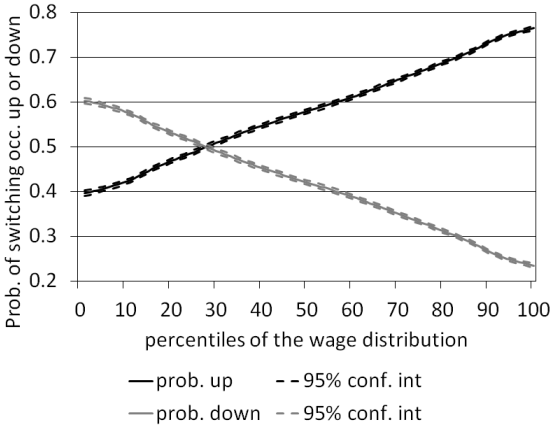


(a) Distribution of raw wages within occupation and year. Average wage in occupation from population.

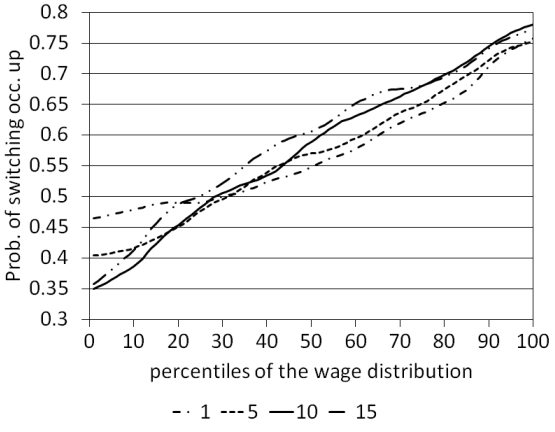


(b) Distribution of wage residuals. Average wage in occupation from time constants in wage regression.

Figure OA-20: Non-parametric plot of direction of occupational mobility, conditional on switching occupation, by worker's percentile in the relevant wage distribution before the switch. Women.

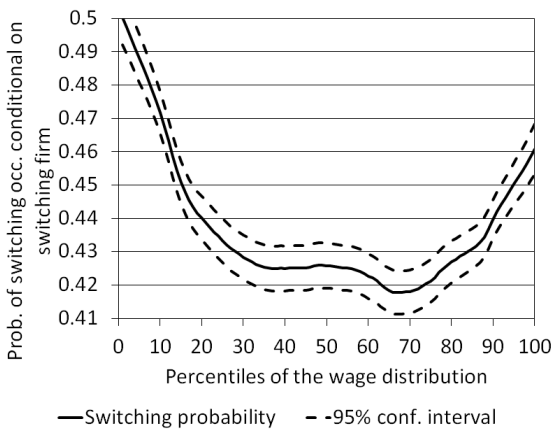


(a) Overall.



(b) For different years after graduation.

Figure OA-21: Non-parametric plot of direction of occupational mobility, conditional on switching occupation, by worker's percentile in the distribution of raw wages within occupation, year, and years after graduation before the switch. Women.



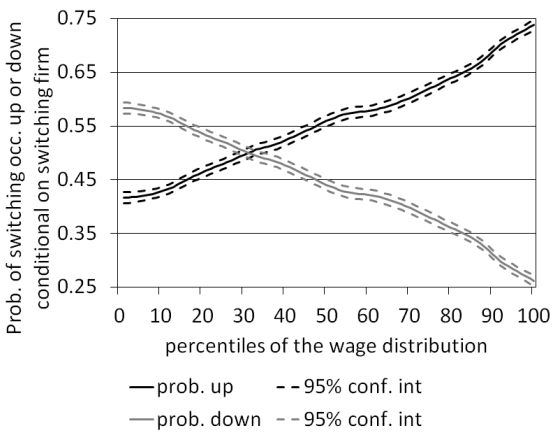
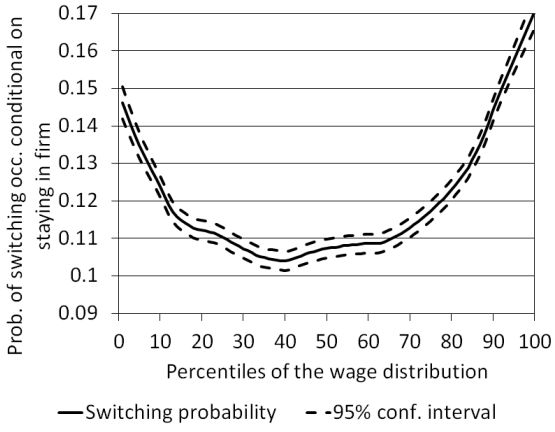


Figure OA-22: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on switching firms* by worker's percentile in the distribution or raw wages. Women.



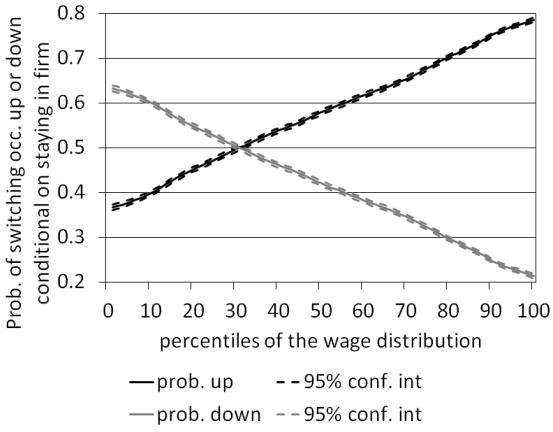
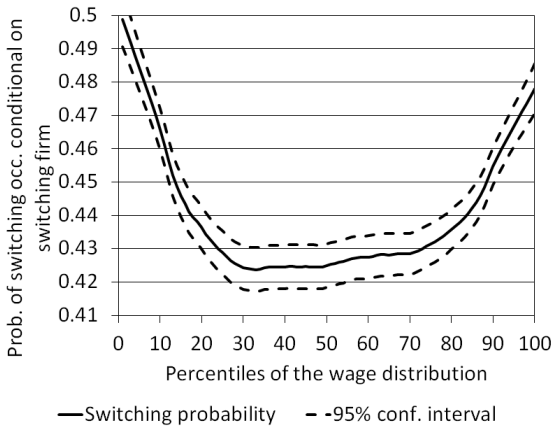


Figure OA-23: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on staying with the firm* by worker's percentile in the distribution of raw wages. Women.



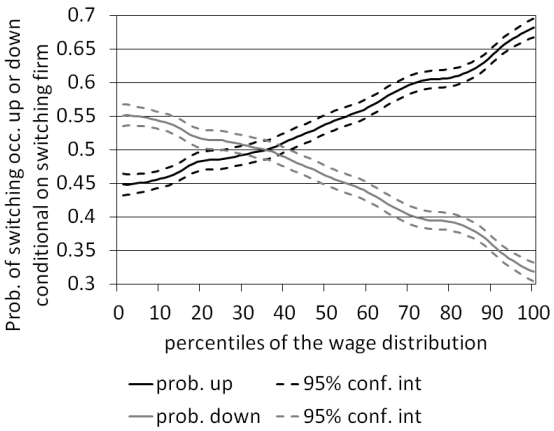
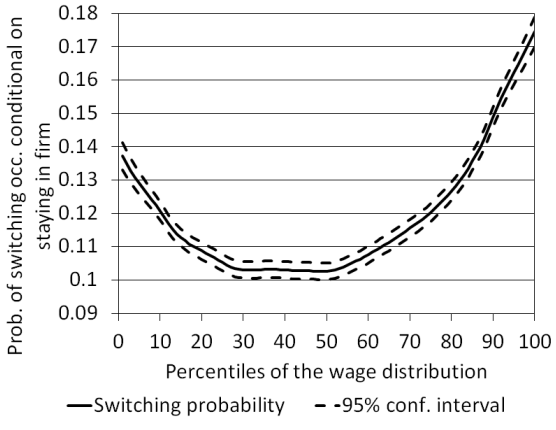


Figure OA-24: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on switching firms* by worker's percentile in the distribution residual wages. Women.



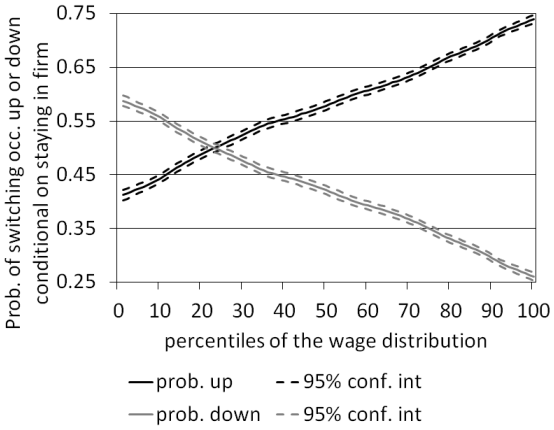


Figure OA-25: Non-parametric plots of probability of switching occupation and of direction of occupational mobility *conditional on staying with the firm* by worker's percentile in the distribution of residual wages. Women.

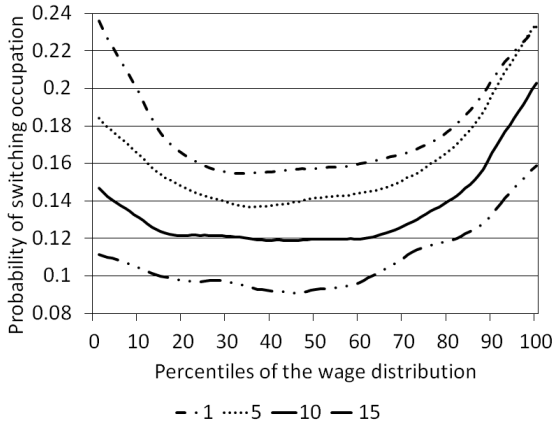
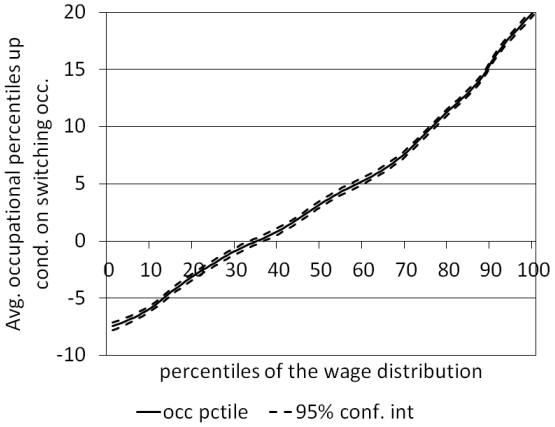
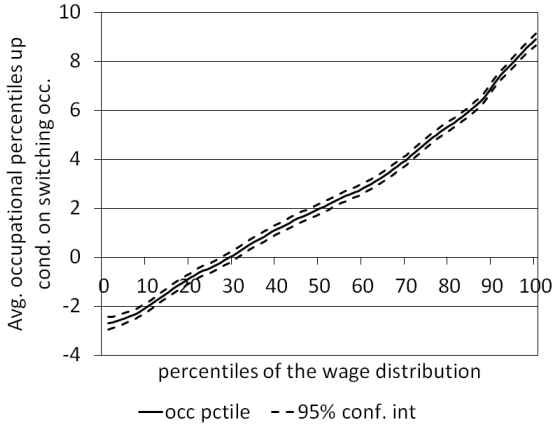


Figure OA-26: Non-parametric plot of probability of switching occupation by worker's percentile in the distribution of raw wages within occupation, year, and experience. Women.



(a) Raw wages.



(b) Wage residuals.

Figure OA-27: Non-parametric plot of direction of occupational mobility in terms of change of occupational percentiles from raw wages or residuals, conditional on switching occupation, by worker's percentile in the distribution of raw wages or wage residuals. Women.

OA8 Sensitivity to Alternative Occupational Classifications

In this online appendix we explore robustness of our findings to a number of alternative ways to define occupations. We begin by considering 1-, 2-, and 3-digit occupational classifications and compare the results to the 4-digit classification used in our main analysis. Figure OA-28 illustrates that our results are robust to using alternative occupational classifications. While the level of mobility falls as occupational classifications become coarser, the U-shaped pattern of mobility remains unaffected. This provides further indication that a considerable part of mobility is driven by movements across occupations that can be vertically ranked which is clearly the case at the 1-digit level.

A potential concern is that some 4-digit occupations may not be sufficiently clearly differentiated (e.g., "Primary education teaching professionals" and "Primary education teaching associate professionals"). This may result in some spurious re-classification of workers' occupations because of reporting errors or when a worker continues to perform essentially the same task but gets re-classified because of a change in an institutional setting (such as teaching a different grade level). To address this concern we perform the following experiment. We access the Statistics Denmark's web page that firms can use to search for the correct occupational category of their employees. Typing in a description of the tasks performed by an employee into a search engine provided on this web page, returns one or more 4-digit occupational codes related to the query. For example, if we search for the word "painter," four distinct 4-digit occupations are returned. These are "Painter and related work," "Varnisher and related painters," "Glass, ceramics, and related decorative painters," and "Sculpture, painters and related artists." Similarly the search for the word "accountant" or "accounting" returns three 4-digit occupations, which are "Accountants", "Bookkeepers," and "Accounting and bookkeeping clerks." We go through all 4-digit occupations, excluding managers, and search for the word that describes the given occupation (this is done in Danish, of course). We then group together all occupations returned by the search engine. This means that a switch from "Accountant" to "Bookkeeper" or to "Accounting and bookkeeping clerks" will not be registered as an occupational switch. A complete description of the resulting occupational groups can be found in Table OA-1, where Column 2 provides a set of occupations related to the corresponding occupation listed in Column 1 (occupational codes and their descriptions can be found in the Online Appendix OA19). In Figure OA-29(a) we plot the probability of switching across these occupational groups as a function of the worker's position in the wage distribution of their occupation.[OA1] We find that the U-shaped mobility patterns are

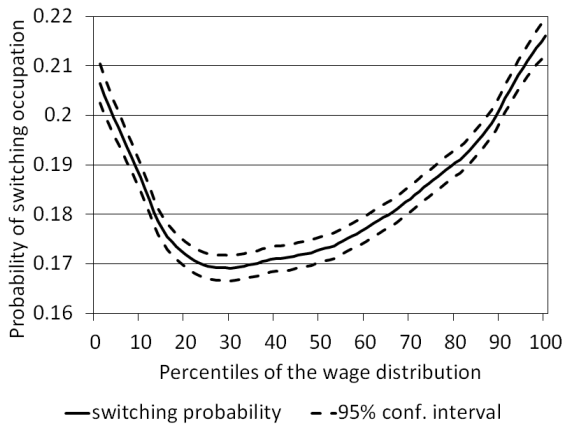
[OA1] We keep the wage percentiles from the 4-digit occupations rather than the new defined occupational groups because the groups are not in a "closed relation." As an example, an "Accountant" is grouped with "Accounting and bookkeeping clerks" who, in turn, are grouped with "Administrative secretaries and related associate professionals." However, "Accountants" are not grouped with "Administrative secretaries and related associate

robust to this re-classification of related occupations, while the level of occupational mobility is naturally somewhat lower.

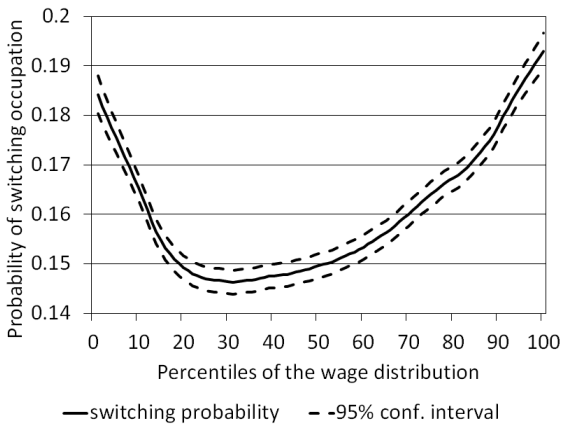
To assess whether our finding that workers with relatively high wages are more likely to leave their occupations is predominantly driven by promotions to managerial occupations we perform the following two experiments. First, we reclassify all managers as one occupation. Second, we exclude all managers from the sample. The results, plotted in Figures OA-29(b) and OA-29(c), respectively, indicate that U-shaped pattern of mobility is not mainly driven by movements in and out of managerial occupations.

Finally, in Figure OA-29(d) we plot the mobility patterns on the sample that excludes "... not elsewhere classified" occupations (their codes end with the number "9"). The U-shaped mobility patterns are not affected by this change in the sample.

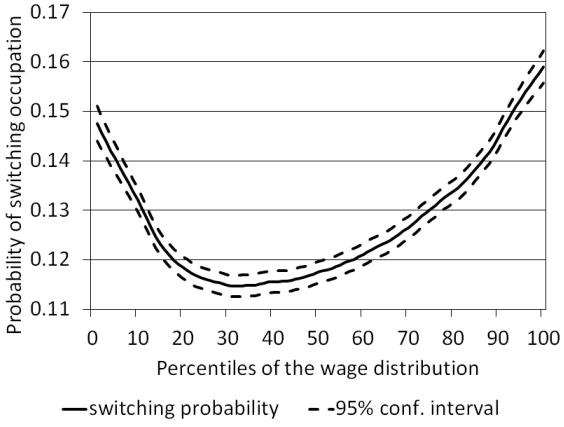
professionals."



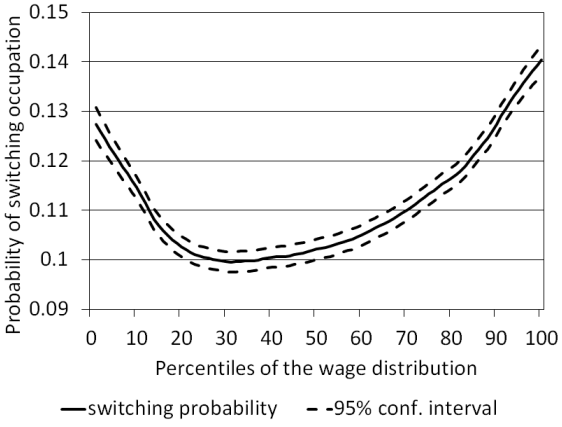
(a) Four-digit classification.



(b) Three-digit classification.

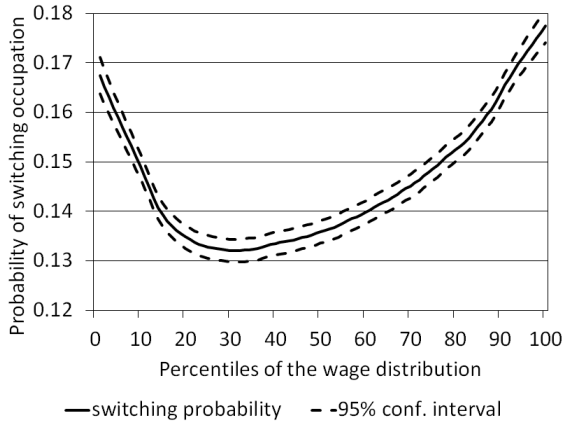


(c) Two-digit classification.

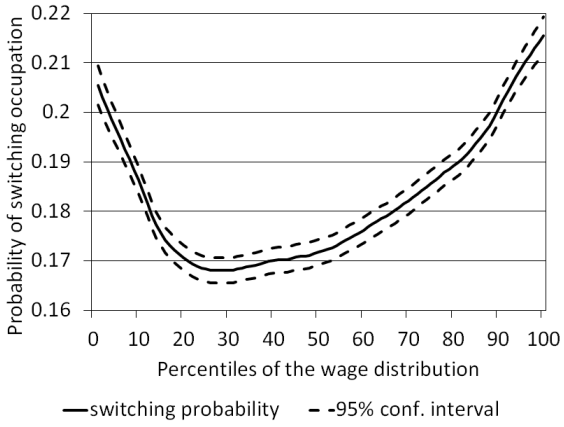


(d) One-digit classification.

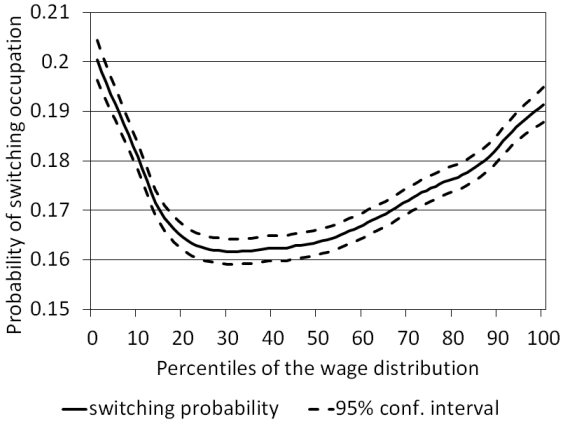
Figure OA-28: Non-parametric plot of probability of switching occupation by worker's percentile in the distribution of raw wages within occupation, year, and number of years after graduation. Various occupational classifications.



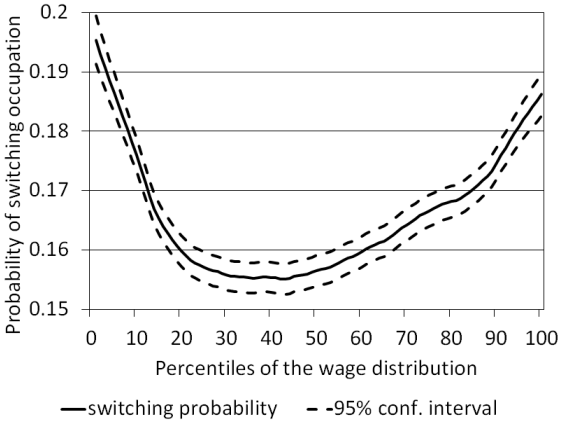
(a) Constructed occupational groups.



(b) All managers in one occupation.



(c) No managers in sample.



(d) No "Not elsewhere classified" occupations.

Figure OA-29: Non-parametric plot of probability of switching occupation by worker's percentile in the distribution of raw wages within occupation, year, and number of years after graduation. Various occupational groupings.

Table OA-1: Grouping of "related" 4-digit occupations

Occupation	Related Occupations
2111	2114, 3111
2113	3119, 3111, 3116, 2146, 3211
2114	8155, 3117
2122	4122, 2411, 4121, 3433, 3413, 3417, 3419, 3412, 3411
2131	2132, 2139, 4113, 7243, 3121, 3122, 3112, 3113, 3114, 3123
2132	2131, 2139, 4113, 7243, 3121, 3122, 3112, 3113, 3114, 3123
2139	2131, 2132, 4113, 7243, 3121, 3122, 3112, 3113, 3114, 3123
2141	3471, 2142, 3112, 2147, 3118
2142	2141, 3112, 3471, 2147, 3118
2143	
2144	3132, 7244
2145	3141
2146	3211, 3116, 3111, 2113, 3119, 2211
2149	3151, 3417, 5161
2211	3211, 2146, 3116, 2113, 3119, 3211
2212	3226, 3228, 2224, 3229
2213	3152, 3212, 6112, 9211, 6141, 2320, 3212, 9212
2224	2212, 3226, 32289, 3229
2229	2224, 2212
2310	
2320	3473, 2454, 2453, 6141, 2213, 3212, 9212, 6112
2331	2352, 2351, 2359, 3310, 3320
2359	2351, 2352, 3310, 2331, 3320
2411	4121, 3433, 3413, 3417, 3419, 3412, 3411, 4122, 2122
2412	2419
2419	2412
2421	2422, 2429, 2470, 3450, 5162
2429	2422, 2421, 2470, 3450, 5162
2432	
2441	
2442	
2443	
2444	
2451	4143
2452	7341
2470	2421, 2422, 2429, 3439, 3432, 3431, 3442, 4115, 4222, 2421, 2422, 2429, 3450, 5162
3111	2113, 3119, 3116, 3211, 2146
3112	2141, 2142, 3471, 2147, 3118
3113	3114, 7242, 8283, 7241, 2131, 2132, 2139, 4113, 7243, 3121, 3122, 7131
3114	3113, 7242, 8283, 7241, 2131, 2132, 2139, 4113, 7243, 3121, 3122, 7131
3115	7311, 8331, 7136
3116	2113, 3111, 3119, 2146
3117	2114, 8155
3118	2141, 3471, 2142, 3112, 2147
3119	2113, 3111, 3116, 4132, 3152, 7224
3121	2131, 2132, 2139, 4113, 7243, 3122, 3112, 3113, 3114, 3123
3122	2131, 2132, 2139, 4113, 7243, 3121, 3112, 3113, 3114, 3123
3123	2131, 2132, 2139, 4113, 7243, 3122, 3112, 3113, 3114, 3121, 8170
3131	7311, 7341, 7343, 7344, 2455, 3139
3132	3144, 7244
3141	2145
3142	8340
3144	
3151	2149, 3417, 5161
3152	2213, 3212, 6112, 9211, 4132, 3119
3211	2146, 3116, 2113, 3119, 3211, 2211
3212	2213, 3152, 6112, 9211, 3213
3213	2212, 3152, 6112, 9211, 3213
3224	4222, 3225, 7311
3310	2331, 3320, 2351, 2352, 2359
3320	2331, 3310, 2351, 2352, 2359
3340	3460, 5132, 3330
3411	2411, 3417, 3419, 3412, 3413, 4121, 3433, 4122, 2122
3415	3419
3416	
3419	2411, 3413, 3417, 3412, 3411, 4121, 3433, 4122, 2122, 3415
3421	3422, 3423, 3429
3422	3421, 3423, 3429, 4133
3429	3421, 3423, 3422
3431	3432, 3439, 3442, 4115, 4222, 2470
3433	2411, 4121, 3411, 3412, 3413, 3417, 3419, 4212, 4211
3434	4121, 4122
3439	3432, 3431, 3442, 4115, 4222, 2470, 2431, 4141
3442	3441, 3431, 3432, 3439, 4115, 4222, 2470
3471	2141, 2142, 3112, 3118

continued on next page

Table OA-2: Grouping of "related" 4-digit occupations

continued from previous page

4113	2131, 2132, 2139, 7243, 3121, 3122
4114	
4115	3431, 3432, 3439, 3442, 4222, 2470
4121	2411, 3433, 3411, 3412, 3413, 3417, 3419, 2122, 4122, 3431, 3432, 3439, 3442, 2470
4122	2411, 3433, 3411, 3412, 3413, 3417, 3419, 2122, 4121, 3431, 3432, 3439, 3442, 2470
4131	9330, 5220, 4223, 4133, 4131
4132	3119, 3152
4133	3422, 4131, 9330, 5220, 4223
4142	2431, 3439, 8324, 9151, 4141, 9152, 9141, 9330, 8321, 9151
4190	4115, 3431, 3432, 3439, 3442, 4222, 2470
4211	3433, 4212
4212	3433, 4211
4222	3224, 3225, 7311, 4223
4223	3224, 3225, 7311, 4222
5111	
5122	3223, 5121
5123	9132, 9141
5131	5132, 5133, 5139, 3222, 2230, 3221, 3133, 3231, 3340, 3460, 3330, 3443, 2446, 5141, 5149
5132	5131, 5133, 5139, 3222, 2230, 3221, 3133, 3231, 3340, 3460, 3330, 3443, 2446, 5141, 5149
5161	3151, 2149, 3417, 5169, 7216
5169	5161, 3151, 2149, 3417
5220	4223, 4133, 4131, 9330
6112	6130, 6111, 2213, 3212, 9211, 3152
6121	2223, 9211, 6129, 6122, 6130
6129	2223, 9211, 6121, 6122, 6130
6130	6129, 2223, 9211, 6122, 6121, 6112, 6111, 2213, 3212, 3152
6141	2213, 3212, 9212, 6112
6152	6151, 6153
7113	7112, 7111, 8111, 8112
7121	7131
7122	9313, 7123, 3112, 7311, 7312, 7331, 8240, 9320
7123	9313, 7122, 3112, 7311, 7312, 7331, 8240, 9320
7124	9313, 3112, 7422, 7311, 7312, 7331, 8240, 9320
7129	9313, 3112
7131	7121
7132	9313, 3112
7134	9313, 3112
7135	
7136	3112, 3115, 7311, 7223, 7213, 7214, 7222, 7221, 8124
7137	3114, 3113, 7242, 8283, 7241, 2131, 2132, 2139, 4113, 7243, 3121, 3122, 7131, 8283, 8282, 8281
7139	9313
7141	7142, 8223, 9313
7142	7141, 8223, 9313
7143	9313
7211	
7212	7213, 7214, 7215
7213	7212, 7214, 7215
7214	7213, 7212, 7215
7221	7136, 7213, 7214, 7222, 7223
7222	7136, 7213, 7214, 7221, 7223
7223	7136, 7213, 7214, 7222, 7221
7224	3119
7231	7232, 7233
7232	7231, 7233
7233	7231, 7232
7241	7242, 7243, 2131, 3132, 2139, 4113, 3121, 3122, 7241, 3113, 3114
7242	7241, 7243, 2131, 3132, 2139, 4113, 3121, 3122, 7241, 3113, 3114
7243	7242, 7241, 2131, 3132, 2139, 4113, 3121, 3122, 7241, 3113, 3114
7245	8332, 9312
7311	7312, 3115, 8331, 7136, 3224, 3225, 4222
7312	7311, 3115, 8331, 7136, 3224, 3225, 4222
7313	
7331	
7341	2452, 8253, 8251, 7345, 9320
7343	
7344	3131, 7311, 7341, 7343, 2455, 3139
7345	8252
7346	
7411	5220, 8271
7412	8274
7413	8272
7414	
7422	7124, 7311, 7312, 7331, 8240, 9320, 9313, 3112, 9313
7423	8240
7437	7432, 7433, 8261, 8262, 8263, 7434, 7435, 7436, 7431, 7441, 7442
7442	7432, 7433, 8261, 8262, 8263, 7434, 7435, 7436, 7437, 7441, 7431

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Table OA-3: Grouping of "related" 4-digit occupations

continued from previous page

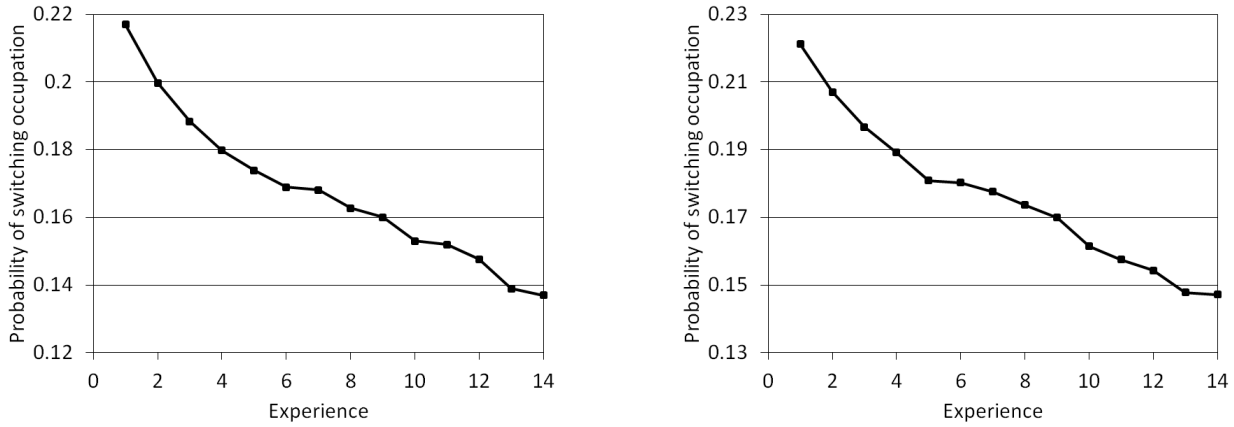
8112	7111, 7112, 7113, 8111
8113	
8122	8121, 8123, 8211
8123	8122, 8121, 8211
8124	7136
8131	8139
8139	8131, 7324, 7323, 7322, 7321
8141	8142, 8143, 6141, 8240, 9330
8143	8142, 8141, 6141, 8240, 9330
8151	8212, 8152
8155	2114, 3117
8159	8229
8161	
8162	9311
8170	3132
8211	8121, 8122, 8123
8212	8151, 8152
8221	
8223	7142, 7141, 9313
8229	8259
8231	
8232	
8240	8142, 8143, 6141, 9330
8251	8252, 8253, 7345, 7341, 9320
8252	8251, 8253, 7345, 7341, 9320
8253	8252, 8251, 7345, 7341, 9320
8261	7431, 7432, 7433, 8262, 8263, 7434, 7435, 7436, 7437, 7441, 7442
8262	7431, 7432, 7433, 8261, 8263, 7434, 7435, 7436, 7437, 7441, 7442
8263	7431, 7432, 7433, 8262, 8261, 7434, 7435, 7436, 7437, 7441, 7442
8266	8269
8269	
8271	7411, 3416, 5220
8273	
8274	7412
8275	7414
8278	
8279	7416
8281	8282, 8283, 7137
8282	8281, 8283, 7137
8283	8281, 8282, 7137
8284	
8285	
8286	
8287	
8290	
8322	
8323	
8324	
8331	3115, 7311, 7136
8332	7245, 9312
8333	
8334	
8340	3142
9113	
9132	9131, 5123, 9141
9141	5123, 9132
9142	
9151	8321, 4142
9152	
9161	
9211	2213, 3152, 3212, 6112, 6121, 6129, 6111
9212	8332, 7245
9213	6154
9312	
9313	7122, 7123, 7124, 7121, 7129, 7131, 7132, 7133, 7134, 7135, 7136, 7137, 7139, 7141, 7142, 7143
9320	8251, 8252, 8253, 7345, 7341
9330	5220, 4223, 4133, 4131, 8240, 8142, 8143, 6141

OA9 Further Discussion on the Effects of Measurement Error

In this Section we provide additional discussion of the possible effects of the measurement error in occupational affiliation data. Since the occupational code is provided to Statistics Denmark by the firm it is more likely for a worker's occupational affiliation to be miscoded when the worker switches firms. However, we have seen that the U-shapes are robust to workers switching occupation *conditional on switching* firms as well as workers switching occupation *conditional on staying* with the same firm. Similarly, the direction of occupational mobility is also unchanged when conditioning on occupation *and* firm switchers or conditioning on occupation but *not* firm switchers. If measurement error were sizable, we would expect switches across firms to be more random and have a flatter curve than switches within firms. We do not find any evidence of this. These results suggest that measurement error is unlikely to substantially affect our findings. Moreover, in Section 2.4.4 we have also seen that grouping occupations together based on the similarity of their descriptions also did not affect our findings, again suggesting only limited possibility for measurement error to play an important role.

OA10 Occupational Mobility and Labor Market Experience

Figure OA-30 shows, on the large and small samples, the predicted probability of switching occupation by years of experience, conditional on the observables used in the benchmark wage regression in the main text. The switching probability is estimated with a logit model including each year of experience as a dummy variable and including all other explanatory variables from the wage regression (e.g., education, tenure in firm, industry, and occupation, marital status, time dummies, and lagged regional unemployment rates). The figure implies that occupational mobility declines substantially with age, a pattern widely documented in the other sources of data in the literature.



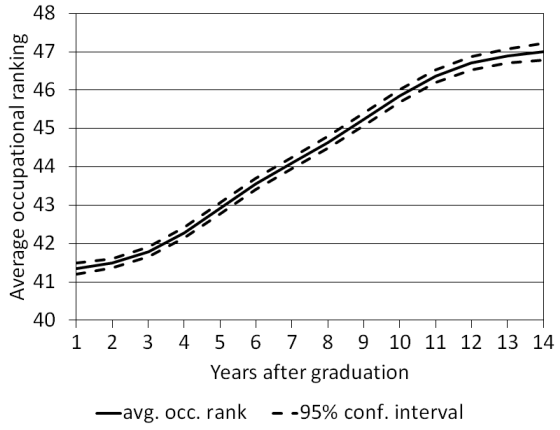
(a) Small sample

(b) Large sample

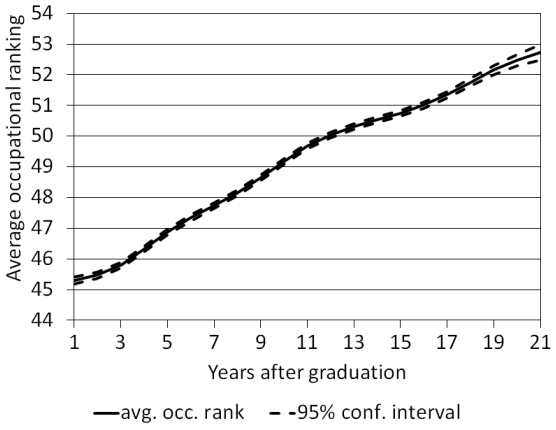
Figure OA-30: Predicted probability of switching occupation by years of experience.

OA11 Average Occupational Percentile by Labor Market Experience

Figures OA-31 and OA-32 show the average occupational percentile by years after graduation. Similar to the findings in the US literature, reviewed in Footnote OA2 in the Online Appendix, we find a strong tendency for workers to move up to higher paying occupations with age.

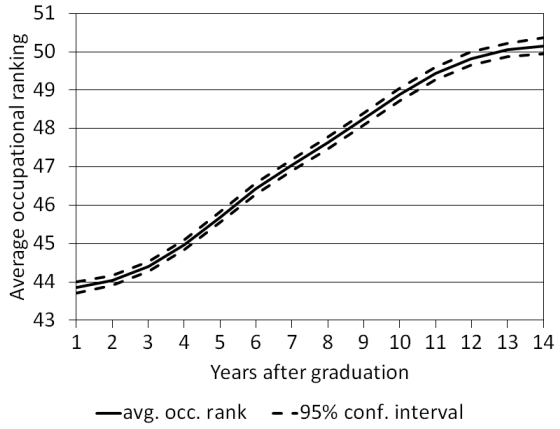


(a) Small sample

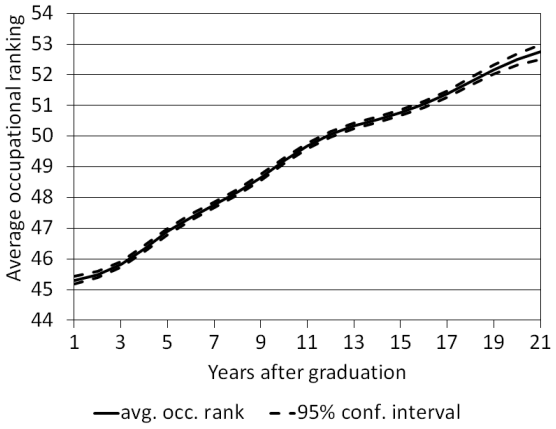


(b) Large sample

Figure OA-31: Average occupational percentile by years after graduation. Occupation percentiles from raw wages.



(a) Small sample

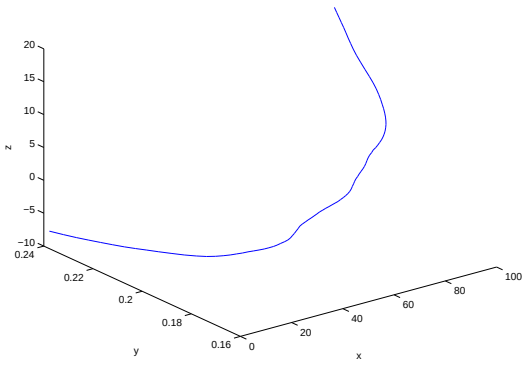


(b) Large sample

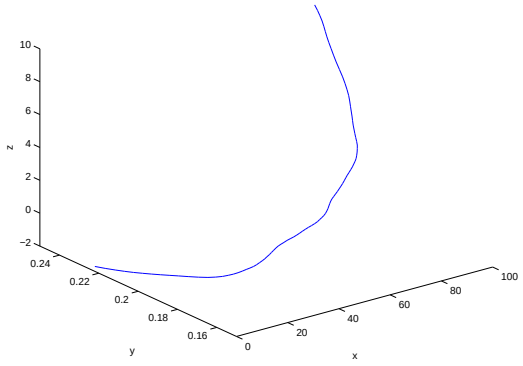
Figure OA-32: Average occupational percentile by years after graduation. Occupation percentiles from wage residuals.

OA12 Alternative Representation of the Patterns of Occupational Mobility

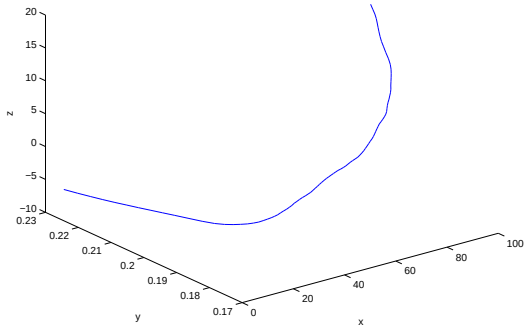
Several key patterns of occupational mobility documented in the main text can be simultaneously summarized in one plot, as in Figure OA-33. The x-axes measures the percentiles of the within-occupation wage distribution, the y-axes measures the probability of switching occupation, and the z-axes measures the average number of occupations a worker moves up (where moving down counts negatively) conditional on the worker switching occupations. While the figure captures all the relevant information in a very concise fashion, it seems relatively difficult to visually interpreted. Instead, in the main text we report the projections of this figure that together provide all the relevant information. In particular, in separate figures we report, for workers at each percentile of the within-occupation wage distribution (1) the probability of changing occupations, (2) the probability that the switch involves a move to a higher ranked occupation, and (3) the average number of ranks moved up (moves down counted negatively).



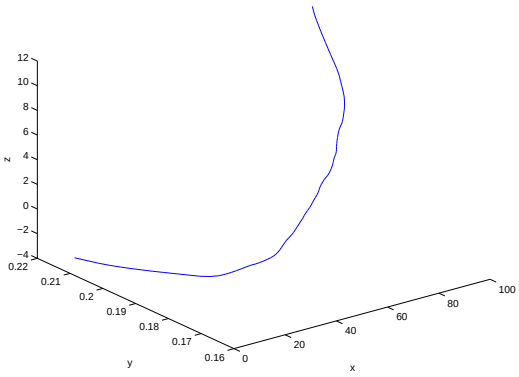
(a) Large sample, raw wages.



(b) Large sample, residual wages.



(c) Small sample, raw wages.

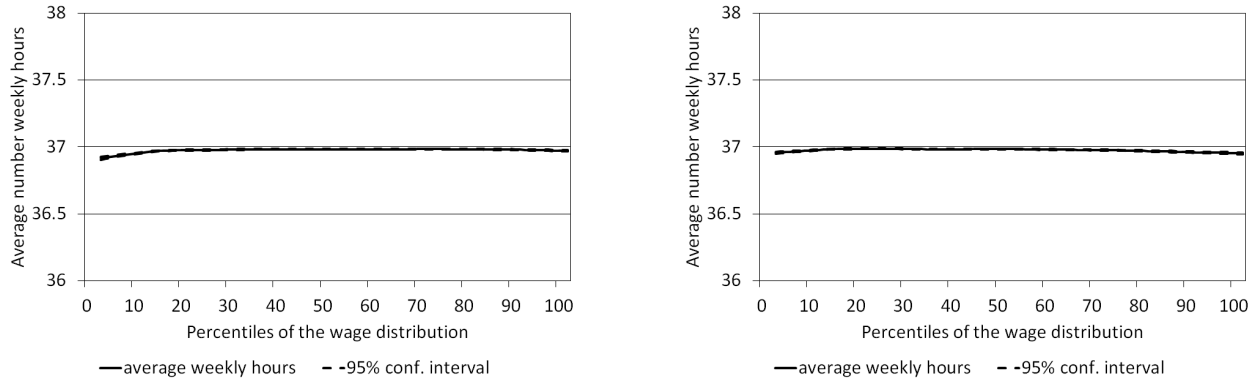


(d) Small sample, residual wages.

Figure OA-33: Non-parametric plot of probability of switching occupations and of the magnitude of a change in occupational rank upon a switch, conditional on workers' position in the within-occupation wage distribution. Sample of male workers.

OA13 Average Hours Worked by Percentile of Within-Occupation Wage Distribution

Figure OA-34 plots the average weekly hours worked by workers across percentiles of the within-occupation wage distribution. We find that average hours are relatively constant, although slightly lower for workers with the lowest wages in their occupations.



(a) Distribution of raw wages.

(b) Distribution of wages residuals.

Figure OA-34: Non-parametric plot of average number of weekly hours worked by worker's percentile in the relevant wage distribution.

OA14 Extensions and Alternative Explanations

As we mentioned, our empirical findings on the shape and the direction of sorting conflict with predictions of match-specific learning models (Jovanovic (1979), McCall (1990), Neal (1999)) and of island-economy models with human capital (Kambourov and Manovskii (2005, 2009a)). In both types of models low wage earners tend to switch, and since they did not receive any additional information about their fit to other occupations they take a random draw for their next occupation. In contrast, the crucial part of our model is that the experience of workers in their current occupation determines their choice of the next occupation, and that the occupations can be ranked. In such a world a bad fit can be characterized by underqualification *or overqualification* of a worker for a particular job. This means that it is not only low wage workers who leave an occupation, but also very qualified workers with high wages. This logic already highlights that it is the vertical sorting part of our theory that is most important. What drives the changes in workers ability is less relevant, even though we belief that learning gives a particularly natural interpretation. In the following we discuss alternative explanations.

OA14.1 Shocks to Ability

Assume that ability is perfectly observable, but ability changes from one period to the next according to $a_{i,t} = a_{i,t-1} + \varepsilon_{i,t}$, where the term $\varepsilon_{i,t}$ still is drawn i.i.d. from a normal distribution with mean zero and variance ϕ_ε. It is easy to see that also in this setting worker sort into better occupations after sufficiently positive shocks, and into lower occupations after sufficiently negative shocks, and mobility remains U-shaped. Yet mobility does not decline with labor market experience, in contrast to the case with learning where over time the relevance of additional information declines. If one combines shocks to ability with learning, we conjecture that mobility does decline because of the role of learning but declines less and remains non-trivial even for older workers due to the presence of the shocks to ability.

OA14.2 Learning-by-Doing, Promotions, and Switching Costs

In our basic model, ability was constant over time. Improvements in general ability through learning-by-doing can be easily incorporated by assuming that ability increases deterministically with years of labor market experience (e.g., $a_{i,t} = a_i + \theta t$ for some parameter θ). Since human capital acquisition follows a known and deterministic process, workers can filter it out and learn the same about the fixed but unknown component a_i as in our basic model. Even though they sometimes revise their assessment about their skills downward after negative output realizations, on average there is a positive drift in their assessment of their skills because they incorporate the deterministic time trend. This leads naturally to a somewhat higher aggregate probability of switching to higher than to lower occupations, as is visible in Figure 3. In the Online Appendix

OA11 we show that indeed the average occupational rank of workers increases with labor market experience.[OA2] Even in the absence of any belief-updating (i.e., even if the variance of the first signal is zero and a_i is fully observed) the accumulation of general human capital would generate upward mobility in the model. Downward mobility can arise either through belief-updating as in our model, but would also arise if large amounts of skill become obsolete at stochastic points in time.

We should note that general human capital accumulation through learning-by-doing as discussed in the previous paragraph differs from occupation-specific human capital accumulation. In particular, the latter acts as a switching cost since it is lost when changing occupation. While the workers problem now becomes a dynamic program that is harder to analyze, numerical examples suggest that for plausible specifications of general and occupation-specific human capital accumulation the high levels of occupational mobility and the U-shapes persist, as indicated for a particular parametrization in Figure OA-36 in the Online Appendix OA17. It might be worth noting that the wage-distribution within different occupations have overlapping support because of the switching costs, which accords with the substantial overlap in the data but was absent under costless switching when wages are given by (6). Such overlap is always present if wages are at least partially paid according to (5) because in that case wages do reflect actual output and not only the prior about mean ability.

Part of the Online Appendix OA17 lays out a general formulation for human capital accumulation and switching costs, and formalizes the workers dynamic program and the market equilibrium. We think that this is important in future work that tries to control for selection precisely to estimate these aspects of human capital improvements. In the Online Appendix OA18 we show that our structure shares key elements with a more reduced form specification in Gibbons, Katz, Lemieux, and Parent (2005), and therefore inherits the instruments that they employ to control for endogeneous sectoral choice.[OA3] While these are permissible only if there

[OA2] Hall and Kasten (1976) and a number of later papers (e.g., Miller (1984), Sichernam and Galor (1990)) have also found that there is a systematic tendency for workers to move up to higher paying occupations with age. Wilk and Sackett (1996) have noted the tendency of workers to move to occupations requiring higher cognitive skills with age. Note that human capital accumulation is not necessary to induce an upward bias in switching: Depending on the precise values of the γ_k's and P_k's the workers might enter mostly in low occupation when young and then move up (or the reverse, depending on parameters). The main effect of general human capital is that it adds an *additional* element that unambiguously shifts young low-human-capital workers to less productive occupations and older high-human-capital workers to more productive occupations.

[OA3] Gibbons, Katz, Lemieux, and Parent (2005) consider the partial equilibrium problem of a worker that faces a similar payoff structure as in our model. They argue which lagged variables can serve as instruments for occupational choice within the structure. They use this on a small dataset and do not check the implications for occupational mobility that our work highlights. Also, their partial equilibrium model has the worker payoffs raised to an exponential power which has the feature that in the absence of human capital accumulation young workers would work in high occupations because the upside potential of their ability within the exponential structure is particularly high. Over time workers on average move to lower occupations in the absence of human capital accumulation. Despite these differences, the main message in terms of applicability of instrumental variables still applies here. We discuss the connections more deeply in the Online Appendix OA18.

are no shocks to occupational productivity over time, they might constitute a promising first step to assess human capital accumulation in the presence of endogeneous selection of the kind highlighted in this paper.

OA14.3 Compensating Differentials

It might be possible to obtain U-shaped switching based on compensating differentials.[OA4] Assume workers do not only differ in their productivity but also in their disutility of working in a particular occupation, and there are switching costs and bargaining within the job. Then workers with high disutility have higher value of leaving the job, and the firm can only entice them to stay by bargaining up to a higher wage. High wage workers would be either very productive or disliking the job, and the latter are more likely to change if an opportunity arises. Similarly, low paid workers might either be unproductive or have low disutility of working in this occupation, and in this case the former would be more inclined to leave the occupation if a new occupation would allow them a new draw of productivity. This could include U-shapes in occupational switching, but does not immediately suggest a particular direction in terms of the new occupation that workers select.

One might also conjecture that high-wage workers are low-hours workers, who turn out to have high wage (earnings divided by hours) because they have low hours. They might move to seek longer hours, even if their wage rate falls, because they want more earnings. We investigate this possibility further in the Online Appendix OA13. In particular, in Figure OA-34 we plot the average weekly hours by percentile of the within-occupation wage distribution. We find that average hours are relatively constant, although slightly lower for workers with the lowest wages in their occupations. The variation in hours appears too small to have a substantial impact on our main findings.

OA14.4 Internal Labor Markets within Firms

In Section 2.4.2 we documented U-shapes in occupational mobility both in the total sample, as well as conditional on staying with the same firm or switching firm. In figure OA-35 we replicated the graphs where wage percentiles are computed from residual wages and added two extra lines of minimum and maximum mobility in the graphs. Despite an overall similarity in pattern, there do remain substantial differences between the graphs. First, the solid lines of Figures OA-35(a), OA-35(b), and OA-35(c) indicate that the average level of occupational mobility is very different, ranging from 18.3% overall to 14.2% for firm-stayers and 34.5% for firm-switchers. Second, there are large differences in the depth of the U-shape given by the difference between the minimum occupational mobility and the maximum occupational mobility (measured as the average mobility

[OA4] We thank an anonymous referee for pointing out this possibility.

of the top 5 percentiles and bottom 5 percentiles of the within-occupation wage distribution). It is 4.0% overall and increases to only 5.0% for firm-switchers even though average mobility is roughly doubled. It is 3.0% for firm-stayers. Finally, the U-shape is more skewed to the left on the sample of firm switchers and to the right on the sample of those staying with the firm.[OA5]

It is possible that conditions within a firm are a driver of occupational mobility. That more high-ability workers change occupations within firms might be due to sophisticated contractual and information settings within the firm. For example, if firms use up-or-out contracts and learn workers' ability before the workers themselves do, they would promote the higher-ability individuals to new tasks and separate from the others. However, the right hand side of the directional graphs OA-12 and OA-13 in these figures are nearly identical, meaning that conditional on ability a worker who switches occupation is not more likely to move to a higher ranked occupation within the firm than across firms. While there might still be a role of within-firm contracts for occupational mobility, this observation led us to abstract from the role of firms in the simplest benchmark version of our model.

An alternative viewpoint is that occupational mobility might affect mobility across firms. We explore this channel here in more detail, and show that our model of frictionless occupational mobility combined with a very simple "theory" of firm switching can quantitatively account for the observed patterns of occupational mobility conditional on switching firm and conditional on staying with the firm without affecting any of the analysis so far in the paper. We retain the overall theory of frictionless mobility and, in addition to our structure on occupations, we envision firms that comprise of many jobs in various but possibly not all occupations. Consider workers who switch employers for random reasons as well as when a change in occupation is desired but the new occupation is not available within the firm (Papageorgiou (2011) proposes a similar logic in a model without occupational hierarchies). In such a setting, the probability of switching occupation conditional on switching employer would be substantially higher than conditional on not switching employer, because some employer changes are precisely motivated by the desire to change occupations, which might explain the level difference between the graphs in Figures OA-35(b) and OA-35(c). To match the observation that conditional on staying within the same firm the U-shapes are more pronounced at the top, while conditional on switching firms they are more pronounced at the bottom, we need the asymmetry that workers tend to find it easier to switch up within the firm than to switch down within the firm. We find this to be the case in the data, although a more elaborate theory of firm-worker matching is required to understand why workers tend to be in firms where there is more scope for upward switching than for downward

[OA5]These numbers are for U-shapes in wage residuals. Similar patterns are evident for raw wages, and a similar methodology to the one that follows can be applied to those. The case of wage residuals gives a more balanced unconditional U-shape and the different direction of skewedness conditional on staying versus switching firm is more visible, making this a clearer benchmark.

switching.[OA6]

In the following, we illustrate that our simple view of firms has the potential to account for the data-patterns that we observe. To be more specific, assume that workers randomly switch firm with probability δ. Moreover, if they want to switch occupation, then there is a chance that the new occupation is not available within the same firm, in which case they also have to switch firm. Let γ denote the average probability that this is the case. We will explore the consequence that this is not constant across the wage-spectrum a bit later. In our data, the average probability α of switching occupation is 18.3%. The average probability β of switching occupation conditional on staying with the same firm is 14.2%. Since

$$\beta = \frac{\text{occ switching \& staying with firm}}{\text{staying with firm}} = \frac{(1-\delta)\alpha(1-\gamma)}{(1-\delta)(1-\alpha\gamma)}, \tag{OA1}$$

we can back out an implied value for the average chance of not finding the desired occupation within the current firm of $\gamma = 26.4\%$. Similarly, the average probability $\hat{\beta}$ of switching occupation conditional on not staying with the same firm is 34.5%. Since

$$\hat{\beta} = \frac{\text{occ switching \& not staying with firm}}{\text{not staying with firm}} = \frac{\delta\alpha + (1-\delta)\alpha\gamma}{\delta + (1-\delta)\alpha\gamma}, \tag{OA2}$$

we can back out an implied value for the firm-switching shock of $\delta = 16.3\%$. This means that workers leave their firm on average every six to seven years for reasons orthogonal to our theory of occupational mobility, which seems a plausible magnitude.

While these numbers were computed to rationalize the difference in average occupational mobility between firm-switchers and firm-stayers, we now use them to analyze the implied effect on the depth of the U-shape. For firm-stayers, (OA1) is the relevant equation. For firm-switchers, (OA2) is the relevant equation. Instead of using the population-wide average occupational mobility α in these formulas, we can use the high mobility at the extremes of the within-occupation wage spectrum or the minimum mobility in the interior of the wage spectrum. Using those numbers instead of the average mobility in (OA1) and (OA2), respectively, we can analyze how much mobility should vary for the subgroups of firm-stayers and firm-switchers across the wage spectrum.

In terms of population-wide numbers, the bottom horizontal line in Figure OA-35(a) indicates a minimum mobility of $\underline{\alpha}$= 16.8% and when we average the mobility at the top and bottom 5 percentiles of the wage distribution, as indicated by the top horizontal line, it shows a mobility

[OA6] One obvious explanation is that there are moderate but strictly positive costs of switching firm and that human capital accumulation induces an upward trend in workers' ability. In that case, after paying the switching costs, a worker would try to find a new firm with more upside than downside potential relative to his current ability since it is more likely that it will develop positively. If the expected ability does decline, the worker might unfortunately fail to find the right occupations within the firm. We leave a full development of this theory for future work.

of $\bar{\alpha} = 20.8\%$, yielding a depth of the U-shape of 4.0%. This should have consequences for the mobility of firm-stayers. If we replace the average occupational mobility α in formula (OA1) by this minimum mobility $\underline{\alpha}$ and this average maximum mobility $\bar{\alpha}$, respectively, we obtain the following implied values for firm-stayers: a minimum mobility of 13.0% and an average maximum of 16.2%, implying a reduction of the depth of the U-shape to 3.2%. These numbers are close to the actual numbers for firm-stayers in Figure OA-35(c), where the minimum is 12.9% and the averaged maximum is 15.9%, with a depth of the U-shape of 3.0%.

Similarly, we can consider the implications for firm-switchers by replacing the average α in (OA2) by $\underline{\alpha}$ and $\bar{\alpha}$, respectively. We obtain the following predictions: a minimum mobility of 32.2% and an averaged maximum mobility of 38.1%. This suggests a depth of the U-shape for firm-switchers of 5.9%, which might be surprising because the level of mobility is nearly 100% larger for firm-switchers relative to the full sample but the depth of the U-shape is only increased by 50%. In the data underlying Figure OA-35(b) we indeed find a U-shape with depth 5.1% for firm-stayers, driven a minimum mobility of 33.0% and an averaged maximum utility of 38.1%. In this sense our "theory" of firm mobility tracks the actual data surprisingly closely.

The calculations in particular track the minimum occupational mobility conditional on firm-staying or switching well. For the maximum, we averaged the mobility on the left and on the right of the wage spectrum. This is clearly a simplification. As mentioned earlier, relative to the overall U-shape in Figure OA-35(a), the U-shape for firm-switchers in Figure OA-35(b) is tilted to the left and the one for firm-stayers in Figure OA-35(c) is tilted to the right. While we do not have any asymmetry in this "theory" so far, the data suggest an interesting interpretation: workers in the top of the occupational wage distribution are more likely to have their new occupation within their current firm than workers at the bottom of the occupational wage distribution.[OA7]

Assume, for illustration, that the workers with wages in the top 5% of their occupation who want to switch occupation have a 10% higher probability of finding the new occupation within their current firm relative to the workers in the bottom 5% of within occupation wage distribution.[OA8] That is, high wage earners within an occupation have a chance $(1 - \gamma_H)$ of having their new occupation in their current firm that is 1.1 times the chance $(1 - \gamma_L)$ that low-wage workers face, but they have unchanged average so that $(\gamma_H + \gamma_L)/2 = \gamma$. This implies that $\gamma_L = 29.9\%$ and $\gamma_H = 22.9\%$. We can now differentiate the mobility at top wages from the

[OA7] Occupational switchers who are within top 5% of the wage distribution in the occupation they left have a 9.2% higher probability that the occupation to which they move is present within their old firm relative to occupational switchers who come from the bottom 5% of the wage distribution in their occupation. One reason why high earners might have an easier time finding the new occupation within their own firm is that most workers are in jobs where more upward mobility is possible within the firm and the top wage earners within an occupation tend to have a higher chance to move upward. We do not have a theory why workers select this way, but one possibility is that there are moderate switching costs and since there is some trend of becoming more able over time the upward mobility is more important, so workers tend to choose to enter firms that allow for more upward than downward mobility. We leave this investigation for future work.

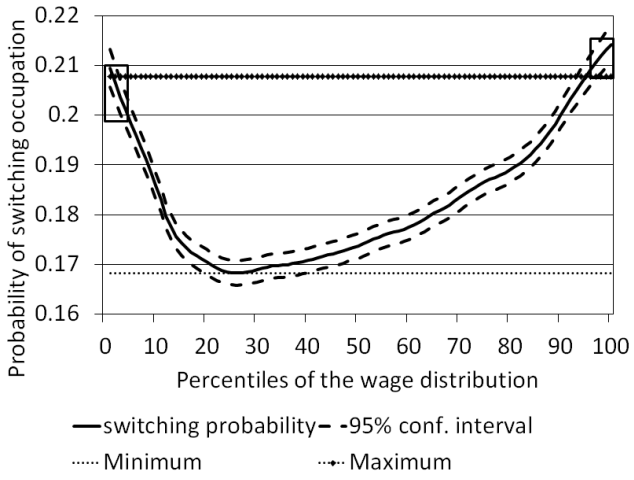
[OA8] This number is in line with that in Footnote OA7.

mobility at bottom wages. While both are higher than average, they now differ in magnitude. Mobility at the top end of the wage spectrum is computed using $(\gamma_H, \bar{\alpha})$ instead of (γ, α). Mobility at the bottom end is computed using $(\gamma_L, \underline{\alpha})$, because for these workers the probability of finding the new occupation within their current firm is lower. For firm-stayers we apply these values in equation (OA1), which yields differences in occupational mobility between the top and the bottom earners of +1.3% (16.8% at the top and 15.5% at the bottom). In the data for firm-stayers the difference is +2.1% (16.9% at the top and 14.8% at the bottom). The occupational mobility of firm-switchers is given by (OA2), and we obtain a difference of -3.6% of mobility between the top and bottom earners (36.3% at the top and 49.9% at the bottom). In the data it is -2.2% (36.9% at the top and 38.1% at the bottom). The fact that we overshoot for firm-switchers means that even for somewhat lower values of $\gamma_L - \gamma_H$ we would do well on this margin. While this exercise does not match the data perfectly, it tracks it rather closely, suggesting that future work along this lines might hold promise.

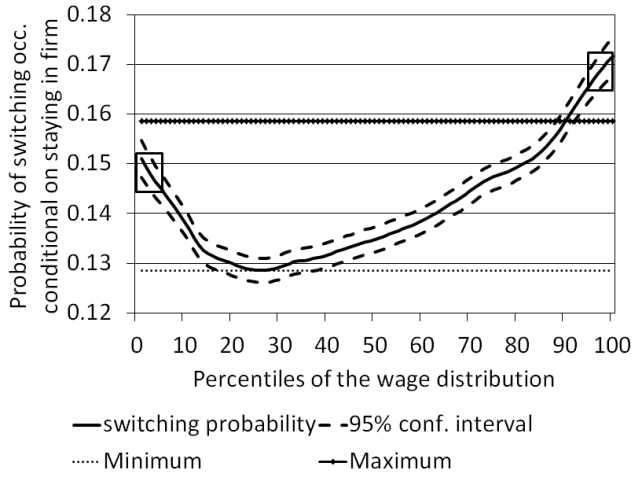
We view these findings as an indication that firms can be integrated into our study of occupational mobility in a way that retains the basic insights on occupational mobility but with additional insights on firm mobility. We do acknowledge, though, that a more careful study of the role of firms is necessary. One might conjecture that firms themselves have types and workers sort across firms in a similar manner as they sort across occupations. This might ultimately yield a unifying theory of occupation-firm-worker matches, but it exceeds the scope of this paper. Abstracting from occupations, this path has been pursued in the recent literature that confronts matched employer-employee data.[OA9] Our choice to focus instead on occupational mobility was driven by the large mobility on this dimension and by the large reduced-form estimates on human-capital regressions associated with occupational tenure that seems to require an adequate model to control for selection.[OA10] Since the same regressions do not give the same prominence to firm or industry tenure, since many of the qualitative features are similar for firm-stayers and firm-switchers, and since this section suggests that a simple notion of firms has the potential to explain many features of the data without changing the conclusions on occupational mobility, we concentrated on occupational mobility while abstracting from firm mobility for the main analysis in the paper.

[OA9] Starting with the work of Abowd, Kramarz, and Margolis (1999) on two-sided fixed-effect estimation in matched employer-employee data, the firm-worker matching has received increasing attention. Amongst others, Gautier and Teulings (2006), Lopes de Melo (2009), Eeckhout and Kircher (2011), Hagedorn, Law, and Manovskii (2012) provide further literature review, discussion of the structural problems with the fixed-effects estimation, and suggest potential solutions. The concerns carry over to occupation-worker matches, which is one reason why we take a very different empirical path in our analysis. Our approach side-steps these issues, but requires a lot of workers per occupation, which is the reason why we have not used it for the study of firm-worker-matches as we point out in Section 2.4.6.

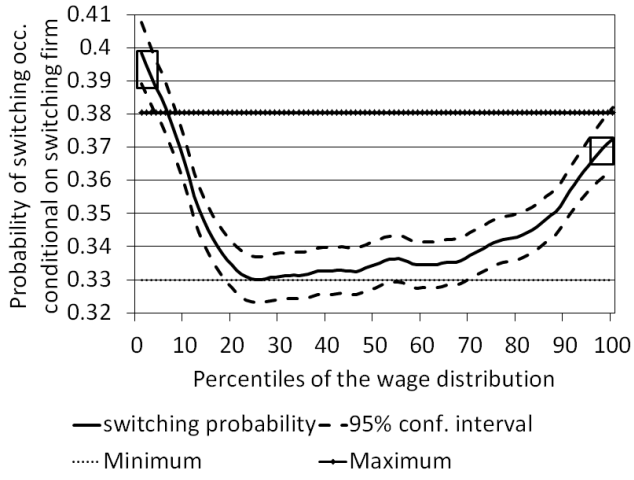
[OA10] For the human-capital analysis, see e.g., Shaw (1984, 1987), Kambourov and Manovskii (2009b), and Groes (2010).



(a) Occupational mobility



(b) Occupational mobility conditional on switching firm



(c) Occupational mobility conditional on staying in firm

Figure OA-35: Non-parametric plots of probability of switching occupation, unconditional, and conditional on switching and staying in the firm. Occupation percentiles from wage residuals

OA15 Mobility in Response to Changing Occupational Productivity: Theory

In our study of changing occupational mobility in the main body of the paper, only one occupation changed its productivity. Here we allow simultaneous changes in productivity and show that the main result generalizes. To show this, we need to slightly expand the notation. Denote calendar time by τ and index occupations by a name $r \in \{0, 1, ..., K\}$ instead of their rank in terms of productivity (since the rank is now changing), with $r = 0$ still being home production with constant productivity of zero. We retain the same notation as in the main text, with the adjustment for the name of the occupation and an additional superscript indicating calendar time. For example, $P_r^\tau > 0$ denotes the productivity of occupation r at calendar time τ. Productivities can be deterministic functions of calendar time, but are also allowed to be realizations of some stochastic process. Stochasticity does not affect the analysis since workers can still costlessly change occupations each period. Importantly, the cross-sectional distribution F of beliefs remains unchanged because it does not rely on occupational choice. Therefore, the model can still be solved period by period. We assume that each period productivities can be strictly ordered.

We also continue to assume that the measure γ_r of entrepreneurs in each occupation r remains constant, although our results are robust as long as entry is sufficiently inelastic to induce competition among workers for scarce jobs.[OA11] Inelastic labor demand might arise, for example, because a job in an occupation needs a particular type of physical capital that is not easily adjusted when the demand for the services of the occupation changes. See the further discussion in the Online Appendix OA16.

Given the productivities that prevail in period τ, let $\underline{B}_r^\tau$ and $\overline{B}_r^\tau$ be the lower and upper bounds on the ability (analogous to bounds B_k and B_{k+1} in the preceding section). That means that workers with beliefs in $[\underline{B}_r^\tau, \overline{B}_r^\tau)$ choose to work in occupation r. Equation (8) readily reveals that these beliefs depend exclusively on the number of jobs that offer lower wages, not on the level of productivity per se. It will therefore be convenient to define Γ_r^τ as the measure of all jobs that have weakly lower productivity than the jobs in occupation r in period τ. We call Γ_r^τ the *position* of occupation r in the distribution of productivities. When the position of a specific occupation r stays constant for two periods, i.e. $\Gamma_r^\tau = \Gamma_r^{\tau+1}$, it follows immediately that the cutoffs that determine who stays in the occupation remain constant, i.e. $\underline{B}_r^\tau = \underline{B}_r^{\tau+1}$ and $\overline{B}_r^\tau = \overline{B}_r^{\tau+1}$, and the switching behavior of workers in occupation r remains essentially unchanged compared to the baseline model analyzed in the main text.[OA12] Switching is maximal at both ends of the earnings

[OA11] We discuss entry in the Online Appendix OA16. When entry is completely elastic, the model resembles the Roy (1951) model, since each worker essentially decides by himself whether to "buy" a job in occupation k, independent of the choices of all other workers.

[OA12] For the baseline model in Section 3 where productivities do not change, define $\hat{s}_{k,t}(X) = s_{k,t}(P_k X - \Pi_k)$ and $\hat{S}_{k,t}(A) = S_{k,t}(P_k A - \Pi_k)$. This gives the switching probabilities based on output/ability rather than on the wages.

(and ability) spectrum, and is lowest at intermediate income levels.

When an occupation improves in rank between period τ and $\tau+1$ in the sense that $\Gamma_r^{\tau+1} > \Gamma_r^{\tau}$, the bounds on ability improve in the sense that $\underline{B}_{r_\tau(k)}^{\tau+1} > \underline{B}_{r_\tau(k)}^{\tau}$ and $\overline{B}_{r_\tau(k)}^{\tau+1} > \overline{B}_{r_\tau(k)}^{\tau}$. An immediate implication of the increased bounds is that workers who stay in the occupation between the two periods are a positive selection of the initial workforce.

Another implication of the increased bounds of an improving occupation is that high ability workers join while low ability workers are driven out. This has direct consequence of the patterns of switching that we observe. In particular, in rising occupations high wage workers tend to stay while low wage workers tend to leave. The following proposition is proved for the case where firms absorb the uncertainty of the production process.

Proposition OA 1 *Consider an occupation r with a sufficient relative rise in productivity such that $\Gamma_r^{\tau+1} \geq \Gamma_r^{\tau}+\gamma_r$. If wages are set according to (6), the probability of switching out of occupation r between and τ and $\tau+1$ decreases with higher wages for workers in the same cohort. The reverse holds for a sufficient decline in relative productivity such that $\Gamma_r^{\tau+1} \leq \Gamma_r^{\tau} - \gamma_r$.*

Proof. We prove the result for a rising occupation; analogous steps establish the result for a declining occupation. Wages in (6) rise in the prior A, and the distance $|\underline{B}_r^{\tau+1} - A|$ decreases in A for all workers that choose occupation r in period τ [since $A \leq \overline{B}_r^{\tau}$ and $\overline{B}_r^{\tau} \leq \underline{B}_r^{\tau+1}$ when $\Gamma_r^{\tau+1} \geq \Gamma_r^{\tau} + \gamma_r$]. Thus, workers with a higher prior are closer to the region $[\underline{B}_r^{\tau+1}, \underline{B}_r^{\tau+1})$ where they stay in r, and therefore it is more likely that their posterior falls into this region (which follows formally from single-peakedness and lateral adjustment of the update G_t). ■

A proposition with similar content can be proved when workers are residual claimants:

Proposition OA 2 *Consider wages according to (5). Consider an occupation r that rises sufficiently in position, $\Gamma_r^{\tau+1} \geq \Gamma_r^{\tau} + \gamma_r$, and consider the probability of staying in r between τ and $\tau+1$. Then only workers who had wages above the occupational mean in τ stay, while all lower wage workers leave. The reverse holds for a sufficient decline in position, $\Gamma_r^{\tau+1} \leq \Gamma_r^{\tau} - \gamma_r$.*

Proof. Consider the case where $\Gamma_r^{\tau+1} \geq \Gamma_r^{\tau} + \gamma_r$,; results for the other case follow analogous steps. Because of the increase in rank, we have $\underline{B}_r^{\tau+1} > \overline{B}_r^{\tau}$, which means that workers only stay in occupation r if their update exceeds the top threshold before the productivity change. It is easy to see that any worker with mean ability in $A \in [\underline{B}_r^{\tau}, \overline{B}_r^{\tau})$ that earns a wage at or below the occupational mean has an update $A' \leq \overline{B}_r^{\tau}$. While he could still be suitable for occupation r if its rank hand not changed, he is no longer suitable given that the occupation has improved and better workers compete for the same jobs. ■

It can be shown that $\hat{s}_{k,t}(X)$ and $\hat{S}_{k,t}(A)$ are invariant to the exact productivity level of occupation k, as long as it retains the same position among the occupations.

OA16 Free Entry into Occupations

In the main body of the paper we have taken the number of jobs per occupation as fixed. Here we briefly outline that the model extends to an economy in which jobs can be created at some opportunity cost. Clearly entry costs have to differ between occupations to sustain several occupations with different productivities (since otherwise only the most productive occupations will operate). Assume that the per-period cost to create and maintain a job in occupation k (or r, if we adopt the notation from section OA15) is given by $C_k(\gamma_k) = \overline{c}_k + c(\gamma_k)$, except for home production sector $k = 0$ where entry costs are $C_0(\gamma_0) = 0$. That is, there is a fixed cost $\overline{c}_k$ independent of the number of other entrepreneurs who create jobs, and a component $c(\gamma_k)$ that depends on the overall number of entrants into the occupation.

If we assume that $c(\gamma_k) = 0$, then we have perfectly elastic supply of jobs. This corresponds to a model in which workers can simply rent jobs at cost $\overline{c}_k$. Occupations with lower productivity have to have lower costs as otherwise no worker would rent the job. The model is particularly simple to solve because firms profits are exogenously tied to the entry costs:

$$\Pi_k = \overline{c}_k. \tag{OA3}$$

This entry assumption corresponds to the standard Roy models which are essentially decision-theoretic: any worker that wants to enter occupation k can do so by "buying" a machine at cost c_k, there are no further congestion effects, and competition between workers is essentially absent.

The drawback of having only fixed costs $\overline{c}_k$ is the response of the market when productivities change over time, as we analyzed for the basic model in Section 4. In a model with absolute advantage, if an occupation becomes more productive than another one but retains its lower entry cost, then the other occupation completely disappears. There are various reasons why we don't expect this to occur: Prices might change in response to output changes or costs might change in response to the number of jobs in the occupation. Costs change for example if there is heterogeneity among entrepreneurs and $c(\gamma_k)$ reflects the costs of the marginal entrant: the more entrepreneurs enter the less able the marginal one is.[OA13] We integrate this idea into the model by assuming that $c(.)$ is increasing and convex. If prices are always high enough to cover the fixed cost, then Inada conditions on the second component ensure that even with changing productivities no occupation completely vanishes, but the level of operation might substantially

[OA13] In this interpretation all infra-marginal entrants will generate profits larger than their costs. Only the marginal entrant will be exactly indifferent to entering.

vary.[OA14,OA15] In the limit where it is zero up to γ_k and infinite thereafter corresponds exactly to the setting in the main body of the paper. Here we see that even for intermediate ranges our results carry over when occupations change rank.

An equilibrium is now a tuple $\Pi = (\Pi_0, ..., \Pi_K)$ of profits and a tuple $\gamma = (\gamma_0, ...\gamma_K)$ of entry levels such that all conditions in Equilibrium Definition 1 are satisfied and additionally it holds that $\Pi_k = C(\gamma_k)$ for all $k > 0$. All results regarding switching behavior from Section 3 apply, only that now the cutoffs B_k are determined in a way that incorporates optimal entry. It is easy to solve for these cutoffs by considering the following set of equations in analogy to (7) and (8)

$$\frac{C(\gamma_k) - C(\gamma_{k-1})}{P_k - P_{k-1}} = B_k, \tag{OA4}$$

$$F(B_k) - F(B_{k-1}) = \gamma_k, \tag{OA5}$$

for all $k > 0$.

Equation system (OA4) and (OA5) allows us to determine the size of each occupation in each period even in the case when productivities are changing as in Section 4. We can now define an improving occupation in the sense of Proposition 5 as one that improves its position at both the high and the low end, i.e. $\Gamma_r^{\tau+1} > \Gamma_r^{\tau}$ and $\Gamma_r^{\tau+1} - \gamma_r^{\tau+1} > \Gamma_r^{\tau} - \gamma_r^{\tau}$, where again superscripts indicate the time period. A sufficient increase additionally means $\Gamma_r^{\tau+1} \geq \Gamma_r^{\tau} + \gamma_r^{\tau}$. With these extended definitions the proposition remains valid. If on the other hand an occupation with increasing productivity expands so much in size that the measure of jobs with strictly lower productivities $\Gamma_r - \gamma_r$ actually decreases, it starts to employ not only more high ability but also more low ability workers. When we consider a smooth increase in the productivity of occupation r and hold the other productivities fixed, it is easy to see that the expansion of the workforce is continuous but the position switches upward when it overtakes another occupation, at which point indeed both upper and lower position Γ_r and $\Gamma_r - \gamma_r$ increase jointly and the ability of the work force improves substantially in the sense of first order stochastic dominance.

[OA14] In particular, it is easy to verify that the following conditions ensure employment in all occupations $k > 0$ in all periods. Assume that $c'(0) = 0$ and there is some constant $\psi > 0$ and employment level $e = [\alpha T - F(\psi)]/K$ such that $\lim_{\gamma \to e} c'(\gamma) = \infty$, which ensures that no occupation employs more than e workers. Moreover, assume that prices evolve according to some (possibly stochastic) process with the feature that there exists a lowest price $P > 0$. That is, no occupation $k > 0$ ever draws a price below P. Then $\psi P > \max_k \bar{c}_k$ ensures that it is optimal to have at least some employment in each occupation at each point in time because the worker with ability ψ never gets employed and therefore could be hired for free.

[OA15] Another alternative formulation that ensures the operation of all occupations is that prices are changing while entry costs remain constant, i.e. $P_k(\gamma_k)$ is dependent on the level of employment and C_k is fixed. Together with some Inada conditions still all occupation remain active, but the requirement that $\Pi_k = C_k$ implies that the equilibrium ordering of the productivities $P_k(\gamma_k)$ of occupations cannot change.

OA17 Human Capital and Switching Costs

In this setting we allow for a general process of general and occupation-specific human capital accumulation and for switching costs. We introduce these elements into the basic environment of Section 3, and then show in simulations that the basic patterns for mobility still arise for reasonable parameter values.

For general human capital, assume that a worker at the beginning of his t^{th} year in the labor market has human capital $H(t)$. In the main body of the paper we only considered $H(t) = \theta t$, but we allow for a more general specification here. Moreover, a worker who starts his ι^{th} consecutive year in occupation k has human capital $h_k(\iota)$. We normalize both forms of human capital to be zero in the first year, and assume that the human capital functions are weakly increasing. If a worker switches occupation, he loses his occupation-specific human capital and has tenure $\iota = 1$ in his new occupation. This introduces switching costs, and thus the optimal decisions have to be calculated from a dynamic program that trades off the future gains from switching with the immediate costs. For completeness, we also allow other switching costs κ_k that may arise when a worker switches from occupation k to a different occupation, which might capture application effort, retraining costs, etc.

Consider a worker with t years of general labor market experience and ι years of occupational experience in occupation k. There are various ways in which human capital can influence the output process. Our preferred specification is in analogy to (2)

$$X_k = a_i + H(t) + h_k(\iota) + \varepsilon_i. \tag{OA6}$$

leading to expected wage

$$W_k(A) = P_k(A_t + H(t) + h_k(\iota)) - \Pi_k. \tag{OA7}$$

Since human capital accumulation is deterministic, a worker who observes his output can back out $a_i + \varepsilon_i$, and therefore learning is not affected by human capital accumulation and the distribution F of beliefs in the population remains unchanged.[OA16] For this adjusted output process (OA6) the wages are still determined by (5) given the profit Π_k that firms want to obtain. The main difference to the preceding analysis is that workers solve a dynamic programming problem when deciding on the optimal occupation decision. We again consider a stationary equilibrium where firms' equilibrium profits Π_k remain constant over time.

[OA16] Alternatively, we could e.g. exponentiate the right hand side of (OA6), which would still leave beliefs in the cross-section unchanged.

As an aside, note that we can add some additional terms $\alpha H(t)$ with $\alpha \geq 0$ to (OA7) to account for general human capital that increases the productivity in all occupations but does not interact with productivity of the occupation. This makes it possible to fit a wider range of wage growth patterns. In particular, this type of human capital does not affect sorting and does not induce a drift toward the more productive occupations.

Specifically, for any given profit vector $\Pi = (\Pi_0, ..., \Pi_K)$ the worker can forecast his expected wage in all occupations for given prior and given experience. He can then evaluate his optimal choice of occupation by simple backward induction. His state vector at the beginning of each period is (t, k, ι, A) : his year in the labor market t, the occupation k he was last employed in, his consecutive years of experience in this occupation ι, and his belief about his mean ability A. New entrants start with home production as their previous occupation. In the last year of his life the worker optimizes

$$V(T, k, \iota, A) = \max \left\{ W_k(A, T, \iota), \max_{m \neq k} \{W_m(A, T, 1) - \kappa_m\} \right\},$$

i.e. he chooses whether to stay in his previous occupation or to switch to a new occupation where this would be his first year of experience and pay the switching costs. This gives a decision rule $d(T, k, \iota, A|\Pi) \in \{0, ..., K\}$ regarding the occupation that the worker chooses given the profits that firms make. Similarly, a worker with $t < T$ years of experience maximizes his expected payoff including the continuation value

$$V(t, k, \iota, A) = \max \left\{ \begin{array}{c} W_k(A, t, \iota) + \beta E_{A'} V(t+1, k, \iota+1, A'), \\ \max_{m \neq k} \{W_m(A, t, 1) - \kappa_m + \beta E_{A'} V(t+1, m, 2, A')\} \end{array} \right\},$$

where $\beta \in (0, 1]$ is the discount factor and A' is the update about the worker's mean ability. The solution to this problem gives again a decision rule $d(t, k, \iota, A|\Pi) \in \{0, ..., K\}$. It is straightforward to show that for given profit vector Π these decision rules are unique for almost all ability levels A. Given the distribution $F_t(A)$ of priors of each cohort and these decision rules, one can derive for given Π the steady-state number of agents that choose occupation k, call it $v_k(\Pi)$. Similar to Equilibrium Definition 1 we can now define:

Definition OA 1 *An equilibrium is a vector of profits* $(\Pi_0, ...\Pi_K)$ *such that* $\Pi_0 = 0$ *and* $v_k(\Pi) = \gamma_k$ *for all* $k > 0$.

Consider first the implication of general human capital accumulation ($H(t)$ strictly increasing) for occupational switching, abstracting from switching costs ($h_k(\iota) = 0$, $\kappa = 0$). Compared to a world without human capital the distribution of worker productivity now shifts by $H(t)$ for workers with t years of experience, since the relevant measure of a worker's ability in producing output is $a_i + H(t)$. Even though the new labor market entrants have the same distribution of ability as in the setting without human capital, with general human capital older workers become more productive and induce tougher competition for jobs in more productive occupations. Therefore, young workers start lower and in expectation move up to better occupations over the lifetime. Human capital induces a drift toward more productive occupations, creating another force for the upward movement through the occupation ladder beyond learning.

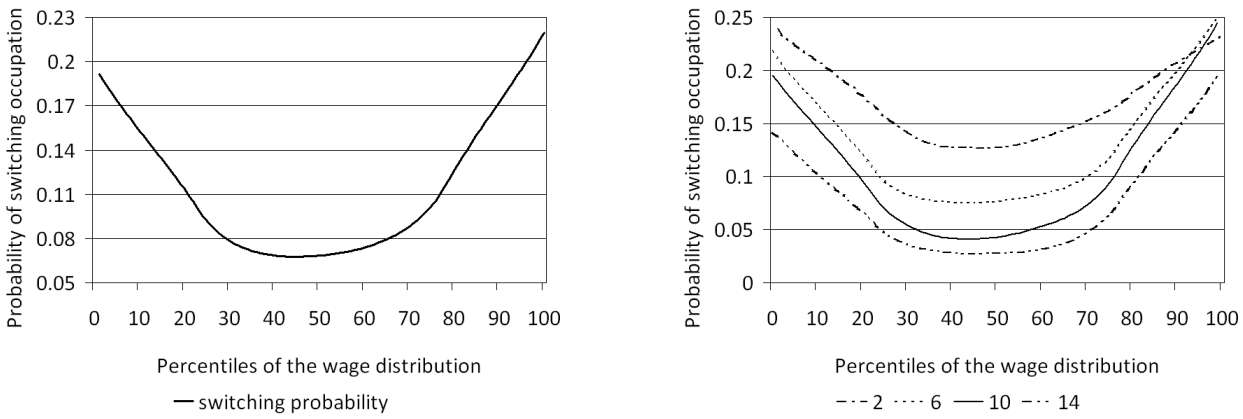
Our insights on U-shapes carry over to the setting with switching costs ($h_k(\iota)$ increasing, $\kappa > 0$). U-shapes still obtain for any wage setting that is weighted average (5) and (6) with positive weight on (5). In this case wages partially reflect the new information obtained through the realized output, and very high (low) outlier wages can only arise because of very high (low) output realizations, in which case the agent learned that he is much better (worse) than he expected and it can be shown that at the extreme wages the update must be so large that the gains from switching outweigh any finite switching costs. In contrast, when workers are fully insured against the output risk by receiving the expected wage according to (6), the current period wage does not reveal any information about what the worker learned in the current period and the logic of the preceding argument does not apply. In this case, it could be that U-shapes do not arise. This could happen, for example, if older workers are more productive and therefore earn higher wages, but face higher switching costs and therefore have low probability of leaving the occupation.

However, in numerical simulations we always found U-shapes for reasonable parameter values. For instance, consider the following numerical example. We set the model period to be one year and assume that workers are in the labor market for 40 years. We assume that there are 25 occupations (plus home production) of approximately equal size with prices given by $P_k = 1 + 0.05k$ for $k \geq 1$. We set $H(t) = 0.008t$ and $h_k(\iota) = 0.008\iota$ for $\iota \leq 5$ and $h_k(\iota) = 0.04$ otherwise. These choices imply that during the first 5 years in an occupation wages grow by 10% and half of this wage growth is due to accumulation of occupation-specific human capital and half due to accumulation of general human capital. To ensure that (nearly) all workers have positive ability we normalize average ability to a sufficiently high value $\mu_a = 50$. Finally, we set the precision $\phi_a = 0.667$ and $\phi_\varepsilon = 0.052$. At these parameter values the model generates the occupational mobility rate of approximately 10% and the variance of log wages of 0.15. Taken together, sorting and human capital accumulation account for a life-time wage growth of 60%.

Figure OA-36 describes the patterns of occupational switching estimated in the model-generated data. The probability of switching is clearly U-shaped in the position of a worker in wage distribution in his occupation. Moreover, this pattern is also apparent when we condition on years of labor market experience. We emphasize that this is just a numerical example and not an attempt to calibrate the model. However, it is representative of the patterns we observe in simulations for various parameterizations under wage setting given by by (6).

OA18 Relation to Gibbons, Katz, Lemieux, and Parent (2005)

Our model of learning is related to work by Gibbons, Katz, Lemieux, and Parent (2005). They also extend the Roy (1951) model to allow for learning about workers' abilities. They do not



(a) Overall

(b) For different years after graduation

Figure OA-36: Non-parametric plot of probability of switching occupation by worker's percentile in the wage distribution within occupation, year, and years after graduation. Model Simulations

use an equilibrium model, and do not explicitly analyze the switching behavior of workers as a function of their earnings. Rather, their focus is on the decision-theoretic problem of an individual worker, for which they propose a instrumental variables method based on lagged occupational choices in order to estimate his choice parameters consistently. Since adaptations of their model allow to back out underlying parameters such as productivities or human capital accumulation even in our model (as long as there are not shocks to occupational productivities), it is important to review the connection.

Consider the expected wages in our model, and assume that productivities are constant over time. Therefore, the profit vector $(\Pi_0, \Pi_1, ..., \Pi_K)$ remains constant over time. This vector implies that a worker at the beginning of his t^{th} period in the labor market who observed output realizations $(X_0, X_1, ..., X_{t-1})$ obtains an expected wage according to (6) of

$$E[P_k(a_i + \varepsilon_{it}) - \Pi_k | X_0, X_1, ..., X_{t-1}] = P_k A_{it} - \Pi_k,$$

where we left out the additive human capital terms for notational convenience. For the decision-theoretic problem of individual worker, profits Π_k can be interpreted as parameters.

Now consider the following transformation where we raise the wage of workers into the exponent:

$$E[e^{\{P_k(a_i+\varepsilon_{it})-\Pi_k\}} | X_0, X_1, ..., X_{t-1}]. \tag{OA8}$$

In this alternative process output can be viewed as $e^{P_k(a_i+\varepsilon_{it})}$, and profits are a fraction of output. The latter part is harder to interpret in a standard equilibrium setting, but nevertheless this specification gives rise to similar switching patterns, as we will see now. It corresponds to the specification in Gibbons, Katz, Lemieux, and Parent (2005), (who also have additional additive

terms in the exponent capturing occupational and overall tenure and other observed characteristics of the worker). Expression (OA8) is equal to

$$e^{\{P_k A_{it} + (1/2)P_k^2 \phi_t^{-2} - \Pi_k\}}.$$

Workers sort themselves to the occupation with the highest expected wage. Since the ranking of wages is preserved under monotone transformations, we can take logarithms and obtain the sorting criterium:

$$P_k A_{it} \ - \Omega_{kt},$$

where $\Omega_{kt} := \Pi_k + (1/2)P_k^2 \phi_t^{-2}$ now reflects the opportunity cost of obtaining the revenue $P_k A_{it}$ in occupation k, in contrast to only Π_k in our model. This is due to the fact that the upside potential of uncertainty is larger than the downside potential after exponentiating. This makes young employees especially attractive, as their uncertainty is higher. To see this formally, note that a worker will choose occupation k if his belief satisfies $A_{i,t} \in [B_{k,t}, B_{k+1,t})$ where the cutoffs $B_{kt} = \Omega_{kt} - \Omega_{k-1,t}/(P_k - P_{k-1})$. This still has the potential to generate U-shapes, but since B_{kt} is increasing in labor market experience t, older agents with the same belief as younger agents sort themselves into a lower occupation, yielding a downward drift. If that drift is too strong, then there will be no U-shapes if workers are paid their expected wage. This downward drift can be offset once accumulation of general human capital is introduced, since it induces an upward drift, yielding overall the potential for a balanced U-shape.

Based on wages according to (OA8), Gibbons, Katz, Lemieux, and Parent (2005) propose a method of quasi-differencing of the wages and using lagged occupational choices as instruments to estimate the underlying parameters. In this paper we provide evidence on mobility patterns and show that it is consistent with the type of selection that Gibbons, Katz, Lemieux, and Parent (2005) provide a method to control for. Since their method can be adapted to the setting in this paper, we view the two papers as complementary to each other.

OA19 1, 2, 3, and 4-digit Occupational Classifications

MAJOR GROUP 1
LEGISLATORS, SENIOR OFFICIALS AND MANAGERS
11 LEGISLATORS AND SENIOR OFFICIALS
111 LEGISLATORS
1110 Legislators
114 SENIOR OFFICIALS OF SPECIAL-INTEREST ORGANIZATIONS
1141 Senior officials of political-party organizations
1142 Senior officials of employers', workers' and other economic-interest organizations
1143 Senior officials of humanitarian and other special-interest organizations
12 CORPORATE MANAGERS (This group is intended to include persons who - as directors, chief executives or department managers - manage enterprises or organizations, or departments, requiring a total of three or more managers.)
121 DIRECTORS AND CHIEF EXECUTIVES
1210 Directors and chief executives
122 PRODUCTION AND OPERATIONS DEPARTMENT MANAGERS
1221 Production and operations department managers in agriculture, hunting, forestry and fishing
1222 Production and operations department managers in manufacturing
1223 Production and operations department managers in construction
1224 Production and operations department managers in wholesale and retail trade
1225 Production and operations department managers in restaurants and hotels
1226 Production and operations department managers in transport, storage and communications
1227 Production and operations department managers in business services
1228 Production and operations department managers in personal care, cleaning and related services
1229 Production and operations department managers not elsewhere classified
123 OTHER DEPARTMENT MANAGERS
1231 Finance and administration department managers
1232 Personnel and industrial relations department managers
1233 Sales and marketing department managers
1234 Advertising and public relations department managers
1235 Supply and distribution department managers
1236 Computing services department managers
1237 Research and development department managers
1239 Other department managers not elsewhere classified
13 GENERAL MANAGERS (This group is intended to include persons who manage enterprises, or in some cases organizations, on their own behalf, or on behalf of the proprietor, with some non-managerial help and the assistance of no more than one other manager who should also be classified in this sub- major group as, in most cases, the tasks will be broader than those of a specialized manager in a larger enterprise or organization. Non-managerial staff should be classified according to their specific tasks.
131 GENERAL MANAGERS
1311 General managers in agriculture, hunting, forestry/ and fishing
1312 General managers in manufacturing
1313 General managers in construction
1314 General managers in wholesale and retail trade
1315 General managers of restaurants and hotels
1316 General managers in transport, storage and communications
1317 General managers of business services
1318 General managers in personal care, cleaning and related services
1319 General managers not elsewhere classified

MAJOR GROUP 2
PROFESSIONALS
21 PHYSICAL, MATHEMATICAL AND ENGINEERING SCIENCE PROFESSIONALS
211 PHYSICISTS, CHEMISTS AND RELATED PROFESSIONALS
2111 Physicists and astronomers
2112 Meteorologists
2113 Chemists
2114 Geologists and geophysicists
212 MATHEMATICIANS, STATISTICIANS AND RELATED PROFESSIONALS
2121 Mathematicians and related professionals
2122 Statisticians
213 COMPUTING PROFESSIONALS
2131 Computer systems designers and analysts
2132 Computer programmers
2139 Computing professionals not elsewhere classified
214 ARCHITECTS, ENGINEERS AND RELATED PROFESSIONALS
2141 Architects, town and traffic planners
2142 Civil engineers
2143 Electrical engineers
2144 Electronics and telecommunications engineers
2145 Mechanical engineers
2146 Chemical engineers
2147 Mining engineers, metallurgists and related professionals
2148 Cartographers and surveyors
2149 Architects, engineers and related professionals not elsewhere classified
22 LIFE SCIENCE AND HEALTH PROFESSIONALS
221 LIFE SCIENCE PROFESSIONALS
2211 Biologists, botanists, zoologists and related professionals
2212 Pharmacologists, pathologists and related professionals
2213 Agronomists and related professionals
222 HEALTH PROFESSIONALS (except nursing)
2221 Medical doctors
2222 Dentists
2223 Veterinarians
2224 Pharmacists
2229 Health professionals (except nursing) not elsewhere classified
223 NURSING AND MIDWIFERY PROFESSIONALS
2230 Nursing and midwifery professionals
23 TEACHING PROFESSIONALS
231 COLLEGE, UNIVERSITY AND HIGHER EDUCATION TEACHING PROFESSIONALS
2310 College, university and higher education teaching professionals
232 SECONDARY EDUCATION TEACHING PROFESSIONALS
2320 Secondary education teaching professionals
233 PRIMARY AND PRE-PRIMARY EDUCATION TEACHING PROFESSIONALS
2331 Primary education teaching professionals
234 SPECIAL EDUCATION TEACHING PROFESSIONALS
2340 Special education teaching professionals
235 OTHER TEACHING PROFESSIONALS
2351 Education methods specialists
2352 School inspectors
2359 Other teaching professionals not elsewhere classified
24 OTHER PROFESSIONALS
241 BUSINESS PROFESSIONALS
2411 Accountants
2412 Personnel and careers professionals
2419 Business professionals not elsewhere classified
242 LEGAL PROFESSIONALS
2421 Lawyers
2422 Judges
2429 Legal professionals not elsewhere classified
243 ARCHIVISTS, LIBRARIANS AND RELATED INFORMATION PROFESSIONALS
2431 Archivists and curators
2432 Librarians and related information professionals
244 SOCIAL SCIENCE AND RELATED PROFESSIONALS
2441 Economists
2442 Sociologists, anthropologists and related professionals
2443 Philosophers, historians and political scientists
2444 Philologists, translators and interpreters
2445 Psychologists
2446 Social work professionals
245 WRITERS AND CREATIVE OR PERFORMING ARTISTS
2451 Authors, journalists and other writers
2452 Sculptors, painters and related artists
2453 Composers, musicians and singers
2454 Choreographers and dancers
2455 Film, stage and related actors and directors
246 RELIGIOUS PROFESSIONALS
2460 Religious professionals
2470: working with administration of legislation in the public sector

MAJOR GROUP 3
TECHNICIANS AND ASSOCIATE PROFESSIONALS
31 PHYSICAL AND ENGINEERING SCIENCE ASSOCIATE PROFESSIONALS
311 PHYSICAL AND ENGINEERING SCIENCE TECHNICIANS
3111 Chemical and physical science technicians
3112 Civil engineering technicians
3113 Electrical engineering technicians
3114 Electronics and telecommunications engineering technicians
3115 Mechanical engineering technicians
3116 Chemical engineering technicians
3117 Mining and metallurgical technicians
3118 Draughtspersons
3119 Physical and engineering science technicians not elsewhere classified
312 COMPUTER ASSOCIATE PROFESSIONALS
3121 Computer assistants
3122 Computer equipment operators
3123 Industrial robot controllers
313 OPTICAL AND ELECTRONIC EQUIPMENT OPERATORS
3131 Photographers and image and sound recording equipment operators
3132 Broadcasting and telecommunications equipment operators
3133 Medical equipment operators
3139 Optical and electronic equipment operators not elsewhere classified
314 SHIP AND AIRCRAFT CONTROLLERS AND TECHNICIANS
3141 Ships' engineers
3142 Ships' deck officers and pilots
3143 Aircraft pilots and related associate professionals
3144 Air traffic controllers

3145 Air traffic safety technicians
315 SAFETY AND QUALITY INSPECTORS
3151 Building and fire inspectors 3152 Safety, health and quality inspectors
32 LIFE SCIENCE AND HEALTH ASSOCIATE PROFESSIONALS
321 LIFE SCIENCE TECHNICIANS AND RELATED ASSOCIATE PROFESSIONALS
3211 Life science technicians
3212 Agronomy and forestry technicians
3213 Farming and forestry advisers
322 MODERN HEALTH ASSOCIATE PROFESSIONALS (except nursing)
3221 Medical assistants
3222 Sanitarians
3223 Dietitians and nutritionists
3224 Optometrists and opticians
3225 Dental assistants
3226 Physiotherapists and related associate professionals
3227 Veterinary assistants
3228 Pharmaceutical assistants
3229 Modern health associate professionals (except nursing) not elsewhere classified
323 NURSING AND MIDWIFERY ASSOCIATE PROFESSIONALS
3231 Nursing associate professionals
33 TEACHING ASSOCIATE PROFESSIONALS
331 PRIMARY EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3310 Primary education teaching associate professionals
332 PRE-PRIMARY EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3320 Pre-primary education teaching associate professionals
333 SPECIAL EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3330 Special education teaching associate professionals
334 OTHER TEACHING ASSOCIATE PROFESSIONALS
3340 Other teaching associate professionals
34 OTHER ASSOCIATE PROFESSIONALS
341 FINANCE AND SALES ASSOCIATE PROFESSIONALS
3411 Securities and finance dealers and brokers
3412 Insurance representatives
3413 Estate agents
3414 Travel consultants and organizers
3415 Technical and commercial sales representatives
3416 Buyers
3417 Appraisers, valuers and auctioneers
3419 Finance and sales associate professionals not elsewhere classified
342 BUSINESS SERVICES AGENTS AND TRADE BROKERS
3421 Trade brokers
3422 Clearing and forwarding agents
3423 Employment agents and labor contractors
3429 Business services agents and trade brokers not elsewhere classified
343 ADMINISTRATIVE ASSOCIATE PROFESSIONALS
3431 Administrative secretaries and related associate professionals
3432 Legal and related business associate professionals
3433 Bookkeepers
3434 Statistical, mathematical and related associate professionals
3439 Administrative associate professionals not elsewhere classified
344 CUSTOMS, TAX AND RELATED GOVERNMENT ASSOCIATE PROFESSIONALS
3441 Customs and border inspectors
3442 Government tax and excise officials
3443 Government social benefits officials
3444 Government licensing officials
3449 Customs, tax and related government associate professionals not elsewhere classified
345 POLICE INSPECTORS AND DETECTIVES
3450 Police inspectors and detectives
346 SOCIAL WORK ASSOCIATE PROFESSIONALS
3460 Social work associate professionals
347 ARTISTIC, ENTERTAINMENT AND SPORTS ASSOCIATE PROFESSIONALS
3471 Decorators and commercial designers
3472 Radio, television and other announcers
3473 Street, night-club and related musicians, singers and dancers
3474 Clowns, magicians, acrobats and related associate professionals
3475 Athletes, sportspersons and related associate professionals
348 RELIGIOUS ASSOCIATE PROFESSIONALS
3480 Religious associate professionals

MAJOR GROUP 4
CLERKS
41 OFFICE CLERKS
411 SECRETARIES AND KEYBOARD-OPERATING CLERKS
4111 Stenographers and typists
4112 Word-processor and related operators
4113 Data entry operators
4114 Calculating-machine operators
4115 Secretaries
412 NUMERICAL CLERKS
4121 Accounting and bookkeeping clerks
4122 Statistical and finance clerks
413 MATERIAL-RECORDING AND TRANSPORT CLERKS
4131 Stock clerks
4132 Production clerks
4133 Transport clerks
414 LIBRARY, MAIL AND RELATED CLERKS
4141 Library and filing clerks
4142 Mail carriers and sorting clerks
4143 Coding, proof-reading and related clerks
419 OTHER OFFICE CLERKS
4190 Other office clerks
42 CUSTOMER SERVICES CLERKS
421 CASHIERS, TELLERS AND RELATED CLERKS
4211 Cashiers and ticket clerks
4212 Tellers and other counter clerks
4213 Bookmakers and croupiers
4214 Pawnbrokers and money-lenders
4215 Debt-collectors and related workers
422 CLIENT INFORMATION CLERKS
4221 Travel agency and related clerks
4222 Receptionists and information clerks
4223 Telephone switchboard operators

MAJOR GROUP 5
SERVICE WORKERS AND SHOP AND MARKET SALES WORKERS
51 PERSONAL AND PROTECTIVE SERVICES WORKERS
511 TRAVEL ATTENDANTS AND RELATED WORKERS
5111 Travel attendants and travel stewards
5112 Transport conductors
5113 Travel guides
512 HOUSEKEEPING AND RESTAURANT SERVICES WORKERS
5121 Housekeepers and related workers
5122 Cooks
5123 Waiters, waitresses and bartenders
513 PERSONAL CARE AND RELATED WORKERS
5131 Child-care workers
5132 Institution-based personal care workers
5133 Home-based personal care workers
5139 Personal care and related workers not elsewhere classified
514 OTHER PERSONAL SERVICES WORKERS
5141 Hairdressers, barbers, beauticians and related workers
5142 Companions and valets
5143 Undertakers and embalmers
5149 Other personal services workers not elsewhere classified
515 ASTROLOGERS, FORTUNE-TELLERS AND RELATED WORKERS
5151 Astrologers and related workers
5152 Fortune-tellers, palmists and related workers
516 PROTECTIVE SERVICES WORKERS
5161 Fire-fighters
5162 Police officers
5163 Prison guards
5169 Protective services workers not elsewhere classified
52 MODELS, SALESPERSONS AND DEMONSTRATORS
521 FASHION AND OTHER MODELS
5210 Fashion and other models
522 SHOP SALESPERSONS AND DEMONSTRATORS
5220 Shop salespersons and demonstrators
523 STALL AND MARKET SALESPERSONS
5230 Stall and market salespersons

MAJOR GROUP 6
SKILLED AGRICULTURAL AND FISHERY WORKERS
61 MARKET-ORIENTED SKILLED AGRICULTURAL AND FISHERY WORKERS
611 MARKET GARDENERS AND CROP GROWERS
6111 Field crop and vegetable growers
6112 Tree and shrub crop growers
612 MARKET-ORIENTED ANIMAL PRODUCERS AND RELATED WORKERS
6121 Dairy and livestock producers
6122 Poultry producers
6129 Market-oriented animal producers and related workers not elsewhere classified
613 MARKET-ORIENTED CROP AND ANIMAL PRODUCERS
6130 Market-oriented crop and animal producers
614 FORESTRY AND RELATED WORKERS
6141 Forestry workers and loggers
6142 Charcoal burners and related workers
615 FISHERY WORKERS, HUNTERS AND TRAPPERS
6151 Aquatic-life cultivation workers
6152 Inland and coastal waters fishery workers
6153 Deep-sea fishery workers
6154 Hunters and trappers

MAJOR GROUP 7
CRAFT AND RELATED TRADES WORKERS
71 EXTRACTION AND BUILDING TRADES WORKERS
711 MINERS, SHOTFIRERS, STONE CUTTERS AND CARVERS
7111 Miners and quarry workers
7112 Shotfirers and blasters
7113 Stone splitters, cutters and carvers
712 BUILDING FRAME AND RELATED TRADES WORKERS
7121 Builders, traditional materials
7122 Bricklayers and stonemasons
7123 Concrete placers, concrete finishers and related workers
7124 Carpenters and joiners
7129 Building frame and related trades workers not elsewhere classified
713 BUILDING FINISHERS AND RELATED TRADES WORKERS

7131 Roofers
7132 Floor layers and tile setters
7133 Plasterers
7134 Insulation workers
7135 Glaziers
7136 Plumbers and pipe fitters
7137 Building and related electricians
7139 Buildingswork elsewhere
714 PAINTERS, BUILDING STRUCTURE CLEANERS AND RELATED TRADES WORKERS
7141 Painters and related workers
7142 Varnishers and related painters
7143 Building structure cleaners
72 METAL, MACHINERY AND RELATED TRADES WORKERS
721 METAL MOULDERS, WELDERS, SHEET-METAL WORKERS, STRUCTURAL- METAL PREPARERS, AND RELATED TRADES WORKERS
7211 Metal moulders and coremakers
7212 Welders and flamecutters
7213 Sheet metal workers
7214 Structural-metal preparers and erectors
7215 Riggers and cable splicers
7216 Underwater workers
722 BLACKSMITHS, TOOL-MAKERS AND RELATED TRADES WORKERS
7221 Blacksmiths, hammer-smiths and forging-press workers
7222 Tool-makers and related workers
7223 Machine-tool setters and setter-operators
7224 Metal wheel-grinders, polishers and tool sharpeners
723 MACHINERY MECHANICS AND FITTERS
7231 Motor vehicle mechanics and fitters
7232 Aircraft engine mechanics and fitters
7233 Agricultural- or industrial-machinery mechanics and fitters
724 ELECTRICAL AND ELECTRONIC EQUIPMENT MECHANICS AND FITTERS
7241 Electrical mechanics and fitters
7242 Electronics fitters
7243 Electronics mechanics and servicers
7244 Telegraph and telephone installers and servicers
7245 Electrical line installers, repairers and cable jointers
73 PRECISION, HANDICRAFT, PRINTING AND RELATED TRADES WORKERS
731 PRECISION WORKERS IN METAL AND RELATED MATERIALS
7311 Precision-instrument makers and repairers
7312 Musical instrument makers and tuners
7313 Jewelery and precious-metal workers
732 POTTERS, GLASS-MAKERS AND RELATED TRADES WORKERS
7321 Abrasive wheel formers, potters and related workers
7322 Glass makers, cutters, grinders and finishers
7323 Glass engravers and etchers
7324 Glass, ceramics and related decorative painters
733 HANDICRAFT WORKERS IN WOOD, TEXTILE, LEATHER AND RELATED MATERIALS
7331 Handicraft workers in wood and related materials
7332 Handicraft workers in textile, leather and related materials
734 PRINTING AND RELATED TRADES WORKERS
7341 Compositors, typesetters and related workers
7342 Stereotypers and electrotypers
7343 Printing engravers and etchers
7344 Photographic and related workers
7345 Bookbinders and related workers
7346 Silk-screen, block and textile printers
74 OTHER CRAFT AND RELATED TRADES WORKERS
741 FOOD PROCESSING AND RELATED TRADES WORKERS
7411 Butchers, fishmongers and related food preparers
7412 Bakers, pastry-cooks and confectionery makers
7413 Dairy-products makers
7414 Fruit, vegetable and related preservers
7415 Food and beverage tasters and graders
7416 Tobacco preparers and tobacco products makers
742 WOOD TREATERS, CABINET-MAKERS AND RELATED TRADES WORKERS
7421 Wood treaters
7422 Cabinet makers and related workers
7423 Woodworking machine setters and setter-operators
7424 Basketry weavers, brush makers and related workers
743 TEXTILE, GARMENT AND RELATED TRADES WORKERS
7431 Fiber preparers
7432 Weavers, knitters and related workers
7433 Tailors, dressmakers and hatters
7434 Furriers and related workers
7435 Textile, leather and related pattern-makers and cutters
7436 Sewers, embroiderers and related workers
7437 Upholsterers and related workers
744 PELT, LEATHER AND SHOEMAKING TRADES WORKERS
7441 Pelt dressers, tanners and fellmongers
7442 Shoe-makers and related workers

MAJOR GROUP 8
PLANT AND MACHINE OPERATORS AND ASSEMBLERS
81 STATIONARY-PLANT AND RELATED OPERATORS
811 MINING- AND MINERAL-PROCESSING-PLANT OPERATORS
8111 Mining-plant operators
8112 Mineral-ore- and stone-processing-plant operators
8113 Well drillers and borers and related workers
812 METAL-PROCESSING-PLANT OPERATORS
8121 Ore and metal furnace operators
8122 Metal melters, casters and rolling-mill operators
8123 Metal-heat-treating-plant operators
8124 Metal drawers and extruders
813 GLASS, CERAMICS AND RELATED PLANT OPERATORS
8131 Glass and ceramics kiln and related machine operators
8139 Glass, ceramics and related plant operators not elsewhere classified
814 WOOD-PROCESSING- AND PAPERMAKING-PLANT OPERATORS
8141 Wood-processing-plant operators
8142 Paper-pulp plant operators
8143 Papermaking-plant operators
815 CHEMICAL-PROCESSING-PLANT OPERATORS
8151 Crushing-, grinding- and chemical-mixing-machinery operators
8152 Chemical-heat-treating-plant operators
8153 Chemical-filtering- and separating-equipment operators
8154 Chemical-still and reactor operators (except petroleum and natural gas)
8155 Petroleum- and natural-gas-refining-plant operators
8159 Chemical-processing-plant operators not elsewhere classified
816 POWER-PRODUCTION AND RELATED PLANT OPERATORS
8161 Power-production plant operators
8162 Steam-engine and boiler operators
8163 Incinerator, water-treatment and related plant operators
817 AUTOMATED-ASSEMBLY-LINE AND INDUSTRIAL-ROBOT OPERATORS
82 MACHINE OPERATORS AND ASSEMBLERS
821 METAL- AND MINERAL-PRODUCTS MACHINE OPERATORS
8211 Machine-tool operators
8212 Cement and other mineral products machine operators
822 CHEMICAL-PRODUCTS MACHINE OPERATORS
8221 Pharmaceutical- and toiletry-products machine operators
8222 Ammunition- and explosive-products machine operators
8223 Metal finishing-, plating- and coating-machine operators
8224 Photographic-products machine operators
8229 Chemical-products machine operators not elsewhere classified
823 RUBBER- AND PLASTIC-PRODUCTS MACHINE OPERATORS
8231 Rubber-products machine operators
8232 Plastic-products machine operators
824 WOOD-PRODUCTS MACHINE OPERATORS
8240 Wood-products machine operators
825 PRINTING-, BINDING- AND PAPER-PRODUCTS MACHINE OPERATORS
8251 Printing-machine operators
8252 Bookbinding-machine operators
8253 Paper-products machine operators
826 TEXTILE-, FUR- AND LEATHER-PRODUCTS MACHINE OPERATORS
8261 Fiber-preparing-, spinning- and winding-machine operators
8262 Weaving- and knitting-machine operators
8263 Sewing-machine operators
8264 Bleaching-, dyeing- and cleaning-machine operators
8265 Fur and leather-preparing-machine operators
8266 Shoemaking- and related machine operators
8269 Textile-, fur- and leather-products machine operators not elsewhere classified
827 FOOD AND RELATED PRODUCTS MACHINE OPERATORS
8271 Meat- and fish-processing-machine operators
8272 Dairy-products machine operators
8273 Grain- and spice-milling-machine operators
8274 Baked-goods, cereal and chocolate-products machine operators
8275 Fruit-, vegetable- and nut-processing-machine operators
8276 Sugar production machine operators
8277 Tea-, coffee-, and cocoa-processing-machine operators
8278 Brewers, wine and other beverage machine operators
8279 Tobacco production machine operators
828 ASSEMBLERS
8281 Mechanical-machinery assemblers
8282 Electrical-equipment assemblers
8283 Electronic-equipment assemblers
8284 Metal-, rubber- and plastic-products assemblers
8285 Wood and related products assemblers
8286 Paperboard, textile and related products assemblers
8287: Assembly line and assembler elsewhere
829 OTHER MACHINE OPERATORS AND ASSEMBLERS
8290 Other machine operators and assemblers
83 DRIVERS AND MOBILE-PLANT OPERATORS
831 LOCOMOTIVE-ENGINE DRIVERS AND RELATED WORKERS
8311 Locomotive-engine drivers
8312 Railway brakers, signallers and shunters
832 MOTOR-VEHICLE DRIVERS
8321 Motor-cycle drivers
8322 Car, taxi and van drivers
8323 Bus and tram drivers
8324 Heavy-truck and lorry drivers
833 AGRICULTURAL AND OTHER MOBILE-PLANT OPERATORS
8331 Motorized farm and forestry plant operators
8332 Earth-moving- and related plant operators
8333 Crane, hoist and related plant operators

8334 Lifting-truck operators
834 SHIPS' DECK CREWS AND RELATED WORKERS
8340 Ships' deck crews and related workers

MAJOR GROUP 9
ELEMENTARY OCCUPATIONS
91 SALES AND SERVICES ELEMENTARY OCCUPATIONS
911 STREET VENDORS AND RELATED WORKERS
9113 Door-to-door and telephone salespersons
912 SHOE CLEANING AND OTHER STREET SERVICES ELEMENTARY OCCUPATIONS
9120 Shoe cleaning and other street services elementary occupations
913 DOMESTIC AND RELATED HELPERS, CLEANERS AND LAUNDERERS
9131 Domestic helpers and cleaners
9132 Helpers and cleaners in offices, hotels and other establishments
9133 Hand-launderers and pressers
914 BUILDING CARETAKERS, WINDOW AND RELATED CLEANERS
9141 Building caretakers
9142 Vehicle, window and related cleaners
915 MESSENGERS, PORTERS, DOORKEEPERS AND RELATED WORKERS
9151 Messengers, package and luggage porters and deliverers
9152 Doorkeepers, watchpersons and related workers
9153 Vending-machine money collectors, meter readers and related workers
916 GARBAGE COLLECTORS AND RELATED LABORERS
9161 Garbage collectors
9162 Sweepers and related laborers
92 AGRICULTURAL, FISHERY AND RELATED LABORERS
921 AGRICULTURAL, FISHERY AND RELATED LABORERS
9211 Farm-hands and laborers
9212 Forestry laborers
9213 Fishery, hunting and trapping laborers
93 LABORERS IN MINING, CONSTRUCTION, MANUFACTURING AND TRANSPORT
931 MINING AND CONSTRUCTION LABORERS
9311 Mining and quarrying laborers
9312 Construction and maintenance laborers: roads, dams and similar constructions
9313 Building construction laborers
932 MANUFACTURING LABORERS
933 TRANSPORT LABORERS AND FREIGHT HANDLERS

MAJOR GROUP 0
ARMED FORCES
01 ARMED FORCES
011 ARMED FORCES
0110 Armed forces

References

Abowd, J. M., F. Kramarz, and D. N. Margolis (1999): "High Wage Workers and High Wage Firms," *Econometrica*, 67(2), 251–334.

Eeckhout, J., and P. Kircher (2011): "Identifying Sorting – In Theory," *The Review of Economic Studies*, 78(3), 872–906.

Gautier, P. A., and C. N. Teulings (2006): "How Large Are Search Frictions?," *Journal of the European Economic Association*, 4(6), 1193–1225.

Gibbons, R., L. F. Katz, T. Lemieux, and D. Parent (2005): "Comparative Advantage, Learning, and Sectoral Wage Determination," *Journal of Labor Economics*, 23(4), 681–724.

Groes, F. (2010): "Occupational Experience, Mobility, and Wages: Patterns in the Danish Data," Manuscript, Copenhagen Business School.

Hagedorn, M., T. H. Law, and I. Manovskii (2012): "Identifying Equilibrium Models of Labor Market Sorting," Working Paper 18661, National Bureau of Economic Research.

Hall, R. E., and R. Kasten (1976): "Occupational Mobility and the Distribution of Occupational Success among Young Men," *American Economic Review, Papers and Proceedings*, 66, 309–315.

Jovanovic, B. (1979): "Job Matching and the Theory of Turnover," *Journal of Political Economy*, 87(5), 972–990.

Kambourov, G., and I. Manovskii (2005): "Accounting for the Changing Life-Cycle Profiles of Earnings," mimeo, The University of Pennsylvania.

——— (2009a): "Occupational Mobility and Wage Inequality," *Review of Economic Studies*, 76(2), 731–759.

——— (2009b): "Occupational Specificity of Human Capital," *International Economic Review*, 50(1), 63–115.

Lopes de Melo, R. (2009): "Sorting in the Labor Market: Theory and Measurement," Working paper, University of Chicago.

McCall, B. P. (1990): "Occupational Matching: A Test of Sorts," *Journal of Political Economy*, 98(1), 45–69.

Miller, R. A. (1984): "Job Matching and Occupational Choice," *Journal of Political Economy*, 92(6), 1086–1120.

Neal, D. (1999): "The Complexity of Job Mobility Among Young Men," *Journal of Labor Economics*, 17(2), 237–261.

Papageorgiou, T. (2011): "Large Firms and Internal Labor Markets," mimeo, Pennsylvania State University.

Roy, A. D. (1951): "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 3(2), 135–146.

Shaw, K. (1984): "A Formulation of the Earnings Function Using the Concept of Occupational Investment," *Journal of Human Resources*, 14, 319–40.

——— (1987): "Occupational Change, Employer Change, and the Transferability of Skills," *Southern Economic Journal*, 53, 702–19.

Sichernam, N., and O. Galor (1990): "A Theory of Career Mobility," *Journal of Political Economy*, 98(1), 169–192.

Wilk, S. L., and P. R. Sackett (1996): "Longitudinal Analysis of Ability - Job Complexity Fit and Job Change," *Personnel Psychology*, 49(4), 937–967.