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Cohort Effects in Wages and Promotions

By
Illoong Kwon
SUNY – Albany
And
Eva M. Meyersson Milgrom
Stanford University
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Stanford Institute for Economic Policy Research
Stanford University
Stanford, CA 94305
(650) 725-1874

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Illoong Kwon
SUNY - Albany

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Eva M Meyersson Milgrom
Stanford University

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Abstract

This paper studies the long-term effect of business cycle, employment rate and employment growth rate, at the time workers enter the labor market on later wages and promotions. Using Swedish employer-employee match data, we find that workers who enter the labor market during a recovery phase of a business cycle (when the employment rate is still low but employment growth is high) receive higher-than-average wages in the long-run. However, these long-term effects on wages are almost entirely driven by the differences in promotion speeds between cohorts. Workers starting in a recovery period are hired into slightly lower ranks, but are promoted at a higher speed than comparable workers during a contraction period. Simple theoretical models based on downward rigidity of wages and promotions, long-term contract, or stigma cannot explain a broad pattern of our findings, but models based on human capital, matching, and cyclical hiring can.

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Contact Information:
Illoong Kwon, Department of Economics, State University of New York at Albany, 1400 Washington Ave., Albany, NY 12222, ikwon@albany.edu.
Eva M Meyersson Milgrom, Stanford Institute for Economic Policy Research (SIEPR) Room 150, 579 Serra Mall at Galvez, Stanford University, Stanford CA94305, eva@meyersson.com.

1. Introduction

A recession, even when it is temporary, can have long-term effects on workers' careers. For example, a cohort of workers who first entered the labor market during a recession may receive lower-than-average wages in the long-run even after the economy recovers or be more likely to become unemployed, compared with other cohorts who first entered the labor market during a boom. (For cohort effects in wages, see, e.g., Freeman 1981, Beaudry and DiNardo1991, and Oreopoulos et al. 2006; for cohort effects in unemployment, see, e.g., Pissarides 1992 and Raaum and Roed 2006.)

Such cohort effects in wages and unemployment can distort workers' labor market participation decisions, (e.g. by delaying graduation during a recession, see Oyer 2007b); reduce the motivation of workers who entered the market during a recession (e.g. because they cannot catch up to those who came during a boom); amplify the business cycle; and require re-evaluation of macro policies.

In this paper, we show that there are cohort effects in promotions. We also show that the employment growth rate as well as the (un)employment rate at the time workers first entered the labor market matters. More specifically, a cohort of workers who first entered the labor market when the employment rate is still low but the employment growth rate is high (i.e. during a recovery phase of a business cycle) get promoted faster and reach higher ranks than other cohorts. This effect persists even after we control for workers' initial jobs.

Promotions have direct effects on workers' job assignments and firms' productivity. Yet, there exist relatively few studies of the relationship between business cycles and promotions.[1] In fact, we show that cohort effects in wages are almost entirely explained by cohort effects on promotions. In other words, workers who entered the labor market during a contraction period receive lower-than-average wages in the long-run because they get promoted more slowly and reach lower rank than other cohorts do.

Also, previous studies have focused on the (un)employment rate at the time of workers' labor market entry, and largely ignored the growth aspect. However, hiring, firing, and promotion may depend more on the employment growth rate than on the level

[1] Solon et al (1997) for instance suggest that "cyclicality in workers job assignments deserve further attention." (p. 402)

of employment itself. Thus, we find that even when the employment rate is low, if workers enter the labor market during a high growth period, they get promoted faster and receive higher wages in the future.

We use the Swedish employer-employee matched data covering the private sector from 1970-1990. The data build on a panel of personnel records of white-collar workers, and contain detailed ranks and occupations information that are *comparable across firms*. Thus, we can analyze promotion patterns of workers in thousands of firms for up to twenty years.

We also survey various theoretical explanations for cohort effects, and find that the simple models based on downward rigidity of wages and ranks, long-term contract, or stigma are not consistent with our findings. However, models based on human capital, matching, and cyclical hiring can explain a broad pattern of our findings. Potential empirical tests for these models are also discussed.

As far as we know, this is the first empirical study that analyzes cohort effects in promotions with representative data. Oyer (2006) is possibly the closest to our paper. He studies the long-term effect of initial job placement for economists, and finds that obtaining a highly-ranked initial job leads to a higher probability of staying at highly ranked universities in the future[2]. Unlike his study, we control for initial jobs and still find that the business cycle at the time of labor market entry affect workers' careers. Furthermore, our analyses cover almost the entire white-collar workers in Sweden, not just economists. Gibbons and Waldman (2006) provides a theoretical model where initial job placements and promotions play an important role in explaining the cohort effects. We find partial support for their model, but their model does not directly explain the cohort effects remaining after controlling for initial jobs. Solon et. al. (1996) and Devereux (2000) study how the business cycle affects workers' current job assignments, but they do not study the business cycle's long-term effects on job assignments or promotions.

The rest of the paper is organized as follows. Section 2 describes the data. In Section 3 we describe how the business cycle, especially employment rate and employment growth rate, affects workers' initial ranks and wages. In section 4, we

[2] See also Devereux (2002) and Gallet (2004) for related results.

estimate cohort effects on wages. Then, in section 5, we estimate cohort effects on promotions. In section 6 we survey various theoretical models, and discuss the degree of consistency between our findings and the predictions of theoretical models. We make some concluding remarks in section 7.

2. Data

To empirically study cohort effects on promotion, an important challenge is that hierarchical ranks/titles are not comparable across firms. For example, a vice president in firm A can have very different authority and tasks from a vice president in firm B. Then, promotions, even those to the same job title, are not comparable across firms. The Swedish employer-employee matched data are ideal for this purpose.

The Swedish longitudinal data of white collar workers, an employer–employee matched data set, covers the entire private sector of Sweden (except for financial sectors) during the period 1970-1990. For each worker, the data contain annual information on wage, age, education, gender, geographic region, work-time status, firm ID, plant ID, industry ID, and BNT codes (described below). Because all the IDs are unique, we can track each individual worker within and across firms throughout his/her career.

The unique feature of this Swedish data is the BNT code. The BNT code is a four-digit code, where the first three digits (called the occupation code) describe types of tasks and the fourth (called the rank code) describes the degree of skill[3] needed to fulfill the tasks. The white-collar workers' occupations cover 51 three-digit occupation groups such as construction, personnel work, or marketing. (For more details, see appendix A.) Within each occupation, the rank code runs from 1 (lowest) to 7 (highest)[4].

The occupation and rank codes served as the input to the centralized wage negotiations, and were gathered and monitored both by The Swedish Federation of Employers and the labor unions. Thus, the occupation classification is of very high quality with minimal potential errors[5]. Most importantly, the occupation and rank codes

[3] Rank also reflects the number of employees and type of skill needed for decisions at that level.
[4] Not all occupations span the entire 7 ranks, some start higher and some do not have the top ranks. For more details, see appendix B.
[5] Occupation classification based on survey responses is typically very noisy because workers often change their job description year to year even when they have not changed the actual jobs. (see, e.g. Kambourov and Manovskii 2002).

are comparable cross firms. Thus, we can analyze workers' promotion patterns for more than one firm and even when a worker changes firms. (See appendix C for more details on the centralized wage bargaining system in Sweden.)

In this study, we focus on the sample of young first entrants, arriving into our data set, at ages below 27 and appearing in the data 10 years after the first entry. Thus, we mostly focus on young white-collar workers who first entered the labor market between 1971 and 1981, and follow their careers for up to 20 years. Note that we interpret the entry to our data as the first labor market entry. Some workers may have already worked in the blue-collar market or in the public sector prior to entering our data. However, given our age restriction, the number of such workers should be quite small, and their experience in such markets should be limited. Also the private white-collar labor market is separate from other labor markets, and represented by separate labor unions and employer organizations. Thus, we ignore workers' possible prior experience in other labor markets before entering our data.

During the period 1971-1981, 78,610 new workers under the age of 27 entered the labor market as full-time workers. Among them, 37.5% are female, and 17.2% have post-secondary education. We track these workers' wages and promotions until 1990, which yields 980,573 worker-year observations. Tenure is measured as the number of years since the first entry[6]. We can follow workers' careers for up to 8 years on average and 20 years at the maximum. Table 1 shows key summary statistics at the time of entry and throughout.

[Table 1 here]

We analyze two aspects of the business cycle at the time of workers' entry into the labor market, (i) employment rate (= 100 – unemployment rate) and (ii) the growth rate of employment rate. For simplicity, we distinguish four different phases in a business cycle as shown in Figure 1. During a *contraction*, employment rate is high but growth rate is small (or negative). During a *recession*, both employment rate and growth rate are

[6] Alternatively, we measured tenure as the actual number of years observed in the data, which yields no changes in qualitative results.

small. During a *recovery*, employment rate is still low but growth rate is high. During a *boom*, both employment rate and growth rate are high.

[Figure 1 here]

Figure 2 shows the business cycle in Sweden between 1971 and 1981. We observe recessions around 1971, 1978, and 1981, and booms around 1974 and 1980.

[Figure 2 here]

3. Starting Wage and Rank and Business Cycle

In this section, we first analyze how the business cycle affects labor market entrants' *starting* wages and ranks. Then, in the next sections, we analyze the effect of the business cycle at the time of entry on future wages and promotions.

[Table 2 here]

In Table 2, we focus only on first time labor market entrants, and analyze how their starting wages are determined. Not surprisingly, the employment rate has a positive and significant effect on starting wages. From column [3], however, the growth rate of employment has negative effect on starting wages. Column [4] also shows that the negative effect of the growth rate is stronger when the employment rate is high. In other words, workers' starting wages are highest when the employment rate is high but the growth rate is low, or during the contraction period.

[Table 3 here]

Table 3 shows how workers' starting ranks are affected by the business cycle. Columns [1]-[4] reveal that workers start, on average, at higher ranks when both employment rate and growth rate are low, i.e. during a recession. It is possibly because

firms hire low-skilled workers relatively less during a recession or because only the highly-qualified workers enter during a recession.

4. Cohort Effect in Wage

In this section, we first analyze whether and how a cohort who entered the labor market in the same year follows the same wage growth patterns in the long-run, called cohort effects on wages, and also whether these cohort effects are driven by the business cycle at the time of entry.

4.1 Unrestricted Cohort Effects in Wages

For estimation of cohort effects on wages, we regress wages on a cohort dummy, $cohort_t$, which is equal to one if a worker's labor market entry year is t, and zero otherwise. As is well-known, however, the coefficients of these cohort dummies, called the *cohort effect in wages*, cannot be identified when we control for both tenure and time effects at the same time, because entry year is equal to year minus tenure.

Following Hall (1971), we identify cohort effects by dropping the first and the last cohort dummies. Thus, we don't identify any linear trend in cohort effects, but we can still identify non-linear components, i.e. fluctuation over the linear trend. Since we are interested in the effect of the business cycle (which is obviously non-linear) on cohort effects, the identification of non-linear components in cohort effects is sufficient for our purpose. To improve efficiency, we also control for tenure by a quadratic function of tenure instead of tenure dummies.[7]

Note that unlike previous studies (e.g. Beaudry and DiNardo 1990, Raaum and Roed 2006, and Oreopoulos et al. 2006), we do not restrict cohort effects to be a function of unemployment rate at the time of entry[8]. Thus, we can not only test (instead of assuming) whether cohort effects are driven by the unemployment rate at the time of entry, but also study whether other aspects of the business cycle, notably growth rate, can drive the cohort effects.

[7] Using tenure dummies does not change qualitative results of the paper.
[8] Baker, et al. (1994a) also estimates unrestricted cohort effects and briefly mentions that they seem to follow the business cycle.

[Table 4 here]

In the first column in Table 4, we regress log of monthly real wages on cohort dummies, tenure, tenure squared, year dummies, and other control variables including age, gender, firm size, industry, occupation, and regions.

[Figure 3 here]

Figure 3 shows the estimated coefficients of cohort dummies, or cohort effects in wages. Compared with Figure 2, the cohort effects appear to follow the growth rate of employment rate, rather than employment rate itself. In other words, workers who entered the labor market during the high growth period receive higher-than-average wages in the long-run. We formally test this in next section.

The cohort effects can be less meaningful if they are driven by a different composition of workers in each cohort. For example, during a recession, only the highly educated workers may get hired. Also, during a recession, firms may hire relatively less at lower ranks. Then, the average new workers' quality may fluctuate along the business cycle, and drive the cohort effects observed in Figure 3.

Therefore, in column [2] in Table 4, we control for workers' education[9] and their starting rank[10] at the time of entry. Figure 3 shows that cohort effects do not change much, which suggests that cohort effects estimated in Table 4 are not driven by a different composition of workers in each cohort.

Even though there can be unobserved quality variations among workers with the same education and the same starting rank, early studies have shown that firms raise their hiring standard during a recession (see e.g. Devereux 2002b). Then, workers who entered during a low-growth period should receive higher-than-average wages in the long-run, not lower-than-average wages.

In column [3] in Table 4, we control for workers' current ranks as well. Compared with Figure 2, Figure 3 shows that cohort effects in wages do not seem to follow the

[9] Education is controlled by dummy variables for elementary, lower-secondary, upper-secondary, bachelor, master, and PhD.
[10] Starting occupations are not controlled as they make little difference.

business cycle systematically. This finding suggests that business cycle at the time of entry affect workers' long-term wages through ranks or promotions. We analyze the cohort effects in promotions in more detail later.

4.2 Restricted Cohort Effects in Wages

Based on these results, we restrict cohort effects to be a function of employment rate and growth rate at the time of entry, and estimate the effect of those on workers' long-term wages. In other words, we replace cohort dummies with employment rate and growth rate at the time of entry.

[Table 5 here]

From column [1] in Table 5, we control for both contemporaneous employment rate and the employment at the time of labor market entry. As expected, contemporaneous employment rate has a strong positive effect in wages: a 1% increase in the employment rate raises real wages by 8.6%. Somewhat contrary to previous studies, we find that employment rate at the time of entry has a negative effect on workers' long-term wages, but the effect is quite small: a 1% increase in the employment rate at the time of entry reduces workers' future wages by less than 1%.

In column [2], we control for both employment rate and growth rate at the time of labor market entry. It shows that employment rate at time of entry still has a negative effect, but the growth rate has a positive and significant effect on workers' long-term wages. In other words, a 1% increase in the growth rate (of employment) raises workers' long-term real wages by 0.6%. In column [3], we also control for the interaction between employment rate and growth rate at the time of entry, and show that the interaction term has a negative coefficient. Column [4] shows again that controlling for workers' education or starting rank does not change the results.

These results suggest that a cohort of workers receives highest long-term wages if they entered the labor market when the economy was in the recovery phase of the business cycle, i.e. when the employment rate was still low but growth rate was high. Note that these results differ from those in previous studies. Previous studies have

focused on the (un)employment rate only without controlling for growth rate, and found that workers who entered the labor market during a period of high unemployment rate period receive lower-than-average wages in the long-run. (see e.g. Beaudry and DiNardo 1991)

Column [5] shows, however, that once we control for workers' current rank, the effect of growth rate at the time of entry disappears. Also the effect of the employment rate at the time of entry decreases significantly. As discussed above, this result suggests that the business cycle at the time of entry affects workers' long-term wages mainly through ranks or promotions.

If the centralized wage bargaining system in Sweden had attached a single wage to each rank, the result in column [5] would not be surprising, because employers could only increase workers' wages by promoting them to higher ranks. However, as we showed in appendix A, there exist large variations in wages within each rank. (see Figure 1A) Furthermore, using personnel data from one US company, Hwang and Kwon (2007) replicates the same result that wage cohort effects disappear if current ranks are controlled for.

5. Cohort Effect in Promotion

In this section, we analyze cohort effects on promotion directly. Two aspects of promotion are considered, (i) reached (or current) rank and (ii) promotion speed.

5.1 Unrestricted Cohort Effects in Reached Rank and Promotion Speed

First, we estimate unrestricted cohort effects on reached rank. The regression equation is the same as in the wage cohort estimation in Table 4, except that the dependent variable is now workers' ranks instead of wages.

[Table 6 here]

The first and second columns of Table 6 show the estimated cohort effects on reached rank. Figure 3 shows the cohort effects in column [2] in a graph (the solid line). Note that even after controlling for age, tenure, education, and starting rank, workers

reach different rank depending on the year they entered the labor market. For example, the cohort of workers who entered the labor market in 1972 reach a rank 0.072 higher on average than the cohort of workers who entered the labor market in 1978. This is a small but still economically significant effect because there are only seven ranks and because workers get promoted, on average, only twice in their careers.

Second, we estimate unrestricted cohort effects in promotion speed where promotion speed is defined as the number of promotions[11] divided by tenure. Figure 3 shows the cohort effects in column [4] in a graph (the dashed line). Again, we see small but significant difference in promotion speed among different cohorts even after controlling for age, tenure, education, starting ranks, etc.

5.2 Cohort Effects in Promotion and Business Cycle

To test whether these differences in promotion patterns among different cohorts are driven by the business cycle at the time of entry, we first regress the estimated cohort effects in column [2] and [4] in Table 6 on the employment rate and growth rate at the time of entry.

[Table 7 here]

Table 7 shows that employment rate at the time of entry or growth rate at the time of entry alone does not explain the cohort effects in reached rank (i.e coefficients of the cohort dummies in column [2] of Table 6). However, when both employment rate and growth rate at the time of entry are controlled for, both are significant and explain more than 70% of the cohort effects in reached rank. If we include the interaction term between employment rate and growth rate at the time of entry, 89% of the cohort effects in reached rank are explained.

These results show that cohort effects in reached rank are indeed driven by the business cycle at the time of entry. Recall that previous studies have simply assumed this. Also note that the employment rate alone does not fully explain the cohort effects even

[11] We define that promotion has occurred when a worker's rank increases within his/her occupation and when a worker's real wage increases by more than 10% when s/he changes occupations.

though previous studies have focused on (un)employment rate only. Both employment rate and growth rate in the business cycle matter.

More specifically, a cohort of workers who entered the labor market when employment rate was low but growth rate was high (that is, the recovery phase in the business cycle) get promoted to higher ranks than other cohort groups.

[Table 8 here]

From Table 8, we find the same pattern for promotion speed. A cohort of workers who entered the labor market during the recovery phase in the business cycle get promoted faster than other cohort groups, even after controlling for age, tenure, education, starting rank, and others. Again note that employment rate and growth rate combined explain more than 70% of cohort effects in promotions.

5.3 Restricted Cohort Effects in Promotion

Based on the results above, we re-estimate cohort effects in reached rank and promotion speed by restricting cohort effects to a function of employment rate, growth rate, and their interaction term.

[Table 9 here]

Column [1] in Table 9 confirms our previous findings. Workers who entered when the employment rate was low and the growth rate was high get promoted to higher ranks. Column [2] shows that a low initial employment rate (or a high unemployment rate) strengthens the effect of the initial growth rate.

Column [3] in Table 9 also confirms that workers who entered when employment rate was low and growth rate was high get promoted faster.

6. Discussion

In this section, we survey potential theoretical explanations for cohort effects on promotions, and discuss the degree of consistency between our findings and the predictions of theoretical models.

First, cohort effects can arise due to the *downward stickiness* of wages or promotions.[12] For example, if workers receive higher wages and start at higher ranks during a high growth period than at other times, the wages and ranks will stay in place even during a low growth period due to downward stickiness. In other words, workers who entered the labor market during a high growth period will have higher wages and ranks in the future as we found in previous sections.

Note that under the downward stickiness explanation, the effect of business cycle at the time of entry should disappear over time, as firms would increase or promote those who got hired during a high growth period more slowly than those who got hired during a low growth period. In other words, the cohort effects for promotion speed should be negative for those cohorts who entered during a high growth period.

However, Table 9 shows that the promotion speed for those cohorts who entered during a high growth period is faster. Furthermore, section 3 shows that workers enter at lower (not higher) ranks during a high growth period in the first place.

Second, the long-term contract model can argue that workers have lower reservation wages during a recession and are willing to commit to lower long-term wages[13]. However, as we discussed in section 3, workers' starting wages are lowest when the employment is low and growth rate is high, i.e. during the recovery phase. If they also commit to lower long-term wages, we would expect that their future wages would be lower as well. But Table 5 shows the exact opposite. That is, workers who entered the labor market during the recovery phase receive higher-than-average wages in the future.

Third, the stigma model predicts that workers entering at lower ranks during a low growth period will signal that they are low-productivity workers and therefore will receive fewer outside offers. Hence, this model predicts that workers entering lower ranks during a low (high) growth period will have slower (faster) promotion rates and lower

[12] For downward wage rigidity, see, e.g. Altonji and Devereaux (1999) or Wilson (1999). For downward rank rigidity, see, e.g., Baker et al. (1994b) and Kwon (2006).
[13] For related models, see Harris and Holmstrom (1982) and Thomas and Worrall (1988).

future wages, as shown in section 4 and 5. However, section 3 shows that workers enter, on average, at higher ranks during a low growth period.

Fourth, the human capital model (e.g. Gibbons and Waldman 2003) argues that workers entering the labor market during a low growth period will start at lower ranked jobs with few or no learning opportunities, and therefore acquire lower skill accumulations and reach lower ranks in the future. However, section 3 shows that workers enter, on average at higher ranks during a high growth period.

On the other hand, if we modify Gibbons and Waldman (2003) slightly and assume that workers accumulate their task-specific human capital by the least amount from learning-by-doing during a contraction period, such a model would be consistent with our findings. For example, suppose that firms hire lots of workers at the peak of a boom. Then, new workers starting after a boom, i.e. during a contraction period, may find fewer jobs to do and consequently learn less. Thus, a cohort of workers entering the labor market after a boom will learn less, become less productive, and consequently receive lower-than-average wages in the future and get promoted more slowly than other cohorts, which is consistent with our findings.

Fifth, suppose that firms hire relatively more skilled workers and promote more frequently at the peak of a boom. Then, new workers starting after a boom, i.e. during a contraction period, may find that all the high-ranked positions are already filled and their promotion paths are blocked. Therefore, this model, like the modified Gibbons and Waldman (2003) discussed above, can explain our empirical findings.

Finally, a worker-firm specific matching model can predict that if the initial matching quality between firms and workers is better during a low employment and high growth period, workers entering then would get promoted faster and receive higher wages in the future. Since there are typically more hiring opportunities both for firms and for workers during a recovery phase, this model can be consistent with our findings.

To summarize, simple theoretical models based on downward rigidity, long-term contract, or stigma are not consistent with a broad pattern of our findings. However, models based on human capital, promotion blockage, and matching can explain our findings. Note that there exist an important difference between the human capital/matching model and the promotion blockage model (our fifth explanation). Under

human capital/matching models, cohort effects arise because different cohorts have different productivities. However, the promotion blockage explanation does not necessarily rely on different productivities among cohorts. Therefore, if one can control for workers' productivity, the human capital/matching model and the promotion blockage model can be potentially distinguished.

7. Conclusion

Previous studies have shown that a cohort of workers who enter the labor market during a recession receive lower-than-average wages in the long-run and become more likely to be unemployed. This paper shows that a cohort of workers who enter the labor market when the employment rate is low but growth rate is high get promoted faster and reach higher ranks than other cohorts. Furthermore, we show that cohort effects in wages are largely driven by cohort effects in reached rank.

Even though there are many potential theoretical explanations, models based on human capital, matching, and promotion blockage are most consistent with a broad pattern of our findings. A more refined theoretical integration of these models and empirical test of these models are interesting topics for future research.

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Appendix A Three-Digit Occupation Codes

BNT Family	BNT Code	Levels	
0			**Administrative work**
	020	7	General analytical work
	025	6	Secretarial work, typing and translation
	060	6	Administrative efficiency improvement and development
	070	6	Applied data processing, systems analysis and programming
	075	7	Applied data processing operation
	076	4	Key punching
1			**Production Management**
	100	4	Administration of local plants and branches
	110	5	Management of production, transportation and maintenance work
	120	5	Work supervision within production, repairs, transportation and maintenance work
	140	5	Work supervision within building and construction
	160	4	Administration, production and work supervision within forestry, log floating and timber scaling
2			**Research and Development**
	200	6	Mathematical work and calculation methodology
	210	7	Laboratory work
3			**Construction and Design**
	310	7	Mechanical and electrical design engineering
	320	6	Construction and construction programming
	330	6	Architectural work
	350	7	Design, drawing and decoration
	380	4	Photography
	381	2	Sound technology
4			**Technical Methodology, Planning, Control, Service and Industrial Preventive Health Care**
	400	6	Production engineering
	410	7	Production planning
	415	6	Traffic and transportation planning
	440	7	Quality control
	470	6	Technical service
	480	5	Industrial, preventive health care, fire protection, security, industrial civil defense
5			**Communications, Library and Archival Work**
	550	5	Information work
	560	5	Editorial work – publishing
	570	4	Editorial work – technical information
	590	6	Library, archives and documentation

6			**Personnel Work**
	600	7	Personnel service
	620	6	The planning of education, training and teaching
	640	4	Medical care within industries
7			**General Services**
	775	3	Restaurant work
8			**Business and Trade**
	800	7	Marketing and sales
	815	4	Sales within stores and department stores
	825	4	Travel agency work
	830	4	Sales at exhibitions, spare part depots etc.
	835	3	Customer service
	840	5	Tender calculation
	850	5	Order processing
	855	4	The internal processing of customer requests
	860	5	Advertising
	870	7	Buying
	880	6	Management of inventory and sales
	890	6	Shipping and freight services
9			**Financial Work and Office Services**
	900	7	Financial administration
	920	6	Management of housing and real estate
	940	6	Auditing
	970	4	Telephone work
	985	6	Office services
	986	1	Chauffeuring

Appendix B Sample Description of Four-Digit Occupation Codes

Occupation Family 1: Occupation # 120- Manufacturing, Repair, Maintenance, and Transportation
11% of 1988 sample
There is no rank 1 in this occupation.
Rank 2 (4% of occupation # 120 employees) - Assistant for unit; insures instructions are followed; monitors processes
Rank 3 (46%) -In charge of a unit of 15-35 people
Rank 4 (45%) - In charge of 30-90 people; does investigations of disruptions and injuries
Rank 5 (4%) - In charge of 90-180 people; manages more complicated tasks
Rank 6 (0.3%) - Manages 180 or more people
There is no rank 7 in this occupation.

Occupation Family 2: Occupation #310- Construction
10% of the 1988 sample
Rank l (0.1%) - Cleans sketches; writes descriptions
Rank 2 (1%) - Does more advanced sketches
Rank 3 (12%) - Simple calculations regarding dimensions, materials, etc.
Rank 4 (45%) - Chooses components; does more detailed sketches and descriptions; estimates costs
Rank 5 (32%) - Designs mechanical products and technical products; does investigations; has 3 or more subordinates at lower Ranks
Rank 6 (8%) - Executes complex calculations; checks materials; leads construction work; has 3 or more subordinates at rank 5
Rank 7 (1%) - Same as rank 6 plus has 2-5 rank 6 subordinates

Occupation Family 3: Occupation #800- Marketing and Sales
19% of 1988 sample
Rank l (0.2%) - Telesales; expedites invoices; files
Rank 2 (6%) - Puts together orders; distributes price and product information
Rank 3 (29%) - Seeks new clients for 1- 3 products; can sign orders; does market surveys
Rank 4 (38%) - Sells more and more complex products; negotiates bigger orders; manages 3 or more subordinates
Rank 5 (20%) - Manages budgets; develops products; manages 3 or more rank 4 workers
Rank 6 (7%) - Organizes, plans, and evaluates salesforce; does more advanced budgeting; manages 3 or more rank 5 workers
Rank 7 (1 %) - Same as rank 6 plus 2-5 rank 6 subordinates

Occupation Family 4: Occupation #900- Financial Administration
5% of 1988 sample
Rank 1 (1%) - Office work; bookkeeping; invoices; bank verification
Rank 2 (7%) - Manages petty cash; calculates salaries
Rank 3 (18%) - More advanced accounting; 4-10 subordinates
Rank 4 (31 %) - Places liquid assets; manages lenders; evaluates credit of buyers; manages 3 or more rank 3 employees
Rank 5 (28%) - Financial planning; analyzes markets; manages portfolios; currency transfers; manages 3 or more rank 4 employees
Rank 6 (12%) - Manages credits; plan routines within the organization; forward-looking budgeting; manages 3 or more rank 5 employees
Rank 7 (2%) - Same as rank 6 plus 2-5 rank 6 subordinates

Appendix C Brief Description of Centralized Wage Bargaining in Sweden[14]

Beginning in 1966, wage setting for most private sector white collar workers in Sweden was determined through negotiations between the Swedish Employers' Confederation (SAF) and PTK, the main cartel for the private sector white collar union. After 1983, the central wage bargaining system started to dissolve despite the government's attempts to save it. For the vast majority of all employees after 1988, wages were determined by industry- and plant-level bargaining (Calmfors and Forslund 1990), while local plant unions continued to represent workers.

The occupation codes (called BNT code) were developed to facilitate the wage negotiation. One of the goals was to pay the same wages for the same tasks, resulting in wage compression within each occupation.

However, in practice, there existed significant wage variations within an occupation. As Figure A.1 shows, the highest-paid workers in a given rank often received larger wages than the lowest-paid workers in a rank above. Also, the wage variation increases with ranks. Such patterns are consistent with those observed in US firms. (see Baker et al. 1994, Kwon 2006)

[Figure A.1 here]

Employers are also allowed to decide autonomously when it comes to hiring and promotion. But firing workers is strictly regulated by law and is monitored by the labor union. Very few workers are fired or laid off, except when the firm can claim that the jobs have become redundant.

[14] For more details, see Ekberg (2004) and Kwon and Myersson Milgrom (2006).

Table 1 Summary Statistics

	Observations	Mean	Std. Dev.	Min	Max
At the Time of Entry (1971 - 1981)					
Age	78,613	23.07	2.79	16.00	27.00
Wage	78,613	2,122.76	505.34	411.56	8,097.69
Rank	78,613	2.42	0.98	1.00	7.00
Tenure	78,613	1.00	0	1	1
Female (%)	78,613	37.50			
Post Secondary Educ. (%)	78,613	17.20			
Part Time (%)	78,613	0			
Throughout Career (1971 - 1990)					
Age	980,573	30.31	5.65	16.00	46.00
Wage	980,573	2,694.66	971.38	307.26	18,542.36
Rank	980,573	3.25	1.19	1.00	7.00
Tenure	980,573	8.17	4.90	1.00	20.00
Female (%)	980,573	36.90			
Post Secondary Educ. (%)	980,573	21.09			
Part Time (%)	980,573	11.29			

Note: Summary statistics for those who first entered the data under the age 27 as a full-time worker and who have at least one observation ten years after the entry. Wage measures monthly real wage in 1970 Kronor. Tenure measures the number of years since the first entry. Post-secondary education includes bachelor, master, doctoral degrees, and equivalents.

Table 2 Starting Wages and Business Cycle
(dependent variable = log(monthly real wage))

	[1]	[2]	[3]	[4]
age	0.049	0.048	0.049	0.049
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
female	-0.053	-0.050	-0.055	-0.055
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
part time	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
firm size	-0.001	-0.001	-0.001	-0.001
(in thousands)	(0.000)***	(0.000)***	(0.000)***	(0.000)***
firm growth (%)	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)	(0.000)***	(0.000)***
employment rate (%)	0.130		0.156	0.162
	(0.001)***		(0.002)***	(0.002)***
growth rate (%)		0.032	-0.033	7.035
		(0.001)***	(0.001)***	(0.356)***
employment rate*				-0.072
growth rate				(0.004)***
Observations	74952	74952	74952	74952
R-squared	0.72	0.69	0.73	0.73

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: This sample includes the first time labor market entrants only, or those with tenure equal to one. Each regression includes education, industry, occupation, county, and year dummies. Female and part time are dummy variables. Education is controlled by six education dummies (elementary, lower-secondary, upper-secondary, bachelor, master, and PhD).

Table 3 Starting Ranks and Business Cycle
(dependent variable = rank at the time of labor market entry)

	[1]	[2]	[3]	[4]
age	0.105	0.105	0.105	0.105
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
female	-0.304	-0.307	-0.305	-0.305
	(0.006)***	(0.006)***	(0.006)***	(0.006)***
part time	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
firm size	0.001	0.001	0.001	0.001
(in thousands)	(0.001)	(0.001)	(0.001)	(0.001)
firm growth (%)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)*	(0.000)	(0.000)
employment rate (%)	-0.070		-0.045	-0.049
	(0.006)***		(0.008)***	(0.008)***
growth rate (%)		-0.051	-0.032	-4.947
		(0.005)***	(0.006)***	(1.641)***
employment rate*				0.050
growth rate				(0.017)***
Observations	74952	74952	74952	74952
R-squared	0.61	0.61	0.61	0.61

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: This sample includes the first time labor market entrants only, or those with tenure equal to one. Each regression includes education, industry, occupation, county, and year dummies. Female and part time are dummy variables. Education is controlled by six education dummies (elementary, lower-secondary, upper-secondary, bachelor, master, and PhD).

Table 4 Cohort Effect in Wages

Dependent Variable	log(monthly real wage)		
	[1]	[2]	[3]
age	0.032	0.017	0.015
	(0.000)***	(0.000)***	(0.000)***
female	-0.142	-0.102	-0.052
	(0.001)***	(0.001)***	(0.000)***
part time	-0.499	-0.495	-0.450
	(0.001)***	(0.001)***	(0.001)***
firm size	0.000	-0.003	-0.003
(in thousands)	(0.000)**	(0.000)***	(0.000)***
firm growth(%)	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***
tenure	0.020	0.037	0.020
	(0.000)***	(0.000)***	(0.000)***
tenure sq.	-0.002	-0.002	-0.001
	(0.000)***	(0.000)***	(0.000)***
cohort=1971	0	0	0
cohort=1972	0.010	0.005	-0.004
	(0.001)***	(0.001)***	(0.001)***
cohort=1973	0.007	0.003	-0.005
	(0.001)***	(0.001)***	(0.001)***
cohort=1974	0.005	0.003	-0.008
	(0.001)***	(0.001)***	(0.001)***
cohort=1975	0.001	-0.005	-0.005
	(0.001)	(0.001)***	(0.001)***
cohort=1976	0.003	-0.001	-0.004
	(0.001)***	(0.001)	(0.001)***
cohort= 1977	0.001	0.002	-0.002
	(0.001)	(0.001)**	(0.001)**
cohort=1978	0.004	0.004	0.001
	(0.001)***	(0.001)***	(0.001)
cohort=1979	0.008	0.011	0.005
	(0.001)***	(0.001)***	(0.001)***
cohort=1980	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)
cohort=1981	0	0	0
education	no	yes	yes
starting rank	no	yes	yes
current rank	no	no	yes
Observations	946785	946785	946785
R-squared	0.71	0.77	0.85

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Each regression includes industry, occupation, county, and year dummies. Female and part time are dummy variables. "cohort=*t*" is equal to one if a worker's labor market entry year is equal to *t*, and zero otherwise. Cohort=1971 and cohort-=1981 are set to zero for identification as discussed in the text. Education is controlled by six education dummies (elementary, lower-secondary, upper-secondary, bachelor, master, and PhD). Starting rank and current rank are controlled by seven rank dummies (1-7). The coefficients for cohort dummies in each column are shown in Figure 3 as well.

Table 5 Cohort Effect in Wages and Business Cycle

Dependent Variable	log (monthly real wage)				
	(1)	(2)	(3)	(4)	(5)
age	0.032	0.032	0.032	0.017	0.015
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
female	-0.142	-0.142	-0.142	-0.102	-0.052
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***
part time	-0.498	-0.499	-0.499	-0.495	-0.450
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
firm size	0.000	0.000	0.000	-0.003	-0.003
(in thousands)	(0.000)**	(0.000)**	(0.000)**	(0.000)***	(0.000)***
firm growth (%)	0.000	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
tenure	0.020	0.020	0.020	0.037	0.019
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
tenure sq.	-0.002	-0.002	-0.002	-0.002	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
employment rate (current)	0.086	0.086	0.085	0.074	0.066
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
employment rate (starting)	-0.003	-0.007	-0.005	-0.006	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
growth rate (starting)		0.006	1.196	1.158	0.023
		(0.000)***	(0.162)***	(0.145)***	(0.119)
employment rate*			-0.012	-0.012	-0.000
growth rate (starting)			(0.002)***	(0.001)***	(0.001)
education	no	no	no	yes	yes
starting rank	no	no	no	yes	yes
current rank	no	no	no	no	yes
Observations	946785	946785	946785	946785	946785
R-squared	0.71	0.71	0.71	0.77	0.85

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Each regression includes industry, occupation, county, and year dummies. Female and part time are dummy variables. Employment rate is defined as 100-unemployment rate (%). The growth rate (%) measures the growth rate of employment rate. Education is controlled by six education dummies (elementary, lower-secondary, upper-secondary, bachelor, master, and PhD). Starting rank and current rank are controlled by seven rank dummies (1-7).

Table 6 Cohort Effects in Reached Rank and Promotion Speed

Dependent Variable	Current Rank		Promotion Speed	
	[1]	[2]	[3]	[4]
age	0.101	0.021	-0.004	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
female	-0.632	-0.390	-0.011	-0.025
	(0.002)***	(0.002)***	(0.000)***	(0.000)***
part time	-0.316	-0.298	-0.039	-0.040
	(0.003)***	(0.002)***	(0.000)***	(0.000)***
tenure	0.040	0.132	0.032	0.024
	(0.001)***	(0.001)***	(0.000)***	(0.000)***
tenure_squared	-0.004	-0.004	-0.001	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
firm size	0.017	0.002	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
firm growth	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
cohort=1971	0	0	0	0
cohort=1972	0.068	0.049	0.008	0.006
	(0.003)***	(0.003)***	(0.000)***	(0.000)***
cohort=1973	0.058	0.053	0.017	0.010
	(0.003)***	(0.003)***	(0.000)***	(0.000)***
cohort=1974	0.066	0.067	0.011	0.009
	(0.003)***	(0.003)***	(0.000)***	(0.000)***
cohort= 1975	0.016	-0.007	-0.026	-0.018
	(0.003)***	(0.003)***	(0.000)***	(0.000)***
cohort=1976	0.023	0.012	-0.018	-0.012
	(0.004)***	(0.003)***	(0.001)***	(0.001)***
cohort=1977	-0.001	0.008	-0.019	-0.013
	(0.004)	(0.003)**	(0.001)***	(0.001)***
cohort=1978	-0.008	-0.002	-0.010	-0.006
	(0.005)*	(0.004)	(0.001)***	(0.001)***
cohort=1979	0.006	0.030	0.004	0.004
	(0.005)	(0.004)***	(0.001)***	(0.001)***
cohort=1980	-0.006	-0.004	-0.005	-0.004
	(0.005)	(0.004)	(0.001)***	(0.001)***
cohort=1981	0	0	0	0
education	no	yes	no	yes
starting rank	no	yes	no	yes
Observations	946785	946785	946785	946785
R-squared	0.57	0.69	0.15	0.21

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Tenure is measured as the number of years since the first labor market entry. Firm size is measured by the number of white-collar workers in the firm. Each regression includes industry, occupation, county, and year dummies. Column [4] also controls for starting occupations. The coefficients of cohort effects in column [2] and [4] are shown in Figure 4.

Table 7 Determinants of Cohort Effects in Current Rank
(dependent variable = cohort effects in rank estimated in Table 6 column [2])

	[1]	[2]	[3]	[4]
employment rate	-0.024		-0.035	-0.038
	(0.016)		(0.010)***	(0.007)***
growth rate		0.021	0.041	5.889
		(0.019)	(0.011)***	(2.225)**
employment rate				-0.060
* growth rate				(0.023)**
Observations	10	10	10	10
R-squared	0.23	0.13	0.72	0.89

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Both employment rate and growth rate are measured in percentage. Adjusted for a first-order auto correlation in the error term using Cochrane-Orcutt transformation.

Table 8 Determinants of Cohort Effects in Promotion Speed
(dependable variable = cohort effects in promotion speed estimated in Table 6 column [4])

	[1]	[2]	[3]	[4]
employment rate	-0.019		-0.022	-0.023
	(0.006)**		(0.005)***	(0.005)***
growth rate		0.003	0.012	1.978
		(0.010)	(0.006)*	(1.755)
employment rate				-0.020
* growth rate				(0.018)
Observations	10	10	10	10
R-squared	0.54	0.01	0.73	0.80

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Both employment rate and growth rate are measured in percentage. Adjusted for a first-order auto correlation in the error term using Cochrane-Orcutt transformation.

Table 9 Cohort Effects in Promotion and Business Cycle

Dependent Variable	Current Rank		Promotion Speed	
	[1]	[2]	[3]	[4]
age	0.021	0.021	-0.000	-0.000
	(0.000)***	(0.000)***	(0.000)	(0.000)
female	-0.391	-0.390	-0.023	-0.023
	(0.002)***	(0.002)***	(0.000)***	(0.000)***
part time	-0.298	-0.298	-0.039	-0.039
	(0.002)***	(0.002)***	(0.000)***	(0.000)***
firm size	0.002	0.002	0.001	0.001
(in thousands)	(0.000)***	(0.000)***	(0.000)***	(0.000)***
firm growth (%)	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
tenure	0.135	0.136	0.027	0.027
	(0.001)***	(0.001)***	(0.000)***	(0.000)***
tenure sq.	-0.004	-0.004	-0.001	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
employment rate (current)	0.073	0.066	-0.000	-0.000
	(0.003)***	(0.003)***	(0.000)	(0.000)
employment rate (starting)	-0.049	-0.039	-0.036	-0.036
	(0.002)***	(0.002)***	(0.000)***	(0.000)***
growth rate (starting)	0.049	5.820	0.013	0.035
	(0.002)***	(0.572)***	(0.000)***	(0.102)
employment rate*		-0.059		-0.000
growth rate (starting)		(0.006)***		(0.001)
education	yes	yes	yes	yes
starting rank	yes	yes	yes	yes
Observations	946785	946785	946785	946785
R-squared	0.69	0.69	0.19	0.19

Standard errors are parentheses.
*: significant at 10%, **: significant at 5%, ***: significant at 1%

Note: Each regression includes industry, occupation, county, and year dummies. Female and part time are dummy variables. Employment rate is defined as 100-unemployment rate (%). The growth rate measures the growth rate of employment rate. Education is controlled by six education dummies (elementary, lower-secondary, upper-secondary, bachelor, master, and PhD). Starting rank and current rank are controlled by seven rank dummies (1-7).

Figure 1 Phases of Business Cycle

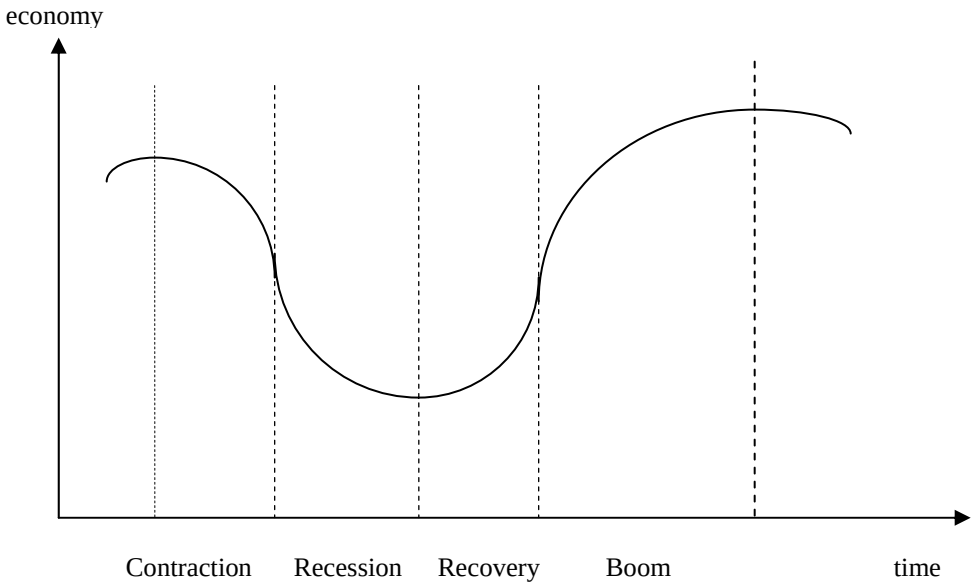
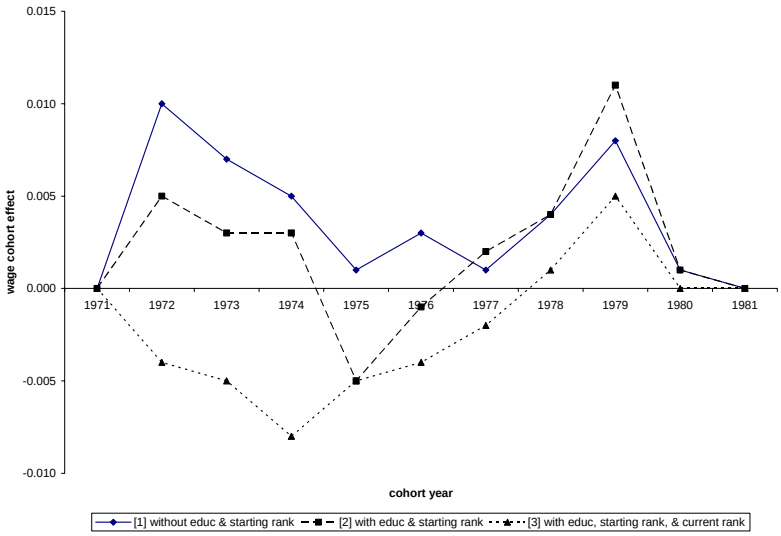


Figure 2 Business Cycle in Sweden (1971-1981)

(Source: OECD)

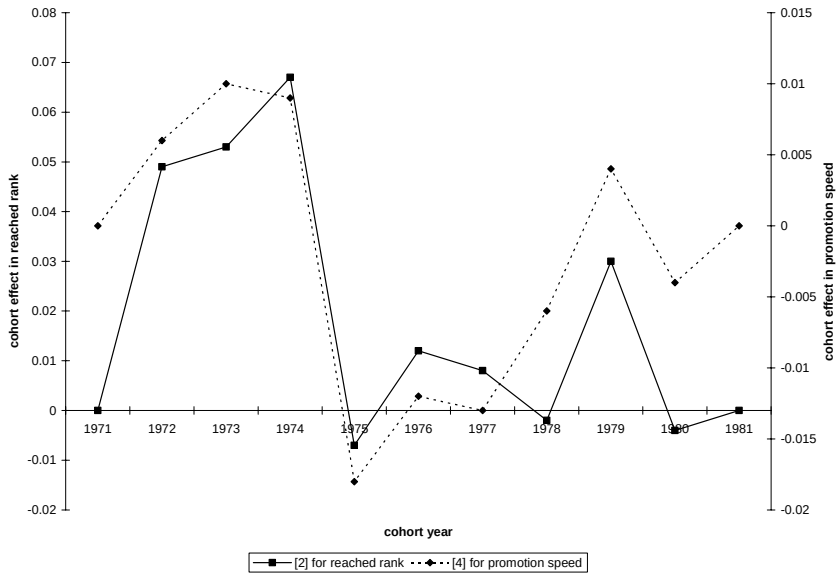
Note: Employment rate is defined as 100-unemployment rate. Growth rate measures the growth rate of the employment rate.

Figure 3 Cohort Effect in Wages



Note: Wage cohort effect without controlling for education and starting rank corresponds to the coefficients of cohort dummies in Table 4 column [1]. Wage cohort effect with controlling for education and starting ranks corresponds to the coefficients of cohort dummies in Table 4 column [2]. Wage cohort effect with controlling for education, starting ranks, and current ranks corresponds to the coefficients of cohort dummies in Table 4 column [3].

Figure 4 Cohort Effect in Reached Rank and Promotion Speed



Note: Cohort effect in reached rank corresponds to the coefficients of cohort dummies in Table 6 column [2]. Cohort effect in promotion speed corresponds to the coefficients of cohort dummies in Table 6 column [4]. Both cohort effects control for education and starting rank.

Figure A.1 Wage Dispersion Within Occupation and Rank: Box Plot
(year=1976, occupation = mechanical engineering (310) and marketing (800))