Changes in wage formation, wage dispersion, and employment since the early 1990s[#]

By

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1. Introduction

Originally, "solidarity wage policy" was conceived as a way to equalize wages within occupations across industries. Plants that were unable to pay those wages would have to close down and labor made redundant by plant-closings should be assisted by an extensive set of labor market policies to find new employment. An explicit aim was thus to increase the pace of structural adjustment. Later versions of solidarity wage policy emphasized overall wage compression across occupations to a greater extent, potentially raising the relative wage of the less skilled further.

Wage policy, implemented by centralized bargaining, clearly produces a different allocation of labor across industries and workers across skills than the market. An explicit aim is to price some jobs out of the market. Moreover, the incentives to invest in skills and mobility may be curbed by wage compression.

In the previous "audit" of the Swedish welfare state, Edin and Topel (1997) examined the consequences of wage policy for observed wage differentials and employed. Two of their main conclusions were the following:

- Centralized bargaining and wage policy compressed wage differentials over and above what would have been generated by market forces.
- Consistent with the original goal of solidarity wage policy, low-wage industries contracted and high-wage industries expanded (see also Davis and Henrekson, 1997).

The puzzle is why wage compression did not contribute to a rise in unemployment among unskilled labor. Public policies do not provide the main answer, although the expansion of public sector employment helped bolster the demand for low-skilled labor, especially women.

Edin and Topel (1997) also used a simple model to rationalize the demise of centralized bargaining in the beginning of the 1980s. The upshot of the model is that allocative inefficiencies are mounting; in the long-run it will be more difficult for employers to hire skilled labor which may have caused them to ultimately reject centralized bargaining. They concluded by saying that allowing for some more inequality is a small cost for improving incentives and allocative efficiency.

In this paper we revisit the relationship between wage policy, wage dispersion, and employment. In short, the basic question is: What has happened since the early 1990s?

Swedish wage policy operates in a very different environment today than it did twenty or thirty years ago. Perhaps most obviously, the macroeconomic setting is radically different in comparison to preceding decades. In the beginning of the 1990s, the most severe economic downturn since the 1930s hit Sweden. In just three years, (open) unemployment rose from two percent to almost ten percent. Since then unemployment has come down substantially, but still hovers above five percent. On top of that, Sweden also entered the European Union during the 1990s, successfully curbed inflation, and started to deregulate many markets.

Another challenge for wage policy is that the Swedish population has become substantially more heterogeneous. Immigration reached post-war highs during the first half of the 1990s. As of 2003, 13.5 percent of the working-age population is born abroad and the immigrant share has increased by almost 3 percentage points in ten years. Moreover, non-OECD immigrants constitute the biggest immigrant group in 2003. Thus, the composition of the immigrant working age population has shifted; it used to be of primarily Nordic origin but now it is mainly of non-OECD origin.

Another change is the rather impressive increase in educational attainment in the Swedish population. From 1992 to 2003, the share of the population with more than 12 years of schooling has increased by 9 percentage points. The mirror image of this development is that the share of the population with compulsory schooling (or less) has been reduced by roughly the same order of magnitude.

Given these changes we should expect to see some changes in wage determination as well. How have wage formation changed since the early 1990s? The 1990s have seen two tides running in opposite directions. There is more coordination alongside more decentralization. Coordination was increased by the introduction of the so-called Industrial Agreement (IA) (*Industriavtalet*). The IA-agreement was signed in 1997 by a number of negotiating parties in the manufacturing sector. Other sectors have followed suit and by 2001 almost 60 percent of the labor market are covered by IA-type of agreements (Elvander, 2003). The IA-model

establishes a set of procedural rules. It may deliver wage-restraint at the aggregate/industry level, but it is less likely that it will affect the wage structure – at least within industry.

The wage structure is presumably affected to a greater extent by the tide towards decentralization. The local level has become more important for the determination of the overall wage increase as well as the distribution of wage increases across groups of employees. This tide is prevalent in the private as well as the public sector, but it clearly represents the biggest change in the public sector. For example, teacher wage-setting was transformed from a highly centralized and regulated system into a system which is individualized, at least in theory, in the mid 1990s.

Thus, Swedish wage-setting has become less regulated in many respects. However, towards the low-end of the skill distribution, central industry agreements may have a bite. Most blue-collar wage settlements still involve minimum wages and minimum wage increases.

In this paper we provide a fresh look of the importance of wage policy for wage and employment differentials. How have relative wages evolved in response to the dramatic changes during the 1990s? What has happened to the employment rates for different categories of workers? Does wage compression at the low end of the skills distribution contribute to the slow employment recovery?

We begin in section 2 by fleshing out the macroeconomic and institutional changes that have occurred during the 1990s. We then move on to document the facts. Thus in section 3 we ask the question: How have relative wages and employment for different categories of workers evolved during the 1990s? In section 4, we pay particular attention to the low-skilled segments of the labor market and ask whether pay compression at the lower end is particularly harmful for this group of workers. In section 5, we look at some of the consequences of the decentralization of pay determination to the individual level. We provide some evidence pertaining to teachers, which is an obvious example of a major change in pay determination during the 1990s.

Our main findings…

2. Background

2.1 The aggregate development since the early 1990s

Figure 1 reports the evolution of the employment rate among 16-64 year-olds from 1976-2004. The crisis of the early 1990s is readily visible in the graph. In just three years the employment rate dropped by more than 10 percentage points – from 83.1 % in 1990 to 72.6 % in 1992. Employment continued to drop until 1997 and has since then risen slightly to reach 73.4 % in 2004.

Figure 1: Employment rate among 16-64 year-olds, 1976-2004, percent
Source: Labor Force Surveys

The shock of the early 1990s hit the manufacturing sector first. Employment in manufacturing started to fall already in 1990. This was then followed by public sector cutbacks during the early years of the 1990s. Figure 2 portrays these developments by showing private and public sector employment from 1987-2004.

Figure 2: Private and public sector employment, 1987-2004, percent
Source: Labor Force Surveys

Employment in the private sector drops in 1990 and public sector employment starts to fall a year later. While private sector employment starts to pick up in 1993, the fall in public sector employment does not level-out until 1997. The public sector employed a substantially smaller share in 2004 (35 %) than it did in 1993 (42.5 %). It is clear that the public sector has not bolstered the demand for the less skilled during the 1990s in the same way as it did during the 1970s.

During the 1990s, Sweden successfully curbed inflation. In 1990, the rate of change in the CPI was above 10 percent. It fell sharply during the crisis years, to even become negative in 1998. Despite relatively solid employment growth between 1998 and 2001, inflation “only”

reached 2.4 % in 2001, well within the bands stipulated by the inflationary target of the central bank (2 ± 1 %).

Figure 3: Rate of inflation, 1980-2004, percent

Source: Statistics Sweden

(**Productivity growth…**)

2.2 Changes in population characteristics since the early 1990s

The amount of dispersion in wages and employment outcomes of course depends on the characteristics of the underlying population. If one look across countries, using the International Adult Literacy Survey, it tends to be true that countries where skills are not so dispersed tend to have less wage dispersion. Of course, cause and consequence is not so clear here, but the fact of the matter is that dispersion of skills and wages go together; see, e.g., Nickell and Layard (1999) and Leuven et al. (2003).

On many accounts the Swedish population was relatively homogenous in the beginning of the 1990s. The most obvious indication of the increase in heterogeneity is that immigration surged dramatically, primarily during the first half of the 1990s. The share of immigrants in the Swedish population in 2003 is similar to the US numbers; see Table 1. Moreover, the increase since the early 1990s is also comparable to the US experience. Non-OECD immigrants account for more than the overall increase in the immigrant population. Immigrants from non-OECD countries have surpassed Nordic immigrants and constitute the majority of the immigrant population in 2003.

Table 1: Immigration

		Immigrant share, population 18-64, percent		
Year	Total	Nordic	OECD	Non-OECD
1992	10.8	4.7	1.5	4.7
1997	12.3	4.0	1.3	6.9
2003	13.5	3.4	1.4	8.7

Source: Calculations based on LINDA; see Edin and Fredriksson (2000)

Another important change occurring during the 1990s is the massive increase in educational attainment in the working-age population; see Table 2. The share of the population with more than an upper secondary degree has risen by some 9 percentage points in a decade. There is a mirror decline in the share with compulsory schooling or less.

Table 1: Educational attainment

	Educational attainment, population 18-64, percent		
Year	Schooling ≤ 9 years	Schooling 9-12 years	Schooling > 12 years
1992	27.5	49.9	22.6
1997	23.9	49.6	26.5
2003	19.2	49.2	31.6
	Educational attainment, population 25-64, percent		
	Schooling ≤ 9 years	Schooling 9-12 years	Schooling > 12 years
1992	28.4	46.7	24.9
1997	23.5	48.2	28.3
2003	17.9	48.5	33.7

Source: Calculations based on LINDA; see Edin and Fredriksson (2000)

Thus, wage policy operates in an environment where the characteristics of the labor force look dramatically different than it did 10 or 20 years ago.

2.3 Institutional changes since the early 1990s

In some important ways the institutional set-up is very different than during the preceding decades.[1] As shown in Figure 3, the double-digit rates of inflation of the 1970s and 80s have been successfully curbed via a combination of a more restrictive monetary policy – implemented by an independent central bank – a rapid worsening of labor market conditions and, possibly, more wage coordination at the national level.

The crisis years of the early 1990s saw a reversion of wage bargaining to a highly centralized level. A stabilization drive in 1990 resulted in a government-appointed commission delivering a proposal for wage-restraint during 1991-93. The proposal was finally accepted after negotiations with over 100 organizations. Wage inflation fell from over 10 percent in the late 1980s to 4 percent in 1992 and further to 2-3 percent in 1993-1994.

[1] This section builds on Holmlund (2003) to a large extent.

The years that followed involved a return to the largely uncoordinated wage bargaining at the industry level of the 1980s. In 1997, however, a new regime emerged. Then the so-called Industrial Agreement (IA) was struck between the unions and the employers in the manufacturing sector. This agreement involves a set of procedural rules. It stipulates, inter alia, time-tables for negotiations, rules for conflict resolution, and gives a prominent role for mediators. The IA model has been followed by similar agreement in other sectors of the economy. As of 2002, almost 60 % of the labor force is covered by IA-type of agreements (Elvander, 2003).

While the IA-model may have delivered incentives for wage restraint at the aggregate level, it is reasonable to think that it has had a minor influence on the wage structure. The agreement seems to have resulted in fewer instances of industrial action in comparison with the 1993-97. Nevertheless, it "only" establishes a set of procedural rules of the game. While there is a bargaining struck at the central level, in general, the negotiated wage increases only come into operation should there be disagreement at the local level. As of 2004, 83 percent of employees are covered by agreements where local bargaining determines the local wage increase; another 10 percent can determine the allocation of a given wage increase locally; while only 7 percent of employees have their wages set by the agreement struck at the industry level (National Mediation Office, 2004). Interestingly, all of the agreements where there is no local influence over the size and allocation of wage increases can be found in the private sector. In fact, in the public sector, previously rigid wage schedules were abandoned in the mid 1990s. In theory, wages are determined locally in the entire public sector and there is considerable leeway for employers to tailor wages such that they can recruit and retain employees.

Many central bargains are still binding when it comes to the lower tail of the wage distribution. In particular, the wage settlements for blue-collar workers involve minimum wages and minimum wage increases.

In sum, apart from a minor episode of re-centralization during 1991-93, there has been a large move towards decentralization of wage determination in the Swedish labor market.

While pay determination has been decentralized, collective agreements and unions appear to be as important on the Swedish labor market as they have been historically. Union density has basically been unchanged during the 1990s and the prominence of collective agreement remains in place in labor legislation.[2]

3. Changes in wage and employment differentials since the early 1990s

The purpose here is to document the changes in the wage structure and employment which have occurred since the early 1990s.[3] What has happened to wage dispersion and employment differentials following the rather dramatic changes occurring during the 1990s?

3.1 Changes in wage differentials

Figure 4 reports some basic statistics concerning the spread of wage distribution. The solid line shows the standard deviation of the log wage distribution while; the dotted line graphs wage dispersion within industry while the dashed line corresponds to the residual log wage distribution.[4]

Figure 4: Overall and residual standard deviation of log wages
Source: Calculations based on LINDA.

Figure 4 shows that the spread of the wage distribution has increased during the 1990s. The raw standard deviation increases from 0.25 in 1992 to 0.30 in 2003. The increase in the variance of the distribution has taken place within industries (dotted line) as well as within worker categories (dashed line). The analysis in Lundborg (2005) shows that wage dispersion increased the most among white-collar workers, which is also where the trend towards

[2] Numbers… Law-suits…
[3] There is of course other relevant papers on this; see, e.g., Edin et al. (2004), Gustavsson (2004), and Le Grand et al. (2001).
[4] The numbers presented in this section come from the wage data contained in LINDA; see Edin and Fredriksson (2000) for a description of these data. In the pre-1998 data there is stratified sampling by firm size in the private sector. We correct for this by weighting using the inverse of the sampling weights at the industry level. We describe this procedure – and other data issues – in the appendix.

decentralization of wage-setting is most pronounced. Among blue-collar workers little has happened to wage dispersion during the 1990s. Moreover, the wage differential between white-collar and blue-collar workers has widened during the 1990s.

Figure 5 examines what has happened at different percentiles of the wage distribution. The solid line shows a precipitous increase in the 90/10 ratio; the 90/10 ratio increased by some 15 log points between 1992 and 2001. The dashed and dotted lines decompose the 90/10 wage gap into 90/50 ratio and 50/10 ratio respectively. The increasing spread of the wage distribution appears to be pervasive in the sense that both the 90/50 and 50/10 gaps are widening over time. However, most of the increase is happening in the upper half of the wage distribution; the 90/50 ratio rose by approximately 10 log points from 1992 to 2001. The widening of wage differentials appears to have come to a halt in the 2000s – wage dispersion has been remarkably stable during the 2000s.

Figure 5: Wage differentials at different points in the wage distribution, 1992-2003.
Source: Calculations based on LINDA.

What has happened to the dispersion of wages in other countries? It is well-known that wage inequality has increased in most other countries – particularly in the US and the UK – from 1980 until the beginning of the 1990s; see Katz and Autor (1999). During the first half of 1990s, the 90/10 ratio continued to increase in the US; see Figure US

Figure US: The log of the 90/10 ratio in the United States, 1980-2000.
Source: CPS??

Another interesting baseline may be obtained from the other Nordic countries. The Nordic countries share the feature of having very low wage inequality in comparison to, e.g., the US. What has happened to wage inequality in the Nordic countries during the 1990s?

In Finland, nothing seems to have happened to wage inequality. If one looks at annual earnings, the log of the 90/10 ratio for full-time working employees stood at 0.91 in 1990; by

2003 this ratio had fallen slightly to 0.89. It is also interesting to note that there have been no institutional changes in wage formation since 1990 in Finland. Industry bargaining has prevailed throughout the time period.[5]

In Norway, annual earnings inequality has risen marginally towards the end of the 1990s. In 1990, the log of the 90/10 ratio for full-time working employees stood at 0.88. By 2002 there had been a slight increase to 0.90. Also, in Norway there have been no changes in the institutional set-up of the wage bargain.[6]

Around 1990, the return to education was relatively low. This is certainly true if you compare to the US. In comparison to countries other than the US, the Swedish wage return is slightly below average. What has happened to the returns to observed characteristics since 1990? Table 3 answers this question by presenting wage differentials by observed characteristics at successive points in time. The estimates are obtained from wage regressions run separately for each year. The right-hand-sides of the regressions include schooling (sometimes splined), potential experience (dummies for each five year interval), gender, immigrant status (separate dummies for Nordic, OECD, and Non-OECD immigrants), and years since migration (dummies for each five year interval). The figures in the table refer to the standardized wage gaps.

Despite the fact that most of the increase in wage dispersion seems to be within groups, there is some action in the returns to observed characteristics as well. The first few rows in the table show that the return to education has increased over the 1990s. On average, the rate of return has risen from 4.9 percent in 1992 to 6.4 percent in 2003. The returns to an additional year of schooling at the university level has consistently been higher than the return at the lower levels and it has increased more since the early 1990s.

Table 3 also shows that there is a minor increase in the return to experience, that the female wage gap has stayed fairly constant as have the wages of two out of three immigrant groups.[7]

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[5] Thanks to Roope Uusitalo for supplying this information.
[6] We thank Kjell Salvanes for supplying this information.
[7] The immigrant wage gap pertains to individuals who have been at least 25 years in Sweden. The immigrant wage gap for those who have been in Sweden for a shorter time is obviously greater in absolute value, but the change over time is the same as that reported in Table 3.

The point where there is some action over time is for immigrants from non-OECD countries: the relative wage of non-OECD immigrants dropped by 4 percentage points between 1992 and 2003. (**We should make sure that this is not due to a change in the country composition of immigrants within this group…**).

Table 3: Log wage differentials by observed characteristics

	Year			
	1992	1996	2000	2003
Additional year of schooling (s)				
Average	0.049	0.052	0.061	0.064
$s \leq 12$	0.030	0.031	0.038	0.038
$s > 12$	0.066	0.068	0.077	0.079
New entrants (relative to peak wage earners)	-0.242	-0.286	-0.270	-0.276
Women (relative to men)	-0.165	-0.182	-0.181	-0.167
Immigrants by region of origin (relative to native-born)				
Nordic	-0.001	0.005	0.005	-0.002
OECD	-0.034	-0.023	-0.023	-0.019
Non-OECD	-0.050	-0.068	-0.085	-0.091

It is well-known that the (wage) rate of return to schooling is an order of magnitude higher in the US. During the 1980s, the rate of return to college almost doubled to reach 14 percent in 1990. However, the college return has stayed constant during the 1990s.

Thus the premium rewarded to characteristics valued highly by the market seems to have increased during the 1990s. Moreover, residual wage dispersion has also risen since the early 1990s. Two potential explanations spring to mind: the first is skill-biased technical change where those with higher observed and unobserved skills are rewarded more in the labor market; the second is decentralization of wage bargaining.[8]

[8] Residual wage dispersion is increasing in the private as well as the public sector. The increase is slightly higher in the private sector, however.

3.2 Employment differentials

Now let us turn to the evolution of employment differentials by observed characteristics. The definition of employment is obtained by combining wage and earnings data. The basic strategy is the following. We divide the data into 32 cells based on observed characteristics. For each cell we calculate the mean of annual earnings for individuals with wages on the 1st to 10th percentile of wage distribution. All individuals in the cell earning more than this threshold are defined as employed. The level of employment generated by this procedure is too low relative to the Labor Force Surveys; however the changes in employment correspond well to the Labor Force Surveys.[9]

Table 4: Employment differentials by observed characteristics, percentage point differences

	Year			
	1992	1996	2000	2003
Education (relative to those with upper secondary schooling)				
Compulsory schooling or less	-3.2	-8.0	-8.1	-9.5
More than upper secondary school	8.4	6.5	3.8	3.8
New entrants (relative to peak wage earners)	-38.1	-43.5	-36.3	-39.9
Women (relative to men)	-7.0	-5.3	-5.0	-4.3
Immigrants by region of origin (relative to native-born)				
Nordic	0.3	-2.2	-2.5	-2.3
OECD	-9.2	-9.4	-7.0	-9.2
Non-OECD	-9.6	-15.6	-13.4	-12.7

Table 4 – which basically has the same structure as Table 3 – shows differences in employment rates by observed characteristics. Again we report standardized differentials.

The first two rows show employment differentials by education. Those with compulsory schooling (or less) are losing ground relative to those with upper secondary education. The fact that the university-educated are also losing ground is perhaps slightly surprising. It seems plausible that this decline is due to the big supply increase of university-educated.

[9] The reason for not using the Labor Force Surveys at this stage is that we only observe foreign citizenship rather than immigrant status in these data. The possibility of standardization is of course an additional virtue of using the micro data.

Some of the other variations in the table have to be down to differential susceptibility to the business cycle. This is obviously the case for the relative employment rates of new entrants and it is probably the case for OECD immigrants.

Other variations seem to be driven more by secular changes. The relative improvement for females is one such example. The employment rates of women are increasing relative to men throughout the 11 years spanned by the data. The evolution of the relative employment rates for non-OECD immigrants is the other instance where secular changes seem to be important for the variation over time. The employment prospects of non-OECD immigrants appear to be trending downwards.

3.3 Wages and employment by skill group

In this analysis we build on Juhn et al. (1992). We thus predict wages for the entire population using an estimated wage equation for 2003. We then rank individuals by skill (i.e. their predicted wage). And finally look at the wages and employment rates by skill group. This procedure will most likely place non-employed individuals too high in the skills distribution, but nevertheless we proceed.

Figure 6 looks at real wage growth for different skill groups. We define skill groups by splitting the data as indicated in figure. There has been an amazing growth of real wages since 1995. This is in sharp contrast to the period 1975-1995 when real wages did not grow at all; see Edin and Topel (1997). Since 1995, real wages have grown for all skill groups. The top decile has experienced the greatest growth where real wages have increased by 2.7 percent a year since 1992. But real wages have also grown substantially at the lower end – 1.7 percent per year since 1992.

Figure 6: Real wage growth by skill group, 1992-2003, 1992=0
Source: Calculations based on LINDA.

The fact that real wages have grown for all skill groups in Sweden during the 1990s is in sharp contrast to the development in the US. Figure US2 shows the growth in average productivity (top line) along with wage growth for the 95th, 50th, and 10th percentile from 1963-2000. During the 1990s, it is only wage growth in the top group that has kept pace with average productivity. Individuals at the median and at the 10th percentile in the US have experienced no real wage growth during the 1990s.

Figure US2: Growth in average productivity and wage growth by percentile, 1963-2000
Sources: CPS ?? and NIPA??

How has non-employment evolved by skill-group in Sweden since the early 1990s? Figure 7 reports non-employment by skill-group (defined as in Figure 6). It is evident that the least skilled (p1-p10) are more susceptible to the cycle than individuals around the median in the skill distribution (p31-p70). Nevertheless, the employment prospects for all other groups than the least-skilled have improved since 1992. The decline in the employment prospects for the least skilled since 1992 relative to the change for the median is significant at conventional levels (the difference in the changes has a t-ratio of -9.6).

In the next section we pay closer attention to the employment prospects of the less skilled and how they are influenced by wage policy.

Figure 7: Non-employment by skill group, 1992-2003, 1992=0
Source: Calculations based on LINDA.

4. Wage policy and the lower-tail of the skill distribution

4.1 Shift share analysis of immigrant employment by industry in the US and Sweden

(Table 5: Employment by industry in Sweden)

(Table 6: Employment by industry in the US)

(Comparable US numbers)

We will ask questions such as:

If a particular industry in Sweden was the same size as in the US, what would happen to immigrant employment?

If a particular industry had grown at the US rate what would happen to immigrant employment?

(**We should also take Freeman and Schettkat analysis into consideration…Davis and Henrekson…**)

Immigrant/native gap in employment to population rates in 1992 (Sweden): 13.7 percentage points

Immigrant/native gap in employment to population rates in 2003 (Sweden): 16.5 percentage points.

(**Immigrant shares in different percentiles of the wage distribution for the US and Sweden**)

4.2 Minimum wages and employment

Here we examine the relationship between minimum wages and, respectively, the wage distribution and employment. Minimum wages in Sweden are bargained at the industry level rather than legislated. Moreover they are generally differentiated by age, occupation, and experience.

A first relevant question is: How high are minimum wages in Sweden? Table 7 addresses this question by showing the minimum wage bite by country in 2004. The minimum wage bite is here defined as the minimum wage divided by the median wage in manufacturing in the respective countries.[10] Apart from Sweden, all countries reported in Table 7 have legislated minimum wages. For Sweden, we report a range since the minimum wage varies by wage settlement. Among the countries covered in Table 7, Sweden has the highest minimum wage bite.

[10] Much of the information on minimum wages in this section comes from Per Skedinger. We have also obtained information on minimum wages in Sweden from Albin Kanelainen. We thank them for supplying the data.

However, minimum wages tend to be higher when they are subject to bargaining rather than legislation. In 2001, minimum wages in Norway and Denmark were higher than in Sweden, while Finland's was slightly lower and Germany's was much lower; Andersson et al (2002).[11] Thus, the Nordic countries share the feature of having high minimum wages (just as they share many other features concerning wage dispersion).

Table 7: Minimum wage bite by country in 2004, percent

Country	Minimum wage bite
Australia	59
Belgium	49
Canada	40
France	57
Greece	48
Ireland	52
Japan	34
Netherlands	46
New Zeeland	54
Portugal	38
Spain	30
Sweden	**60-72**
United Kingdom	43
United States	32

Notes: The minimum wage bite is defined as the minimum wage relative to the median manufacturing wage in each country. For the US we report the federal minimum wage; the number for Canada refers to a weighted average across regions.
Source: Low Pay Commission (2005)

How have minimum wages evolved over time in Sweden? In Figure 8 we graph the minimum wage bite – this time defined as the minimum relative to the mean wage in each industry – for a collection of industries.

It is evident that the bite of the minimum wage is higher in the service sectors than in manufacturing. Moreover, the minimum wage bite has declined over the 1990s in manufacturing. In the private services, on the other hand, the wage bite is been roughly constant (Retail trade) or increased (Hotels and Restaurants). It is clear that minimum wages have significant bite in Hotels and Restaurants which is one of the low-wage industries in the Swedish economy.

[11] For countries with bargained minimum wages, Andersson et al (2002) look at the minimum wage for dish washers and relate that to the mean manufacturing wage. In 2001, the minimum wage bite, defined in this way, was close to 70 percent in Norway, slightly above 60 percent in Denmark, 60 percent in Sweden, and roughly 40 percent in Germany.

Figure 8: Minimum wage bite for different industries.

Source: Minimum wages come from the various wage settlements. Average wages are from Statistics Sweden and the Swedish Municipal Workers' Union.

Of course, minimum wages have differential bite for various worker categories. Table 8 illustrates this by showing the minimum wage bite for the native-born, for the native-born aged 20-25, and immigrants. Here we focus on a single wage agreement – that pertaining to blue-collar workers in the local public sector.

As shown by Table 8, minimum wages have substantial bite in these blue-collar occupations. The minimum wage bite varies in a rather obvious way across worker categories: immigrants and youths have lower wages than the average native-born and, hence, the minimum wage amounts to a greater fraction of the mean wages of these two groups.

The interesting question is, of course, whether minimum wages reduce the employment prospects of the less skilled. This is a controversial question in the literature. In some notable examples, increases in minimum wages even have positive employment effects; see Card and Krueger (1995). Such results are consistent with monopsony in the labor market.

Table 8: Minimum wage bite by worker category, local public sector in 2003

Worker category	Wage bite, percent
Natives, unskilled	79
Natives, semi-skilled	72
Immigrants, unskilled	83
Immigrants, semi-skilled	74
Age 20-25, unskilled	83
Age 20-25, semi-skilled	79

Notes: Unskilled occupations have no educational requirements. Semi-skilled occupations normally require an upper-secondary degree.
Source: Calculation based on LINDA.

There is some previous Swedish evidence on this question. Edin and Holmlund (1994) use time-series data to examine youth employment in manufacturing is related to the minimum wage bite. They find that the minimum wage is negatively related to youth employment.

Skedinger (2005) looks at the consequences of minimum wages in Hotels and Restaurants. Skedinger has access to individual wage and employment data and can thus define who are most likely to be affected by minimum wage changes. He can then relate the wage and employment experiences of this group to the experiences of a comparison group consisting of individuals with similar wages initially but who are less affected by minimum wage changes.[12] Skedinger also finds negative employment effects of increases in the minimum wage.

Here we briefly revisit the relationship between minimum wages, relative wages, and relative employment rates. A major difficulty is that minimum wages are most likely endogenous as they are determined as part of the wage bargain. One possibility to circumvent this issue is to look at substantial changes in the structure of minimum wages. As it happens, there was a substantial change in the minimum wage structure in Swedish hotels and restaurants in 2001. Figure 10 illustrates this change for unskilled blue-collar workers in this industry.

Minimum wages are differentiated by experience in the trade. Before 2001, the amount of differentiation was greater than from 2001 and onwards. For example, the minimum wages for those with 4-5 years of experience relative to those with no experience dropped by around 10 percent between 2000 and 2001. There was an analogous change for semi-skilled workers where the minimum wages for those with 5 years of experience in the trade dropped by almost 7 percent.

Figure 9: Relative minimum wage structure by experience in Hotels and Restaurants, unskilled workers, 1998-2003
Notes: Minimum wages by experience categories are measured relative to those with no experience.
Source: Wage settlements 1998-2003

If we could measure work experience in hotels and restaurants perfectly, the changes illustrated in Figure 9 would lend themselves to a straightforward differences-in-differences

[12] Of course, there is considerable difficulty in finding a comparison group who was not treated by the minimum wage. Most theories predict that minimum wage changes will affect the entire wage distribution.

strategy, where the relative wages (employment rates) could be compared for different categories of workers defined by work experience. However, we only have access to a crude measure of work experience derived from the number of times that the individual appears in the data, working in hotel and restaurants. This proxy has a measurement error which most likely increases with the number of years of measured experience. (**Drop all of this…+ results??**)

If minimum wages affect the relative wage structure the basic prediction is that the relative price of experience in the trade should have declined after the reform. If so, the relative demand for (somewhat) experienced workers should have decreased. In Table 8 we look at some evidence on this issue. The basic strategy is to interact experience in the trade (and its square) with a time indicator equaling unity from 2001 and onwards.

Table 8: Differences-in-differences estimates of minimum wage changes on relative wages and employment in Hotels and Restaurants, unskilled workers.

	Wages	Exit
Immigrant	-0.037	-0.029
	(.005)	(.015)
Female	-0.031	0.008
	(.004)	(.013)
Years of schooling	0.008	0.001
	(.001)	(.004)
Potential experience	0.002	0.003
	(.001)	(.002)
Potential experience squared/(100)	-0.004	-0.002
	(.001)	(.005)
Experience in trade	0.031	-0.018
	(.003)	(.012)
Experience in trade squared/(100)	-0.152	0.087
	(.028)	(.094)
Experience in trade, interaction	**-0.008**	**0.003**
	(.004)	**(.013)**
Experience in trade squared/(100), interaction	**.077**	**-.039**
	(.030)	**(.098)**
# individuals	4,387	2,304
R-squared	0.469	0.025

Notes: The regressions include non-reported time effects. Robust standard errors are reported in parentheses. Experience in the trade is lagged in the exit equation.

Table 8 must be regarded as providing tentative evidence, given the measurement problems involved. Nevertheless, the coefficients on the interaction terms (in bold) are significant and consistent with our priors in the wage equation. Evaluated at 4-5 years of

experience in trade they suggest that relative wages are 1.8 percent lower after the change in the minimum wage structure. Given that the minimum wages dropped by 10 percent for these categories the estimates suggest a minimum wage elasticity of roughly 0.2. Ideally, we would like the estimates to become zero at roughly 6 years of experience, given that there was no change for this category. However, the turn-around does not happen until a couple of years later. However, the exit equation does not suggest that inexperienced workers were displaced to a greater extent. There is a lot of churning in hotels and restaurants, as suggested by the reduction in the sample size. In fact the precision of all estimates are very low suggesting that one should not place much confidence on this equation.

5. Some consequences of the changes in wage-formation since the early 1990s

In section 2 we noted that there are been a substantial move towards decentralization of wage formation. This represents a big change – at least formally – in the public sector.

Here we examine how the structure of an important group of public sector employees – namely teachers – responded to this change. Teacher wage-setting is an interesting case study for a number of reasons. First, teacher wage scales were really rigid prior to decentralization. The rigidity of the relative wage structure may have lead allocative inefficiencies since wages were non-responsive to local market conditions. Second, the relative wages of teachers have been falling for a long time. This has contributed to a shortage of teachers in the aggregate (see Björklund et al., 2003). The number of non-certified teachers in schools has increased rather dramatically in recent years – from 8 percent of teachers in 1994 to close to 19 percent in 2002. With decentralized or individualized wage-setting we would expect wages to be bid up in this situation as schools can use wages to recruit and retain teachers. In the new equilibrium we would expect a greater compensatory component in the wage structure. Wages should compensate for poor school amenities to a greater extent than previously.

Here we draw on fresh evidence from Söderström (2005) concerning the impact of the decentralization of teacher wage-setting. Granqvist and Regnér (2004) papers have looked at the consequences of individualizing wage-setting in general, while Calmfors and Richardson (2004) have examined the consequences for nurses.

The analysis in Söderström (2005) is based on a combination of register information from the Teacher Register, LINDA, and LOUISE. Söderström uses data from 1992 until 2000. There is information on, inter alia, whether the teacher is certified or not, in what school district they are working, at what level they are teaching, their annual earnings, in addition to a set of standard individual characteristics such as education, age, gender, and immigrant background.

A first question that one can pose using these data is whether decentralization of wage-setting has had any real effects. The most obvious way of looking at this question is to ask whether individual unobserved characteristics have become more important after the reform. If decentralization is not just a paper-product, we would expect that this to be the case since with decentralized negotiations there is, e.g., more scope for rewarding behavior that are deemed more valuable by the employer. It turns out that the answer to the question is yes: individual fixed effect contribute more to the explained variance after the reform than before the reform.[13] (**make sure that this is correct!**) One can of course argue that unobserved components have become more important throughout the Swedish labor market – the residual variance in wages is increasing as illustrated in Figure 2. However, this increase in residual wage dispersion may be driven by the fact that there is a pervasive trend towards decentralization in all sectors. Ideally, we would like to compare the changes in the teacher wage structure to a group of public sector workers that had a centralized (and hence rigid) wage-setting throughout the period. Police officers provide such an (although not the ideal) example, since their wages were set through central negotiations throughout the period. It is interesting to see that for police officers, individual unobserved components have become *less* important over time.

The collection of evidence provided by Söderström (2005) tells a rather coherent story. Our interpretation of this evidence is that wages responded to decentralization in the segments of the market where employers face elastic labor supply. This comes out particularly clearly

[13] After the reform, the fraction of the variance explained by adding individual fixed effects to an otherwise standard earnings equation increases by a factor of six or seven in comparison to what happens prior to the reform.

by simple plots of the age-earnings profile before and after decentralization. Figure 11 provides such an example. It graphs the log of annual earnings by age in 1992 (solid line) and 2000 (dashed line) controlling for working-time.

Figure 10: Age-earnings profiles for teachers in 1992 (solid) and 2000 (dashed)
Source: Söderström (2005)

The message is clear. After decentralization, the earnings of new entrants have increased relative to peak wage earners. We think that this result makes sense since the labor supply of new entrants is more sensitive to wage variations than the labor supply of prime-aged individuals.

(Discuss efficiency. Likely to be a difference between the short-run and the long-run.)

6. Conclusions

In general, wage policy may contribute to allocative inefficiency by curbing the incentives for individuals to acquire the right skills and use these skills in the right place. Wage policy may also price certain individuals/jobs out of the market by lifting the lower tail of the wage distribution. Having said this one should notice that wage policy may also provide valuable insurance to workers (Agell, 200x) – an issue that we have ignored in this paper.

Possible conclusions:

- Wage policy is operating in a very different environment than it did say 20 years ago. Restrictive monetary policies, increasing heterogeneity in the population etc.
- Maybe as a consequence of the above changes, wage policy has been reformed during the 1990s. At the industry level, a new set of, mainly procedural, rules was introduced with the Industrial Agreement (IA). The majority of the workforce is now covered by IA-type of agreements. These agreements presumably contribute to fewer instances of industrial action and give incentives for wage restraint in the aggregate. However, they are likely to have limited effects on the wage structure.
- The wage structure is more influenced by another change in wage formation. There is a trend towards more decentralized wage bargains. For over 90 percent of the workforce, the total wage increase or the allocation of a given wage increase is determined locally, subject to the restriction that the least-paid gets a minimum wage increase.
- Since the early 1990s, there has been a trend increase in wage dispersion and the return to education has increased. It seems likely that these outcomes are in part caused by the trend towards decentralization of wage formation. In short, the changes in wage formation imply that wage policy probably contribute to less allocative inefficiencies than it did 10 years ago.
- At the other end of the skill distribution, there have been no major changes in wage formation. Bargained minimum wages are still in effect. And minimum wages may well price certain activities and the least-skilled individuals out of the market. If so, and given

the increase in immigration over the 1990s, minimum wage policies may potentially be more harmful to employment than they were some 10 years ago.

- Policy conclusions?? It is not up to the legislator to decide on wage policy. Other policy instruments?? Differential pay-roll tax reduction. Earned income-tax credits. Certification of immigrant skills.

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Data appendix

Characteristics of sample used in sections 3 and 4

We sample employees aged 20-64 whose educational attainment is not missing…

Trimming

There were some (although very few) obvious measurement errors in the lower tail of the wage distribution. Therefore, we trimmed the lower tail of the wage distribution by deleting those earning less than 17.45 SEK per hour (roughly 2.2 dollars an hour at the current SEK/dollar conversion rate). This had the effect of deleting 121 individuals in 1999 and less than 5 for all other years.

Weighting

The wage data prior to 1998 have been collected by stratified sampling of the employed in the private sector. Small firms have been sampled with low probability (0.02 for firms with less than 10 employees) and the sampling probability increases with firm size (it is unity for firms with more than 500 employees.) Unfortunately, there is no information on the individual sampling probability in the data. However, we know the firm size distribution in each industry. These data together with the sampling probabilities we calculate the average sampling probability for each two-digit industry. Pre-1998 private sector data are thus weighted by the inverse of the sampling probability by industry to obtain estimates that are representative of the population. As a check on whether this procedure delivered sensible results we used data from 2003. In the 2003 data, which are representative of the population, we know who would have sampled under stratified sampling. Assuming that the difference in sampling procedure has a proportional effect on the measured standard deviation (for all years) we can calculate the adjustment necessary to go from the representative population to the population obtained by stratified sampling. The line labeled “adjusted” reports the standard deviation obtained using this adjustment and the line labeled “weighted” report the

estimated standard deviation using our weighting strategy. As shown by the figure these two estimates more or less go together.

Years of schooling

We have imputed years of schooling from attainment data. The attainment data come from registers which records the degrees of the individuals. This education register has gradually become more informative over time; in later years it includes adult education and courses taken at the university level. The latest versions of the education register include measures of the normal time to degree for all attainment levels. For all years there is information on when the degree was obtained. We opt for an algorithm where we assign the most informative measures of education also for the earlier years when it is obvious that the individual has not upgraded his/her education between these two time points…

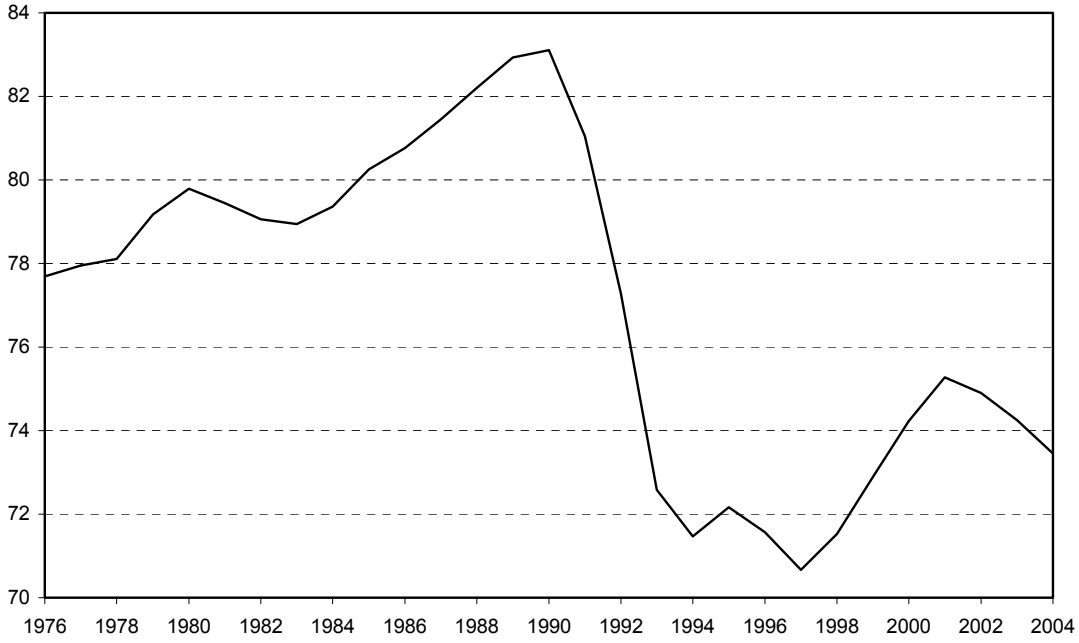
Defining employment

For each year, we divided the wage data into 32 cells based on gender, schooling, region of origin and experience. Then we identified the wages of the individuals on the 1st percentile and the 10th percentile for each cell and calculated average earnings for individuals within the interval defined by the 1st to 10th percentile. All individuals with earnings above this threshold are defined as employed. The level of employment generated by this procedure is too low relative to Labor Force Survey. But the evolution of employment over time corresponds well to the Labor Force Surveys. Graph illustrating this…

Table 5: Employment by industry

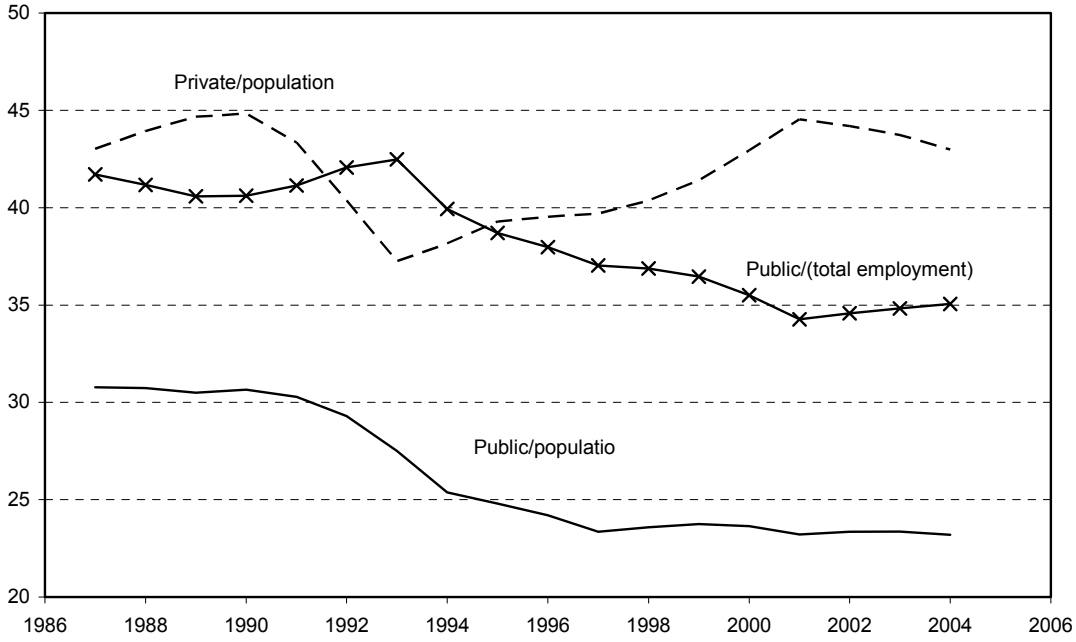
		Percent of total employment			Concentration ratio	
ISIC92	Year	All	Immigrants	Non-OECD	Immigrants	Non-OECD
Agriculture, forestry and fishing	1993	0.9	0.4	0.1	0.4	0.1
ISIC69=1	2003	0.7	0.3	0.2	0.4	0.2
	Change	-0.2	-0.1	0.1		
Mining	1993	0.3	0.1	0	0.3	0
ISIC69=2	2003	0.2	0.1	0	0.4	0.1
	Change	-0.1	0	0		
Manufacturing	1993	20.6	27.8	27.3	1.3	1.3
ISIC69=3	2003	19.4	23.2	22.9	1.2	1.2
	Change	-1.2	-4.6	-4.4		
Power and water plants	1993	0.8	0.3	0.2	0.4	0.3
ISIC69=4	2003	0.6	0.2	0.1	0.3	0.2
	Change	-0.2	-0.1	-0.1		
Construction	1993	5.6	3.2	1.3	0.6	0.2
ISIC69=5	2003	5.4	2.6	1.4	0.5	0.3
	Change	-0.2	-0.6	0.1		
Retail and wholesale trade	1993	11.2	8.6	8.4	0.8	0.7
ISIC69=61+62	2003	11.3	9.4	9.5	0.8	0.8
	Change	0.1	0.8	1.1		
Hotels and restaurants	1993	1.4	3.4	5.1	2.4	3.6
ISIC69=63	2003	1.7	3.8	5	2.3	3
	Change	0.3	0.4	-0.1		
Transport and communication	1993	6.7	6.2	6.4	0.9	0.9
ISIC69=7	2003	6.5	6.5	6.8	1	1
	Change	-0.2	0.3	0.4		
Financial services	1993	2.8	1.4	1.3	0.5	0.5
ISIC69=81+82	2003	2.5	1.3	1.1	0.5	0.4
	Change	-0.3	-0.1	-0.2		
Real estate	1993	8.7	8.8	8.6	1	1
ISIC69=83	2003	12.1	12.4	12.5	1	1
	Change	3.4	3.6	3.9		
Public administration, defence	1993	5.4	2.7	2.1	0.5	0.4
ISIC69=91	2003	4.3	2.1	1.8	0.5	0.4
	Change	-1.1	-0.6	-0.3		
Education and health care	1993	32.5	34	35.2	1	1.1
ISIC69=93	2003	32	35.3	36	1.1	1.1
	Change	-0.5	1.3	0.8		
Other services	1993	3.1	3.2	3.9	1	1.3
ISIC69=92,94,95	2003	3.3	2.9	2.8	0.9	0.9
	Change	0.2	-0.3	-1.1		

Figure 1: Employment rate among 16-64 year-olds, 1976-2004, percent



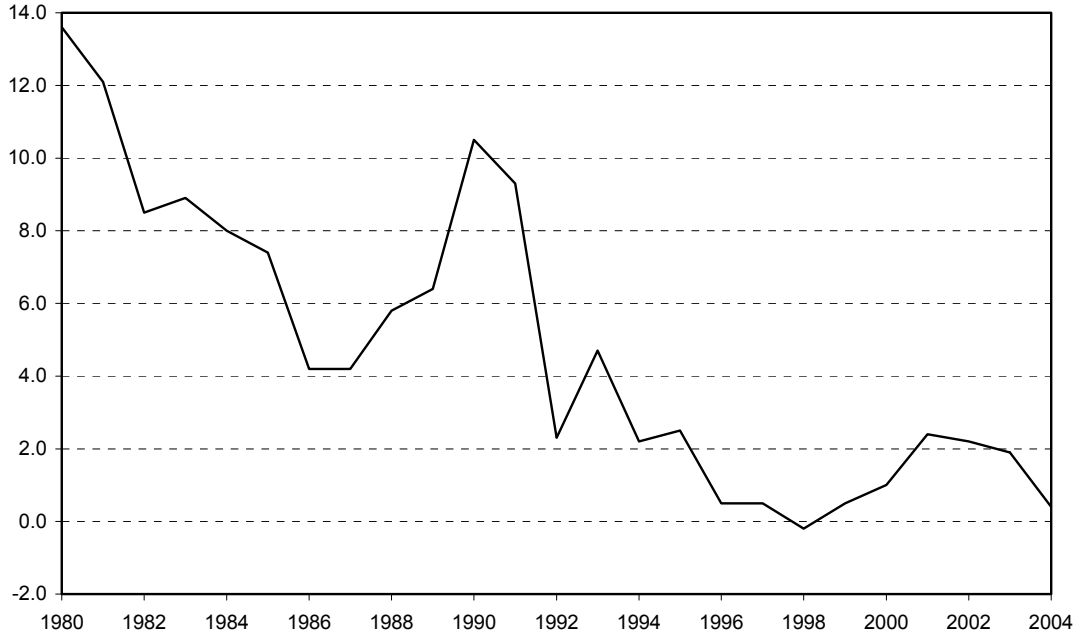
Source: Labor Force Surveys

Figure 2: Private and public sector employment, 1987-2004, percent



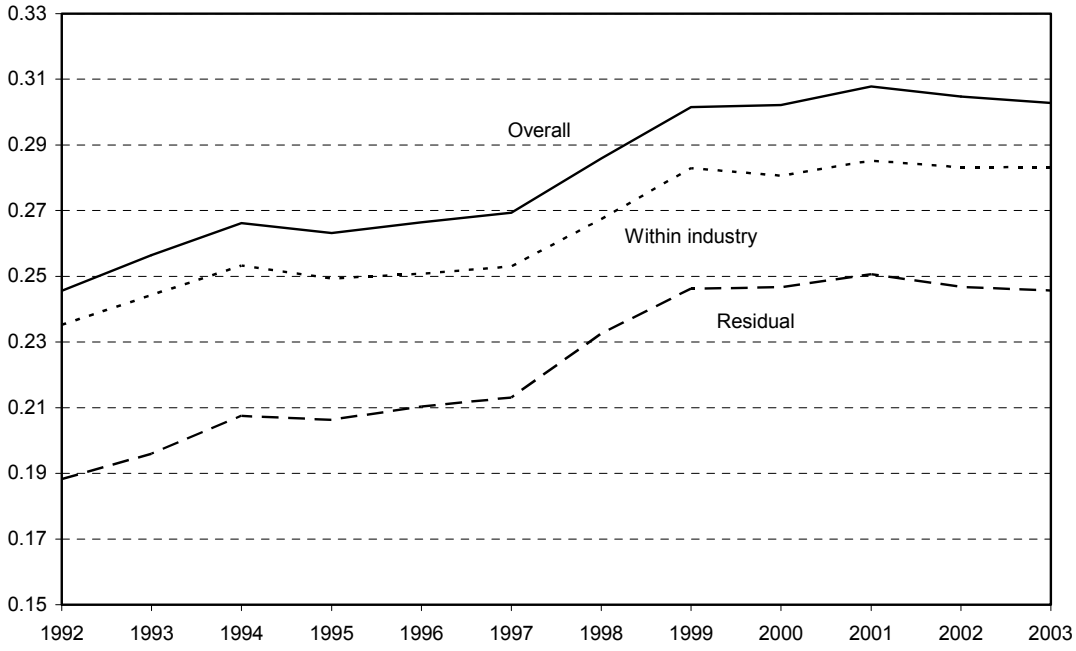
Source: Labor Force Surveys

Figure 3: Rate of inflation (based on the CPI), 1980-2004, percent



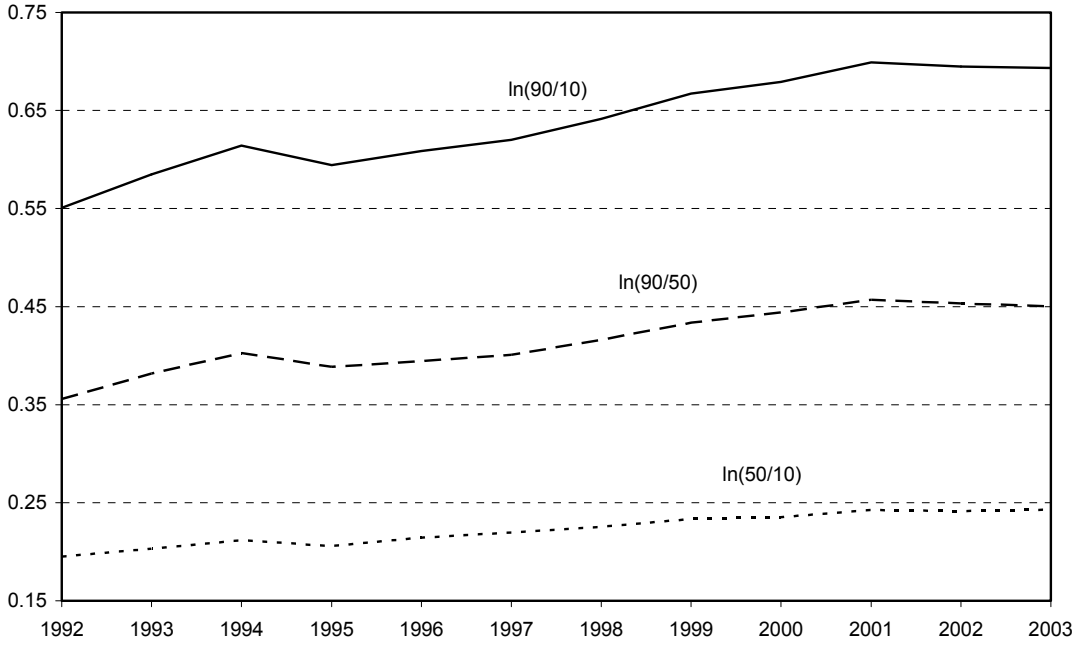
Source: Statistics Sweden

Figure 4: Overall and residual standard deviation of log wages



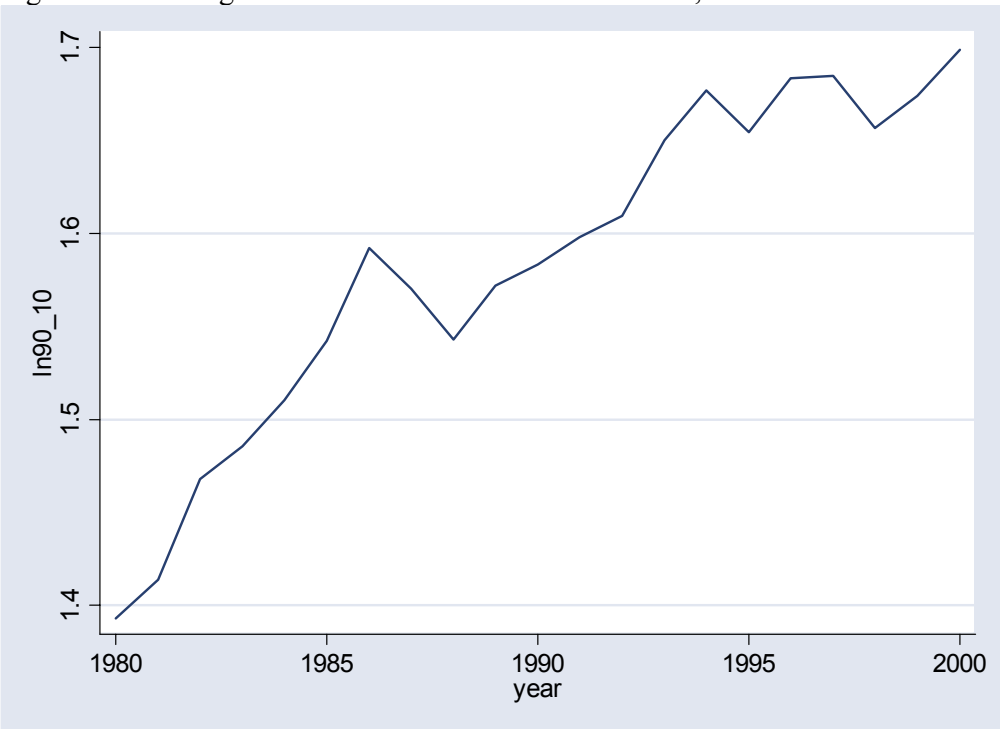
Source: Calculations based on LINDA.

Figure 5: Wage differentials at different points in the wage distribution, 1992-2003.



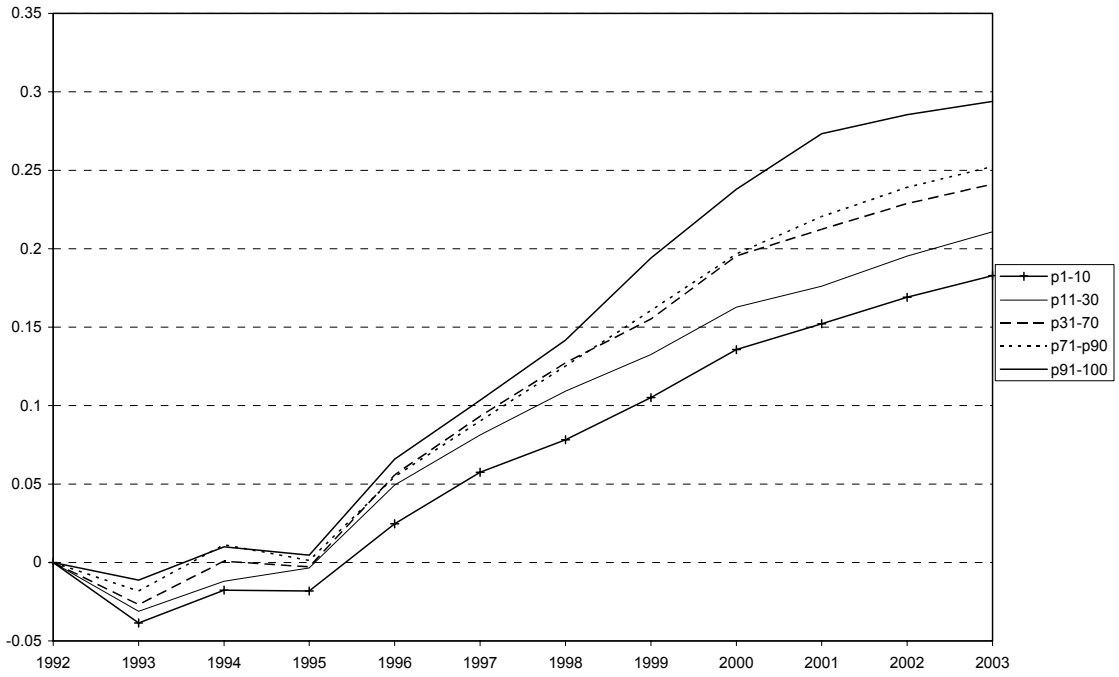
Source: Calculations based on LINDA.

Figure US: The log of the 90/10 ratio in the United States, 1980-2000.



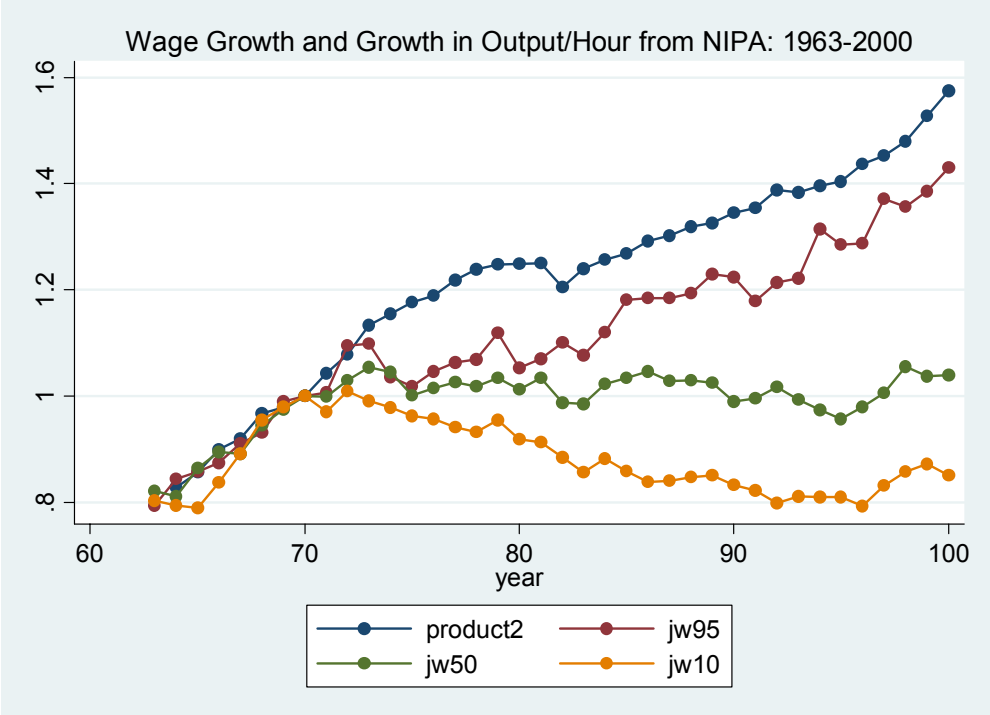
Source: CPS??

Figure 6: Real wage growth by skill group, 1992-2003, 1992=0



Source: Calculations based on LINDA.

Figure US2: Growth in average productivity and wage growth by percentile, 1963-2000

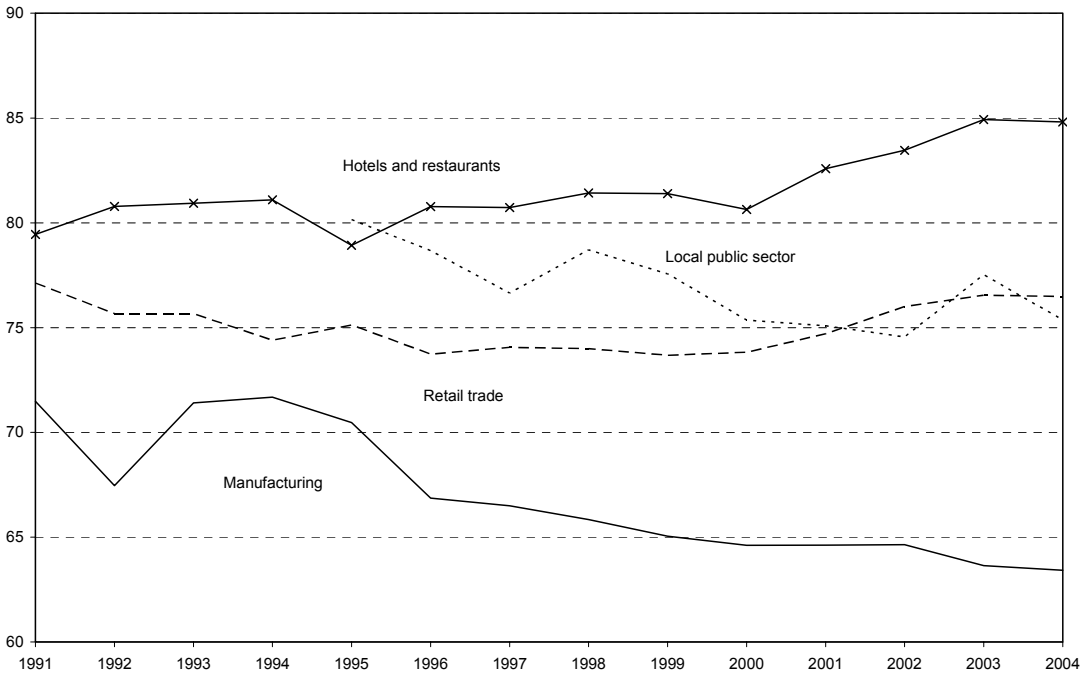


Note: All series are indexed to 1970.

Figure 7: Non-employment by skill group, 1992-2003, 1992=0

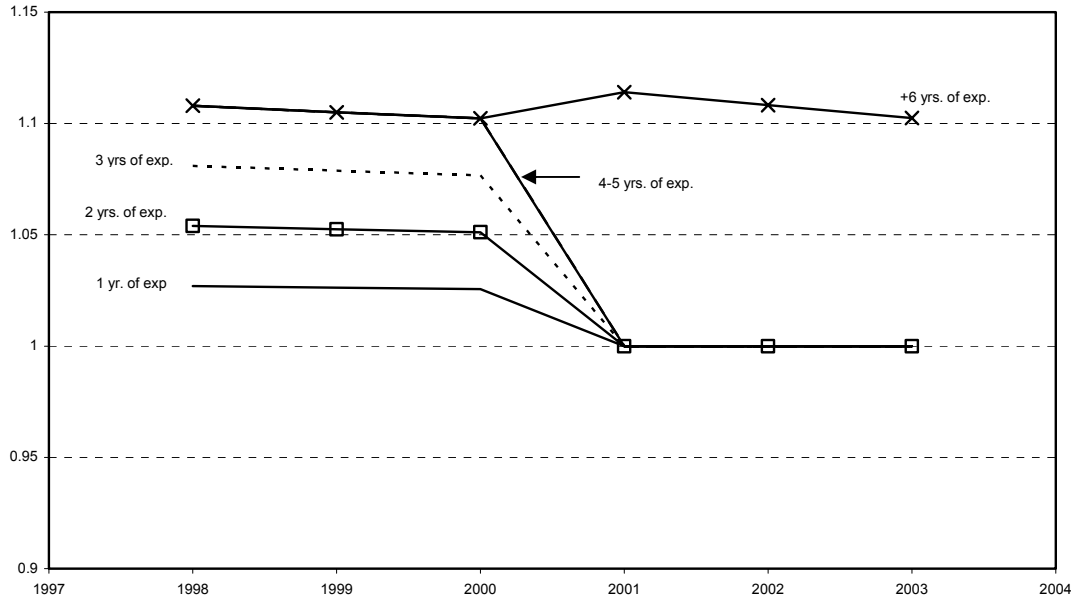
Source: Calculations based on LINDA.

Figure 8: Minimum wage bite by industry, 1991-2004, percent



Source: Minimum wages come from the various wage settlements. Average wages are from Statistics Sweden and the Swedish Municipal Workers' Union.

Figure 9: Relative minimum wage structure by experience in Hotels and Restaurants, unskilled workers, 1998-2003



Notes: Minimum wages by experience categories are measured relative to those with no experience.
Source: Wage settlements 1998-2003

Figure 10: Age-earnings profiles for teachers in 1992 (solid) and 2000 (dashed)

Source: Söderström (2005)