

# Wage Structure, Raises and Mobility

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Abstract

Think about the following questions:

1. Do all firms have the same wage structure? If not, how does the wage structure vary? Are some firms' wages more compressed than other firms' wages? If so, what factors account for differences across firms?

2. Every country has wage variation across individuals. Not all workers earn the same amount. Is this because workers find themselves in different firms, some of which are high wage while others are low wage, or is it because within every firm, some workers are highly paid and others are less well paid?

3. Income is skewed for a country as a whole, but are salaries within firms skewed or does the skewness result from a few very high wage firms? Skewness is relevant in the context of tournament theory, which suggests that there salary jumps at the higher end of the hierarchy are greater than salary jumps at the lower end of the hierarchy.

4. Do choices about wage structure affect productivity? Specifically, are firms that have compressed wages also low wage firms, and if so, why?

5. Are raises uniform within firms or are some workers treated very differently from others? It is possible that workers move relatively lockstep within firms, and that differences in wage growth in the economy is accounted for primarily by firm differences. It is also possible that average wage growth is similar across firms, but that the within-firm variation across workers dominates.

6. Does pay compression result in losses of the most able or of the retention of the least able?

7. Finally, how different are these features across various countries? Do the patterns help explain differences in productivity across countries?

Until very recently, it would be impossible to answer these questions because they require that data be available on all of the workers in a firm for a large number of firms. Now, but now, the required data are available from a number of different countries. These data sets, from many European countries and from the US, contain information on all workers in that country or at least, on a large subset of those workers. As a result, it is possible to examine a the worker in the context of his or her entire firm. Additionally, the existence of data for a large number of firms permits new questions, like those listed above, to be asked.

This is not the first time such questions have been asked. The first economics paper on this subject is Lazear (1992). That study made use of a complete data set on one large firm and studied both wages and mobility. The work was followed by similar papers by Baker, Gibbs, and Holmstrom (1994,a,b). They studied a different company and also examined the structure of promotion, ports of entry, and wages. The advantage of those analyses is that it is possible to examine the entire firm, thereby analyzing promotion paths, determinants and consequences, as well as wage determination and structure. The disadvantage is that because the studies only cover two different firms, it is difficult to generalize the results and not all results are consistent across papers.

It is important, therefore, to have data not only on entire firms and all workers in them, but on a large number of firms so that results can be generalized. The authors in this book have used the new style of data to ask and answer questions that cannot be answered with traditional data sets.

For example, many of these data sets can be used to calculate returns to experience and tenure and can perhaps do it better because of their richness. We have steered away from such questions because they are addressed well by the panel data sets that use the individual as the unit of analysis and sample randomly from a large population. Those data sets have very few observations from the same firm and in most, the identity of firm is unknown. As a consequence, neither a firm's wage structure nor its hiring and promotion patterns can be gleaned from traditional data. Our focus is on exactly the questions that could not be answered historically.

In this introduction we set out to do two things. First, we use the data from all countries in an attempt to generalize about firm wage structure, promotion, hiring and mobility patterns. We also examine firm heterogeneity within countries to determine how much variation across firms exist within a country and how much variation there is across countries. Two extremes make the point clear. We know from years of research on wages that there is considerable variation in worker earnings. There are many ways to generate income inequality, but two polar cases demonstrate the usefulness of the new data sets. It is possible that every firm is a microcosm of the overall economy. All firms share the same distribution of income within the firm as does the entire economy. If so, the firm in which a worker finds himself may be of little consequence because all incomes and presumably opportunities are represented. Alternatively (and equally implausible), all firms have but one wage. All workers within the firm earn the same amount and the way by which a non-degenerate income distribution is generated is that firms differ in the single wage that they pay. If the latter characterizes the labor market, then the only way for a worker to change his earning situation is to change firms. Were mobility limited (also observable in these data sets), the

consequence of initial firm assignment could be much more significant.

Because this kind of analysis is new and because we are covering a large number of countries and studies in this introduction, we will raise as many questions as we provide answers. But the questions themselves may be useful, if for no other reason than they cast light on the kinds of issues that can be addressed with this type of data.

### The Data

The data come from all of the Scandinavian countries (Denmark, Finland, Norway, Sweden) and from Belgium, France, Germany, Italy as well as the United States. The sampling frames are different across countries, but with the exception of Italy, each country provides a substantial number of observations coming from a given firm across a large number of firms. In some countries, e.g., Denmark and Norway, every worker in the entire country is represented. In the United States, every worker in selected states is included in the data set, but not all states in the U.S. are present. There are two data sets for Sweden. One (Oyer) covers only a subset of the country but provides rich data on jobs. The other data set (Edin, Holmlund, Oskar...) is more comprehensive, but does not have the same detail on some variables that are of interest.

Key to using the data is that there is substantial information on a cross section of workers within each firm across many firms to draw inferences about wage structure, worker mobility, and promotion and hiring patterns. Only Italy falls short on this score, but the Italian authors provide information on synthetic firms by taking data from similar industries and locations and blending

them into cells, which they treat as firms. Each paper describes its own data in detail. We point out differences across data sets and variable definitions when relevant.

### **Primary Finding**

The main finding is that countries are remarkably similar in their wage structures and wage changes. Most wage variation is within firm. Although there is a good bit of variation between firms in every country, firms have a large range of the wage distribution within.

Furthermore, with respect to wage growth, there are consistent patterns. Although firms differ with respect to the average raises they give in a particular year, firms do not tie all workers to the same raise. The standard deviation of raises within firm is between 10% and 20%, even when average raises are close to zero. This is most consistent with the view that firms respond to outside pressure (either market or governmental) to raise workers' wages commensurate with some occupational or skill standard.

Mobility levels differ across countries, but even here, mobility patterns seem relatively consistent. *The highest paid and lowest paid are the most likely to leave; the former because they seem to be underpaid and quit. The latter because they seem to be overpaid and get the idea that they should leave, even in countries with much protection. TRUE?*

### **Some Themes**

There are a number of theories of wage setting that permeate the literature. The best known among economic theories is the theory of human capital, which states in its most basic form, that workers are paid on the basis of their general skills and that skills can be measured by a scalar,

meaning that there is one skill: Everything can be expressed in efficiency units of that skill. Were human capital the only determinant of wages, then it would not matter at all in which firm a worker finds himself. The competitive labor market would require that all firms pay the worker exactly the same thing, irrespective of the firm in which he works. Otherwise, other firms could easily steal him away by paying a slightly higher wage and capturing the profits. This is most easily described as a spot market view of the labor market, where competition forces workers to be paid on the basis of the productivity, which is in turn reflected perfectly in measurable skills.

A purely institutional theory of wage determination has the same implication, namely, that a worker's wage is independent of firm in which he is employed. Suppose that wages were set by a central authority and the authority set the wage based on the worker's occupational title, where occupational title was determined by worker characteristics. For example, a particular level of experience and educational background could be used to determine occupational status using some index such as

$$\text{Wage} = a + b(\text{experience}) + c(\text{years of schooling completed})$$

Although the index might look similar to a human capital wage function, there need be no direct relation of the coefficients  $b$  and  $c$  to anything having to do with productivity. The central authority might simply determine that the selected weights  $b$  and  $c$  are appropriate in some sense, based on equity or any other consideration.

A complication to human capital theory was introduced even in Becker's (1962) early paper on human capital, where he defines "firm-specific" human capital. This is skill that affects

productivity in the worker's current firm, but not in other firms in the economy. It is important to distinguish between general and firm-specific human capital. The latter creates an immediate reason why wages might differ from firm to firm, even for the same worker. For example, a worker who had a great deal of firm-specific human capital and who encountered an unanticipated job loss, say, because his plant closed, would suffer a wage reduction in moving to another firm because the skills used at the first firm would not all be transferable to the new firm.

There are other theories that create divergence between wages across firms. Most contract theories create divergence between wages and productivity. Tournament models<sup>1</sup>, for example, which are most applicable to white collar workers, suggest that wage structures within firms serve incentive purposes and that it is the structure, rather than the current wage that determines the strength of the incentive. In tournament theories, workers at higher levels of the firm's hierarchy receive pay that has impacts on those below them. Lower level workers want to become higher level workers and their desire to climb the internal job ladder depends on the raise that workers receive when they are promoted (non-monetary as well as monetary). Since the optimal size of the raise depends on internal conditions like the riskiness of the activity and the shape of the firm's hierarchy, tournament theory suggests that workers will be treated differently in different firms, even though they have the same basic characteristics.

There are other contract approaches as well that suggest the importance of firm-based wage setting.<sup>2</sup> Bargaining theories, where the outside alternatives as well as the worker's value to firm

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<sup>1</sup>Lazear and Rosen (1981)

<sup>2</sup>For example, see McLeod and Malcolmson ( ), Stole and Zweibel ( ).

affect the actual wage level, create a separation between the wage that a particular firm pays and the “market,” which is less well defined, once contracting and bargaining are taken into account. The details of the models are interesting, but not particularly important for the purposes here.

The type of data that are available in the new data sets allow researchers to get a good start at examining these issues. For example, it is possible that all workers in the firm receive similar wages, in line with egalitarian notions of wage setting. But it would be impossible to even get a start at answering this question without the new data. Below, we find that even in countries that are thought to be egalitarian (like Sweden), there is considerable variation both within firms and between firms, in wage levels, in raises and in mobility probabilities.

As for labor mobility, again there are a number of theories that might be examined with the new data. One hypothesis is that firms lock their workers into a wage slot. In order to obtain higher wages, workers must move. There is already evidence<sup>3</sup> that young workers experience wage growth when they move whereas older workers suffer wage cuts. These data come from panel data sets. But countries differ in the restrictiveness of their employment policies as well as the centralization of wage setting. Some have suggested that in Scandinavia (except Denmark), it might be necessary to leave a job in order to obtain wage increases because of strict job-based wage setting. A worker wanting a higher wage must move to another firm and be reclassified into another position. It is possible to examine this, by country and by the wage policy of the firm within country. If some firms adopt more of a lock-step wage policy, do they find that their workers are more likely to leave? Related, firms that have more compressed wage structures at the top would expect to see

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<sup>3</sup>The earliest being Bartel and Borjas ( )

competition stealing away their best workers. This is a cost of pay compression and could imply lower productivity for the firm and perhaps even for the country in the long run. Is there evidence of this kind of selective turnover?

## **The Structure of Wages**

### Wage Levels

To get started, let us point out some initial observations. There are two (among many) ways in which data have been displayed by the authors of this book. The first is to use the individual as the unit of analysis. The second, and way most unique to this structure, is to use the firm as the unit of analysis. Table 1 does the comparison. Here, the average level of wages, the standard deviations, and 90<sup>th</sup> and 10<sup>th</sup> percentile are displayed. The units are own country currencies so comparisons cannot be made across countries without conversions to ratios or other unit free numbers. The mean level of average wages in the firm based data is always lower than that of the mean for the individual based data, although there is some variation in ratios across countries (see table 1, row labeled “Average wage firm/country”). This reflects weighting. If all firms were of identical size, then the firm average would equal the individual average. But they are not and there is a correlation between firm size and average wage. The fact that the firm mean is below the individual mean implies that the largest firms, which account for disproportionately more workers, have higher average wages than the smaller firms. The firm average, which does not weight by firm size, puts relatively more

emphasis on the small firms and pulls the average wage down. That firm size and average wage are correlated is not a new result. (Brown and Medoff;, Fox,; Eckberg).

Also, most countries, with the significant exception of France, have similar patterns. The coefficient of variation for the country as a whole is around .35, but France has wage dispersion that is about twice as large as that for other countries in the sample. Also, the firm means tend to vary around the population mean, but the ratio of the standard deviation of firm means to the average wage for firms as a whole is generally less than .2.

### Similarity of Firms

The more general point is that the difference between means based on unit of analysis already suggests that firms differ in some key ways. It is useful to examine this in greater detail.

First, if all firms were alike, then their wage distributions would be identical to the distribution for the country as a whole as shown in figure 1a. At the other extreme, firms might treat their workers very similarly, and the variation in wages throughout the country could be accounted for by differences in the mean value of wages between firms, as shown in figure 1b.

As already shown, the means differ and this seems to be correlated with firm size. It is also true that the firm wage variance is smaller than the variance for the overall distribution. One interpretation of this is that firms make up parts of the overall distribution as shown in figure 1b.

The typical pattern is illustrated by Figure 1c, for Norway. Norway's situation is a compromise between Figure 1a and Figure 1b. The overall distribution for the country as a whole

is much more dispersed than that for the typical firm. The actual distributions for the typical firm that is below the 10<sup>th</sup> percentile is considerably tighter than that for the country as a whole. The same is true for the typical firm around the median and for the typical firm with mean wages in the top 10% of firms.<sup>4</sup> Although there is some overlap, the wage distributions of high wage and low wage firms are by and large disjoint. Still, firms have considerable dispersion within. The typical firm is not the almost spiked distribution as shown in Figure 1b. Furthermore, and more later, the dispersion varies with overall level of wages, with high wage firms having more dispersion than low wage firms.

France, by comparison, has more dispersion for the country, but less *relative* within-firm variance. France has smaller within firm standard deviations in log wages relative to country standard deviation in log wages than do other countries. For example, the ratio of

std. dev. wage country / average within-firm std. deviation in wage

is about .56 in France, but is significantly higher in all other countries. The Scandinavian countries (Denmark, Finland, Norway and Sweden) have ratios closer to .8 . France has a great deal of variation in wages in the entire country. As a result the absolute level of within firm wage variation is large, but not relative to the country level variation.

Figure 2 provides a graphical representation of country-wide wage variation, showing the ratio of standard deviation of wages to mean wages for the country as a whole. France has the most dispersion and Norway the least. Figure 3 plots the standard deviation of firm means relative to

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<sup>4</sup>The typical firm was constructed by averaging the mean and standard deviation of log wages for firms in the 0-10th percentile, the 45-55th percentile and the 90<sup>th</sup> and above percentile. The distributions were constructed assuming that wages are distributed log normally.

country mean wage (by country). Now the picture reverses. France has tight within firm variation in wages relative to other countries, as already mentioned.

Countries are similar in that the ratio of the standard deviation of the mean firm wage to the mean wage is between 10 and 20 percent. The low number belongs to Italy and the Italian data contain synthetic firms which are closer to a random draw from the overall population. This reduces reported dispersion below the amount that would be present in real firms.

The conclusions are that firms are different, but countries do not differ dramatically in their patterns of differences.

A continuing theme that will reappear throughout this introduction and the book itself is that there are at least two possible reasons why firms might have variation within in wages. First, and most obvious, is that workers are different. Firms do not employ identical workers and as a result, wages may reflect the skills of the workers within the firm. Those wages might be determined completely externally, either by a competitive labor market process, in the extreme by a spot market, or by a centralized wage setter, like a government or tripartite (labor, management, government) body. If worker skills are different within firms, and wages are set externally, then wages within firms will reflect the underlying skill distributions within them. Low wage firms might have different skills represented than high wage firms, which could account for the truncation of the upper part of the distribution seen in Figures 1c and 1d.

Alternatively, wage distributions might reflect wage policy. Even if all workers were identical ex ante, a wage policy could result in paying different wages to different people. This happens in a tournament, for example, where pay is more dispersed than ex ante talent and where

the relation of pay to ex post output is positive, but with a correlation far from one. In the other direction is that wages may be more compressed than ex ante ability. Pay compression might simply reflect wage policy of the firm. It is well-known, for example, that certain institutions, like labor unions, compress wages relative to non-union firms. It is also possible that wage setting in a centralized or negotiated environment might result in wage compression that brings up the wages of the least skilled and cuts the wages of the most skilled. There is no reason why this pattern would necessarily be uniform across firms, industries or occupations. Thus, pay policy is another variable that lies behind the within-firm wage distribution.

It is key to try to disentangle these two explanations. That takes us beyond this introductory analysis, but we will allude to some evidence that speaks to the question and will try to suggest additional questions or lines of research that might assist in obtaining answers.

The ultimate question is whether wage policy specifically and labor policy in general has an effect on productivity. It is conceivable that data of this type might allow investigation of this issue within country and among countries. Within country, firms that (randomly) adopt different policies with respect to the types of workers they hire and how they pay them might experience different levels of productivity. By examining firm profitability, or in the absence of profitability, firm survival, we may get some hints as to the effects of various policies. For example, if it were found that firms with either a too compressed or too disparate wage policy were more likely than firms in the middle to go out of business, this would be a starting point. Then, an examination of the detailed nature of turnover at those firms might shed additional light.

There is another dimension along which firms might differ from one another. Not only is

the mean wage different among firms, but the amount of within firm variation is different as well. Figure 5 shows that countries are remarkably similar with respect to within-firm coefficients of variation. For example, Finland has considerably different firms in that the firms with larger internal wage dispersion have coefficients of variation equal to about .35, whereas those with little internal wage dispersion have coefficients of around .15. But the average is around .25, which is about the same value as the average value for almost all countries. The average firm across Europe has a standard deviation of wages that is about one-fourth the wage of that firm. This is slightly higher in some countries and slightly lower in others, but the variation is small relative to the within-country differences in coefficients of variation for wages. Whether this reflects some kind of universal constant remains to be determined. More important is understanding what it means. Does it imply that there is a typical skill distribution for countries and these are reflected in the coefficient of variation that is seen for the country as a whole? Or does it imply that wage policies vary across firms, but tend to average out at the country level because firms adopt the same distribution of wage policies irrespective of country? These questions remain open ones.

Finally, a related question is whether those countries that “allow” some firms to have very high wage variation within do better in the sense of overall productivity. This would be quite important as some have suggested that firms limit the levels of top salaries to median salaries within firm. Since the unit of analysis for such policies is the firm, these are the only kind of data that can speak to that issue.

Is this wage policy or worker heterogeneity? Firms may differ in the wage mean and variance primarily for two reasons. One is that they select differing wage policies. Firms sometimes

target a position in the market, deciding that they would like to be above average in pay, but not the highest paying firm in the market. In the US, it is not uncommon to hear human resource managers talk about aiming to be at a particular percentile in the overall wage distribution for the relevant industry (allowing differences by occupation).

Another reason for differences across firms is the obvious one. Firms produce different products and employ different groups of workers. For example, a law firm would not be expected to have the same average wage as a cleaning service firm. Average wage might differ simply because the firms' typical workers are different. Not only might firms differ in their means, but they might have different wage variance for the same two reasons. The first is wage policy. Some firms might adopt a more compressed wage structure than others, either by choice or because they are constrained by institutional factors, such as centralized wage bargaining or unions. Alternatively, firms might have high variance in wages because they have high variance in worker skill within the firm. It is possible to distinguish the two, at least in part by using the panel data structure and the fact that some workers move between firms. As a result, a worker-specific effect can be estimated, which can be thought of as a measure of skill (see Abowd and Kramartz). After taking these effects into account, residual wage variation can be attributed to policy.

Why does all of this matter? As already mentioned, the fact that there is considerable wage variation within firm means that at least potentially, workers are not locked into a particular wage slot as a function of their first job assignment. In this context, it is particularly interesting whether or not residual wage variation is significant. If all of the variation in wages within firm were accounted for by person effects, then there would be constancy over time in a worker's position,

given his initial position. Workers care that their position can improve in the firm as a result of experience and promotion. If there is no within firm residual variation, then the only way for a worker to improve his relative position is to move.

Again, it is possible to examine the relation between within-country mobility and within-country variation mobility. If residual variance is low, then mobility is expected to be high.

A key determinant of whether within-firm wage variation reflects wage policy or underlying characteristics is the pattern of mobility. For example, consider a firm that has a small standard deviation of the log of wages. This could reflect a policy of pay compression or it could reflect a homogeneous work force. If it is pay compression that hurts the top relative to the bottom, then the top workers should be more likely to leave the firm than the bottom workers. If we find a pattern where firms with tight wage distributions also have disproportionate exit of the highest paid workers, then the inference that we would draw is that the pay compression is policy. Conversely, if low wage workers have their pay increased relative to the market in such firms, then they should be less likely to leave. There would be no reason for top workers to leave disproportionately nor for bottom workers to stay disproportionately if all were paid their competitive wage.

Two correlations are relevant here. First is the correlation between log wage and spread in log spread. Second is the correlation between wage spread and mobility among various worker groups, particularly the high and low wage.

Figure 6 provides some evidence on the first for three countries. The correlation between log wage and spread is positive for the three countries in which it is reported. The correlation is between .1 and .3. There are two ways to put this: Firms that allow high wage spread also have

higher wages. This pushes the t productivity interpretation where firms that allow disparate wage treatment also reap the benefit through incentive and selection effects of higher productivity. Firms that compress wages drive out their best workers and stifle incentives to produce.

Alternatively, the result can be stated that high wage firms also have high spreads. This points in the direction of worker heterogeneity. It is possible that there is more heterogeneity in high wage firms than in low wage ones. Law firms must have janitors, but building cleaning contracting firms need not have lawyers.

To speak to this issue, the second set of numbers on wage spread and mobility is important. The data are incomplete at this point, but for the limited countries (Denmark, Norway and Finland), but if anything, the pattern suggests that more compressed wage firms have less mobility among top workers than less compressed firms - see figure 7. If these findings hold up, they would suggest that the pattern observed reflects worker heterogeneity more than it does wage policy. One possibility is that firms that are more compressed have a more homogeneous work force and that within that group, there is less difference between the top workers and the median workers. As a result, top workers are less likely to be underpaid in that environment.

What might explain this? Three candidate explanations are:

1. Firm size - Compression may be correlated with firm size and mobility (at all parts of the wage distribution) might be correlated with firm size.

2. Selection when entering the firm. If a firm has a compressed top, the best people may shy away from those firms. Then those who are there may have already sorted. This would explain a zero correlation, but it is unlikely to explain a negative correlation.

3. Unions or other institutional factors. Unions tend to both compress and raise wages. If all workers earn rents in compressed wage firms, then there would be low labor mobility for all workers in these firms.

More evidence would help address these possibilities. Obtaining information on firm size and mobility would speak to (1). Figure 8 presents some data on this. The ratio of mobility in the larger firms (>100 workers) is compared to overall mobility. The ratio is almost always below one, meaning that larger firms have lower mobility levels. If larger firms also have more compressed wage structures because of their bureaucratic nature, then the relatively low mobility of top workers compressed wage firms might simply be picking up firm size. Obtaining information on mobility of different lower wage workers in compressed versus non-compressed firms would address (1) and (3). Examining the observable characteristics of workers in compressed and non-compressed firms would speak to (2). Holding constant unionization and other institutional factors would shed light on (3).

The general conclusion from this section is that there is considerable within firm variance in wages in all countries. Although firms differ considerably within a country, both in terms of average wage and in terms of wage spread, there is a significant amount of variation within each firm. Some of this reflects differences in workers within each firm, but some may reflect wage policy. At this point it is difficult to distinguish, but the wage compression evidence points more to heterogeneity than to policy, at least in Norway, Denmark and Finland.

*Why Care About Within-firm Wage Variation?*

It is important to determine the amount of within-firm wage variation. If wages were very compressed within firms, mobility would be necessary in order to change one's position, both over the life cycle and relative to other workers. Luck might play an important role. If a worker landed in a low wage firm like the one pictured at the far left of figure 1b, he would have no hope of changing his income without leaving the firm. In an economy where mobility is costly, either as a result of market forces or because of government mandated severance pay that makes firms reluctant to hire new workers, workers who begin in low wage firms suffer significant lifetime losses on their human capital. At the other end, those who start in high wage firms experience a windfall.

The reality is far from this extreme picture. Firms do not have completely overlapping distributions, but there is a significant amount of within-firm variation. Still, in Norway and even Denmark, in figures 1c and 1e, there is little overlap in the wage distributions of very low wage firms and very high wage firms. A worker who starts in a very low wage firm would have to move to another firm to have much of a shot at high wages. Conversely, a worker who could not produce at a level consistent with that of a very high level wage firm would find that he was being pressured to leave, rather than being assigned to a low wage slot within the firm.

Another reason to care about within-firm variation in wages and even more to the point, worker characteristics, is that it may help us learn about the nature of the firm's production function. One possibility (as shown in figure 1a) is that workers are almost identical within firm, both in wages and in characteristics. The need for different skills to produce a product might be handled by the market, say, where low skilled workers sell the commodity that they produce to more highly skilled workers who know how to market and distribute the product. Alternatively, team production

may make it essential to have many different types of workers within the same firm. It may be difficult to use the discipline of the market to supervise workers within one firm by workers in another firm. Consider, for example, the production of research. It is possible to have all the researchers in one firm and all the support staff in another firm, located perhaps in another country. Separation of the two groups might increase communication costs sufficiently to make production under these circumstances too costly. The consequence is that firms would contain high wage, highly skilled researchers and lower wage, lower skilled support staff. But whether this is true or not is an empirical question and the findings from this study begin to provide some answers to that question.

In general, the distribution of workers within firms might give us a clue as to the labor ingredients required to produce, how those ingredients vary over time and among industries, and might shed some light on the nature of team production.

### Wage Level and Wage Variance

Already mentioned is that there is a positive relation of wage variance to wage level (see figure 6). There are a number of interpretations of this finding. Two are worth mentioning. The first is causal; the second is statistical. The causal explanation is that firms might intentionally choose wage policies that compress wages. Such policies can be harmful to productivity because they induce adverse sorting and adverse incentives.<sup>5</sup> This has already been discussed.

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<sup>5</sup>The sorting mechanism is more important at the firm level than at the country level. Within country, between country there is less sorting than between firms within a country. Workers who do not like pay compression in Sweden might choose to move to Denmark, but

Incentives can be reduced as a result of wage compression as well. The easiest way to see this is to consider a firm that pays a piece rate given by

$$\text{Pay} = a + b \text{ Output}$$

The higher is  $b$ , the greater is the amount of effort that a worker puts into a job.<sup>6</sup> A completely compressed wage structure has  $a > 0$  and  $b = 0$ , which reduces effort to a minimum.<sup>7</sup> Both of these factors could explain why firms that adopt a low variance wage policy have low productivity and therefore low wages.

More straightforward is the effort mechanism. The high wages that high effort firms pay could be equalizing. Even if all workers had identical preferences, some workers might choose to work at high wage, high effort firms, whereas others might choose low wage, low effort firms. In this case, the increased productivity (although not increased compensation) should vanish if effort

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less readily than those at Volvo move to Saab. As a result, the correlation between average wage and variance in wage might be expected to be stronger within county than between. (Problem: Difficult to compare wages across countries because of exchange rates, ppp issues of non-tradeable goods, etc.)

<sup>6</sup>The worker maximizes  
 $a + b (\text{output}) - C(\text{output})$

where  $C(\text{output})$  is the effort cost of producing a given output level and where  $C', C'' > 0$ . The first order condition is

$C'(\text{output}) = b$ . Since  $C' > 0$ , increasing  $b$  increases the amount of effort.

<sup>7</sup>But see Lazear ( Power of Incentives ) which argues that hourly wages do not result in zero effort, but merely similar effort among workers. Even firms that pay straight hourly wages or salaries require, implicitly or explicitly, some minimum amount of effort in order to retain the job. By altering the requirement and wages paid, effort can be altered.

is accounted for appropriately. Furthermore, the higher wages would not indicate higher utility because it would be offset by higher effort. With heterogeneity of tastes, the marginal worker is indifferent between high wage, high effort firms and low wage low effort firms. All others prefer their current situation to the alternative so the choice of a compressed wage policy does not result in inferior outcomes for those workers who voluntarily choose to work at those firms. Nor is there any obvious externality.

A second explanation for the correlation between average wage and its standard deviation is purely statistical. Suppose that the underlying distribution of wages reflects worker heterogeneity and competitive wage setting. Suppose further that there is significant positive skew in worker ability. Finally, suppose that firms are partitions of the overall income distribution. A positive correlation between average and standard deviation of wage would result. For example, suppose that there were only two firms and that the bottom 50% of wage earners worked for one whereas the top 50% worked for the other. The high wage firm would have higher variance. See figure 9. All with wages below  $X$  work at one firm and all with wages above  $X$  work at the other firm. The variance of wages at the high wage firm is higher than the variance of wages at the low wage firm. This could merely reflect differences in the skill distribution or luck among the top workers.

For example, workers who were at Microsoft during the early years received stock options in varying amounts. Those who received many options ended up having extremely high incomes in some years and those with almost no options had incomes around the average for their occupations and industries. The result is that Microsoft is a high average wage firm and also a high wage variance firm. In some sense, this distribution could be attributed to wage policy because the

pattern of option grants in the first place was a wage policy. But the distribution of earnings at Microsoft based on the ex ante value of the options and that based on the ex post value of the options would be very different.

A first pass at whether the correlation between average wage and standard deviation is merely a reflection of the overall population distribution can be made by examining the wage distribution for the population as a whole. If that distribution does not exhibit positive skew, then it is unlikely that firms are partitions as in figure 9. It is well known that income distributions are approximately log normal and therefore have positive skew. So the statistical argument remains a possibility. Further investigation of the actual firm and population wage distributions would provide additional evidence on this point. In particular, taking out person-specific effects would shed light at least on the luck component of the overall wage distribution.

### **Wage Growth**

The common man view of business cycles and economic growth is that when things are good for some, they are good for all. In the US, approximately 30 million workers are hired every year, but the net change in the labor force is a tiny fraction of that during good times or bad. There is parallel with firms and their employment and wage conditions. One extreme view is that firms move lock-step. When the economy is good, wages grow for the economy as a whole and every firm experiences the same increase in wage growth. At an even more micro level, every worker within every firm experiences the same percentage increase in wage growth. During bad times, the reverse occurs with all firms and all of their workers experiencing the same decline in wages. Obviously,

this cannot be true, but is it a reasonable approximation of the truth?

An alternative is that the relevant unit of analysis is the worker. We can think of every worker's annual wage increase being an independent draw from some distribution. The firm wage increase is then merely the aggregation of its workers' increases and the economy as a whole an aggregation of the firms. This view is also extreme and cannot be true almost a priori because given the number of workers in the work force, the average wage increase for the economy as a whole would be almost a constant with very little variance. But again, the question is how close to one or the other extreme is this.

Figure 10 provides some evidence on this. Workers are not all the same within an economy. While hardly surprising, the standard deviation of log wages is much larger than the average level of wage growth for most countries. When wages are rising, at a fast clip, there are plenty of workers who are left behind and when average wages are falling, many workers are still experiencing substantial wage increases. For example, in Germany manufacturing in 2000, average wage increases were about 4%. But the standard deviation in log wages was .09 or about 5 percentage points higher than average wage growth. For other countries, the pattern is even more pronounced than it is for Germany. Even though wages were not growing that rapidly on average, some workers experienced very high wage increases. The economy hardly moves in a lock step fashion. The same is true for virtually all years and all other countries. This is an interesting fact, and one that could have been learned from standard panel data sources. The advantage of the new data is they enable us to look at the firm.

The same is true within firms. The within-firm standard deviation in wage increases is

always larger than the mean wage change and in many countries, very much larger. For example, in Denmark, in 2000, average wage growth for the firm was 3.4%. The within firm standard deviation of growth rates was 8%. Sweden is the one exception, where the within firm standard deviation of wage growth is about the same as the average growth rate itself.

The fact that within-firm variation in wage growth is high suggests a number of things. First, a rising tide does not lift all boats, at least to the same extent. Second, the fact that wage growth is quite varied within the firm suggests that raises are tied to some other factor, like the outside labor market. Lazear and Oyer (2004) find that occupation is a much more important determinant of wage growth than is the firm. At least in Sweden, workers' wages are more closely related to their skill set than to their firms' fortunes. The same appears to be true of other countries, because the within firm variation in wage growth is so high.

Firms are different, however, in that some firms have much more of a lock-step approach to raises than others. Figure 12 plots the standard deviation of the change in log wage for firms with that have very high within-firm variation, specifically are in the 90<sup>th</sup> percentile of firms' standard deviations of the change in the log wage. It does the same for firms in the 10<sup>th</sup> percentile. For example, in 2000 in Finland, the firms that treated workers most disparately with respect to raises had a standard deviation of  $\Delta \log \text{ wage}$  equal to .15, whereas those that treated workers most similarly with respect to raises had a standard deviation of .05. Some firms have a lock-step raise policy. What one worker gets as a raise, the other workers get as well. Other firms do not have much within firm conformity.

As before, there are (at least) two possible explanations. The first is that some firms link

closely to the external market whereas other firms link to some level of profit and treat all workers similarly based on that profit. The second is that some firms have very homogeneous workforces. Since the occupational distribution has little diversity, there is little diversity in raises. Other firms might be much more heterogeneous. In those firms, following the market implies more variation in raises because in some years some occupations do well and others do poorly simply as a result of market conditions.

Another possibility is that the firms with lower rates of average wage growth also have smaller variation in wage growth rates across workers. It has long been known that at the national level, inflation and cross-sectional variation in prices are positively correlated. That is, prices move more differently from one another in periods when the average rate of inflation is high than in periods when the average rate of inflation is low. A variant is that at a point in time, firms that have little wage change also have small variance in wage change. We have not yet investigated this phenomenon, but it is possible to do so with these data.

Why is this interesting? If wages are more variable in high wage growth firms then workers relative positions within the firm are more likely change in high wage growth firms. On the other hand, to the extent that the wage variation reflects market conditions, the flexibility associated with high growth might allow firms to keep their workers' wages more in line with the market. This could be checked by examining turnover patterns. Not only would turnover be higher in low growth firms, but it would be concentrated among workers in those occupations that experienced the highest outside changes. In high wage growth firms, if wages inside are also more variable, then there would be no necessary connection between occupation and turnover.

One way to see how much within-firm lockstep behavior exists is to examine average within firm variance as opposed to overall population variance in wage growth. For example, one extreme result would be that within firm variance in wage growth is zero, whereas population variance is large. Firms would increase their wages identically for all workers within their own firm, but firms would select different rates of wage increase for their labor forces. Then the variation would all be made up by differences in firm means rather than variance within firms. At the other extreme, each firm would have the same variation in wage growth as is observed for the population as a whole. The data from table.

Another possibility for investigation is that the standard deviation of wage changes within firms is probably more stable than average wage growth within firms. For the most part, within firm standard deviation in wage changes is very large, in the range of 5 to 20 percent, depending on country and year (see figure 11). Whether and why the within-firm standard deviation of raises is stable compared to wage growth is something that is an area for future research, but a conjecture is that the structure of the firm remains relatively constant. Firms that have more heterogeneity in skill structure are also likely to be those that have higher within firm standard deviations in wage growth because some occupations enjoy relatively large increases in demand during some years, whereas other occupations enjoy large demand increases in other years. Although it is not the same occupation that experiences high wage growth over time, it is true that firms with many occupations are more likely to have more disparate wage growth than firms with few occupations. If so, there will be relative stability in the within-firm variance in wage growth, even if occupations switch places in terms of which are treated well or poorly in a given year. The same is true for experience

levels. Younger workers have higher wage growth than older ones. If the demographic composition of the firm remains relatively stable, the pattern of large raises for the young and small raises for the old will be repeated over time, adding stability to the structure even as the whole raise distribution shifts left or right.

One way to get directly at these questions is to determine how much of wage variation is accounted for by firm and year effects. A regression could be run for each country year of the form

$$\Delta \ln \text{Wage}_{i,j} = a_0 + a_1 (\text{Firm Dummies})$$

where  $\Delta \ln \text{Wage}_{i,j}$  is the change in log wages of worker  $i$  in firm  $j$ . The estimation would reveal how much of the variation is accounted for by firm effects. Then years could be stacked to see whether high raise firms remain high raise firms for substantial periods. That is, are the firm effects robust only within the year or are they fixed over substantial periods of time so that high wage increase firms, say, in 1985 are also high wage increase firms in 1990. At least at some time interval, the firm effects should vanish or some firms would have wage structures that are far out of line with the average for their industry or occupation.

It is also interesting to examine whether a wage policy where firms give all workers the same raise results in more turnover. One possibility is that homogeneous wage increases breeds discontent, particularly among the high ability workers who are not rewarded appropriately in their own eyes. Is there a negative correlation between turnover rate and within firm standard deviation in wage growth (within firm coefficient of variation in wage growth)? This is discussed below in

the section entitled “Mobility.”

Why does this matter? If workers’ fate is determined primarily by the fate of their individual firm, then wealth can be affected by factors that are largely beyond a workers control. If instead, most of the wage growth is idiosyncratic and specific to the worker, then individuals may have the ability to take actions that affect their wealth levels. In addition, if wage growth is mostly determined by the firm, but this tends to even out over time say because wage growth is negatively serially correlated (high growth firms in one period are low growth firms in the next period), there would be little persistence to worry about and inter-firm mobility would not be required to remove long term discrepancies in wages. But if the firm effects are persistent, then movement by some workers is necessary to keep on track with others’ in the same occupation.

### Raises and Tenure

Standard in the literature on human capital is that wage growth is more rapid during the early years of career than during the latter years. The average wage increase is larger for young workers than older workers. This can come about through a variety of mechanisms. One is that young workers move more than old workers, which is true and will be shown later. The other is that within firms, there is a policy to give larger wage increases to young workers than to older ones. Indeed, the current authors’ dean invariably sends out a letter each year bemoaning the small pool available for raises and justifying small senior professor raises by stating that the pool must be reserved to increase the wages of more junior professors. Is this a valid characterization of the typical firm and how general is this policy across firms and countries?

Figure 13 provides evidence on average wage increases for low and high tenure individuals within the firm, averaged across firms in the economy. The difference is almost always positive, and in some country-years, it is large. Of course, this is wage growth for those who stay in the firm. Much of the difference in wage growth at the individual level that occurs over the life cycle may work through mobility.

There is a tendency for the wage growth among the 90<sup>th</sup> percentile raises within a firm among low tenure workers to be significantly higher than that for the 90<sup>th</sup> percentile of high tenure workers within the firm. See figure 14. This suggests more positive skew in the distribution of raises among the young than among the senior. Some young workers do very well and may be on a fast track. To ascertain that, it would be necessary to examine the pattern of raises for a given worker over time, which is possible in these data but left for another study. Where the raises negatively serially correlated, a large raise in one year could be undone by a small raise in the next year. What is clear, though, is that firms have a policy of allowing the wages of at least some young workers to grow more rapidly than the wages of the best treated of the senior workers. The notion of skewness in wage growth as a policy is a new finding that warrants further investigation and conceptualization.

A very interesting pattern emerges. The picture for wage levels is mirrored and amplified in wage growth. Compare figure 15a to 15b. France has much higher variation in wage growth, both at the country level and at the firm level. In Norway, firms are microcosms of the country in terms of wage growth, but the country has low dispersion in levels of growth overall and within firms at all levels of the average wage growth distribution. The “microcosm” description fits France as well, except for firm that have close to the median level of wage growth.

## Mobility

Exit rates vary substantially across firms and countries. The typical firm's exit rate varies from lows of around 15% in Norway, Sweden, Finland and early observations for Germany, to highs of 35% in France. As expected, entry rates and exit rates are highly correlated. In countries where exit rates are high, entry rates are high. This must be true to provide an equilibrium where approximately the same number of workers are employed over time. Specifically, if there are  $N_t$  workers initially, then after  $t$  years the ratio of individuals in the labor force in year  $t$  to the initial number is

$$\frac{N_t}{N_0} = (1 + \Delta)^t$$

where  $\Delta$  is the difference between the (average) entry rate and exit rate. For example, if  $\Delta = .02$ , the employment number would grow by about 22% over ten years. As a result, the average entry and exit rates must be close to the same to accommodate the actual growth (or decline) of the labor force.

There are some notable exceptions. Germany, during the early 90s, had exit rates that far exceeded entry rates. This invariably reflects the re-unification and fundamental changes in the labor market that occurred during that period.

### Mobility and Wage Levels:

There is a negative correlation between both exit and entry rates and wage levels - see Figure 17. Firms that are high wage firms are also low turnover firms. This could reflect one of two

phenomena. First, high wage firms may pay above the market. Workers queue for jobs in those firms. When they finally land a job in a high wage firm, they keep it because their alternatives are rarely better. Low wage firms scrape for workers, lose them whenever something better comes along, and must have high hiring rates to compensate for the high quit rates.

An alternative explanation is that high wage firms have more skilled workers and the turnover rates for the less skilled are higher than those for the more highly skilled. Work experience could account for this alone. A firm with many high tenure workers would be expected to have lower turnover rates than those with low tenure workers.

A very interesting new fact comes from figure 18. Growing firms tend to be low wage firms. The firms with the high entry rates also have the lowest average wages. The pattern holds across countries and over all years, but is stronger in some cases than others. The findings make sense. New firms are likely to be growing more rapidly than older firms (Gibrat's Law notwithstanding) and new firms are also likely to be smaller than mature firms. It is also interesting that the pattern holds across countries.

#### Mobility and Firm Size:

Another related and new fact is that entry rates in big firms are lower than entry rates in the average firms - see figure 19. The pattern is consistent across countries with only one country-year exception. There is more hiring at small firms than at large firms relative to the size of the firm, but this could simply reflect more turnover and not less growth in employment by large firms. Figure 20 speaks to this by looking at the net entry rate (entry - exit rates) and then taking the difference

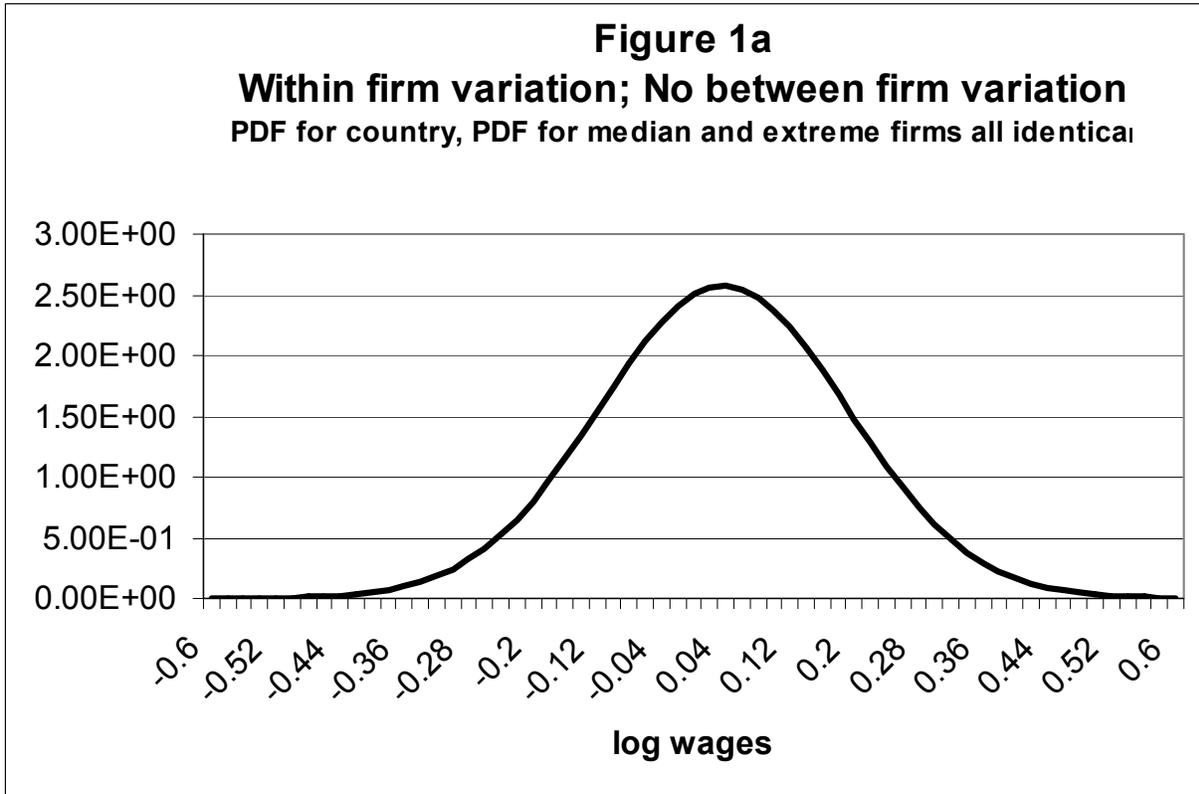
between all firms and big firms. There is no consistent pattern. This neither supports nor rejects Gibrat's law. In some country years, there is a pattern of growth being lower in large firms. In other country years the reverse is true. But the difference is rarely zero, which would be the prediction of Gibrat's Law. (Given the number of firms in each sub-sample, the differences shown in fig. 20 are most likely significant in almost all cases.) Apparently other factors are important in determining the size distribution of growth rates and the statement that growth is independent of firm size seems to be inaccurate. A more accurate statement is that growth rates vary with firm size across time and location. The causal nature remains unknown at least for this study.

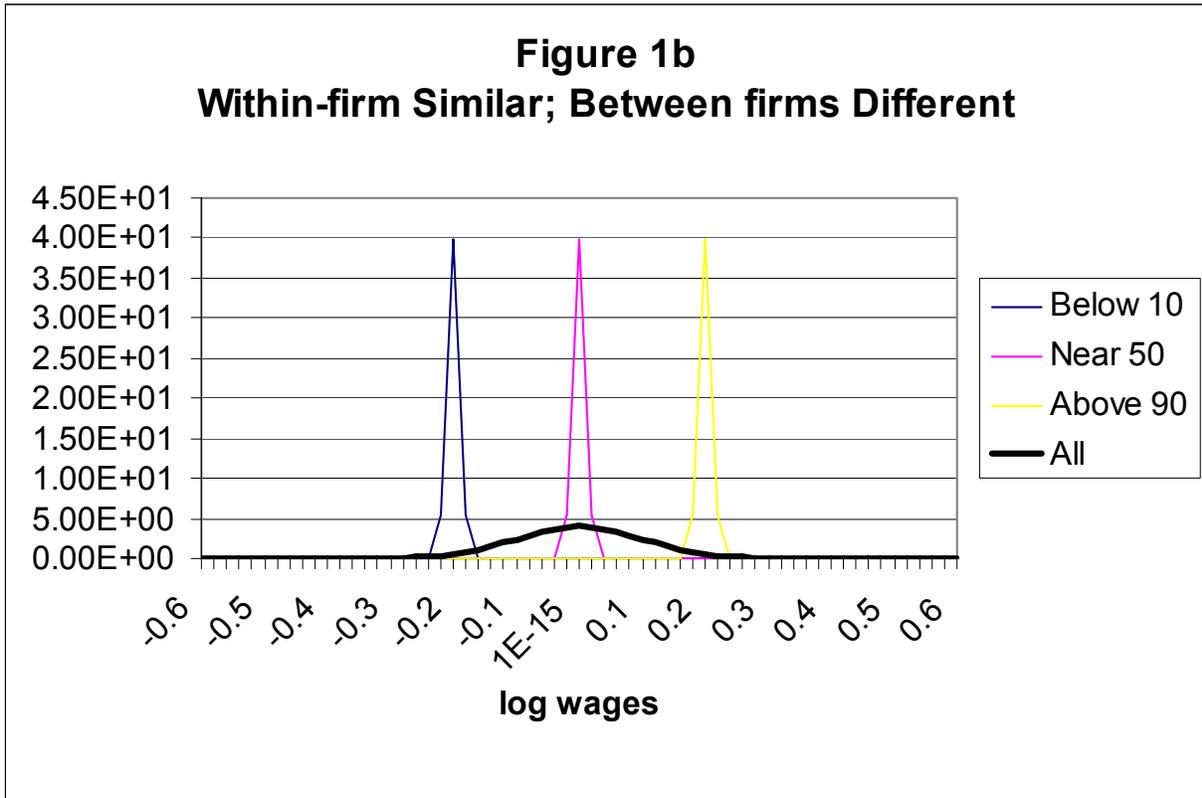
The determinants of firm turnover rates (industry, occupation, wage, skill, average tenure, etc.) could be investigated. Although we present no evidence on those factors here, it is a possible to perform an analysis of this sort using the country-wide datasets used in this book.

#### Firm Mobility and Wage Growth:

If the typical labor market allows for some rent sharing between capital and labor, worker wages should rise when firm profits rise. It is also reasonable to expect that profits and employment would be positively related. Firms that are profitable are likely to be doing more net hiring than firms that are unprofitable. When profits are down, firms typically cut the size of their labor force. As a result, good times might be accompanied by super-normal wage growth and also by super-normal employment growth. The cross-country data provide evidence on the correlation between wage and employment policy and we believe that this is the first evidence of this sort that cuts across many firms.

Table 3 reports that the correlation between wage change and entry rates tends to be positive. In a given country-year, firms that are raising wages are also likely to have higher than average entry rates. But firms that are raising wages do not consistently (across country-years) have lower exit rates. In the most open countries, like Denmark, the finding is strong. High wage growth and low exit rates move together. But in Sweden, the results are weak and in the opposite direction. This might reflect the “Dot.com Boom” phenomenon. During the dot.com boom, the typical view was that the Silicon Valley labor market was in a talent war. Programmers and other skilled technical workers moved from firm to firm frequently, as demand shifted to reflect the fortunes of one company or another. Firms with rapidly growing wages hired many workers, but also lost them to other firms with rapidly growing wages because of the nature of industrial structure. Turnover rates were lower, and wages were increasing less rapidly, in more traditional parts of the economy where the situation was closer to stable. So exit rates and high wage growth might go together if they characterize firms that are in industries which are undergoing rapid change. Again, this is a question that requires additional evidence, obtainable in these data sets, but is not presented here.





**Figure 1c:  
Norway 1997**

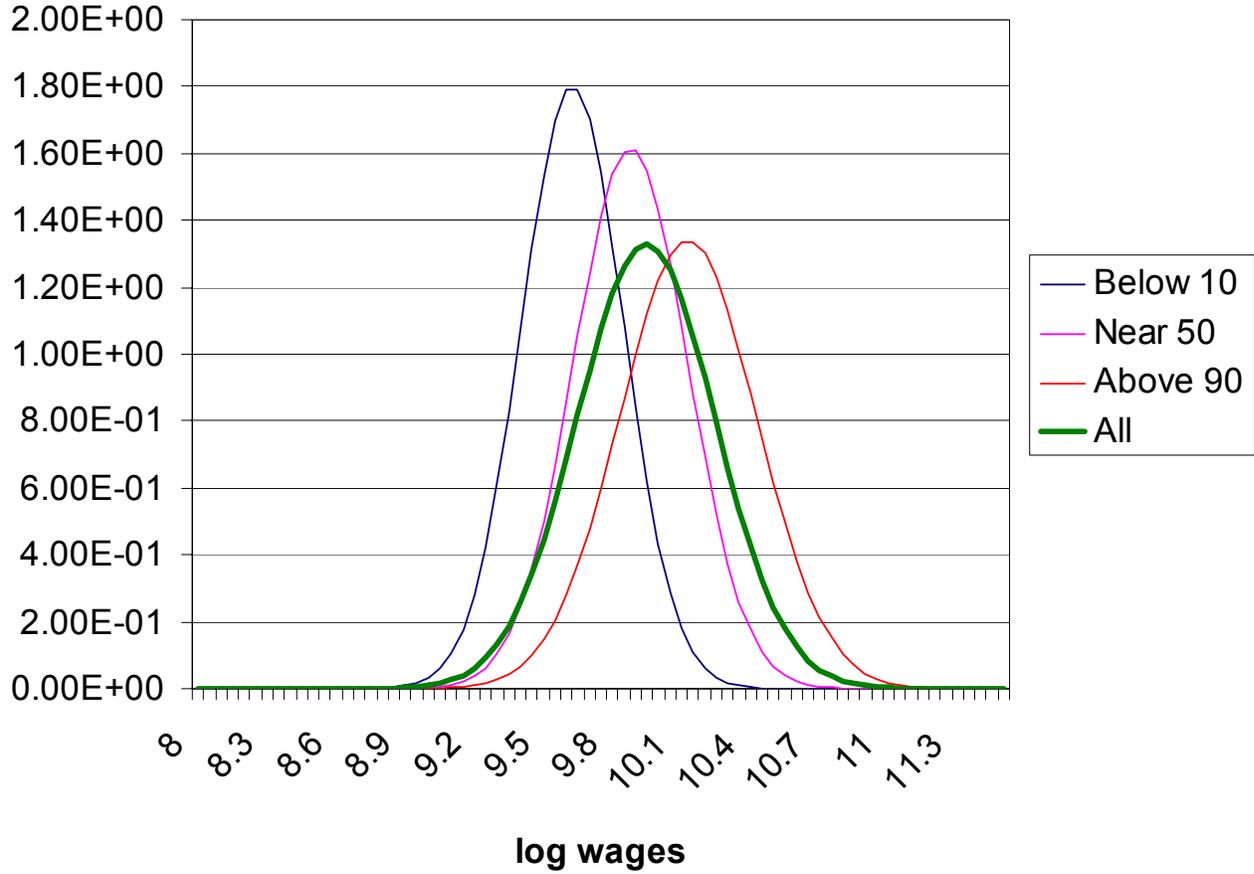
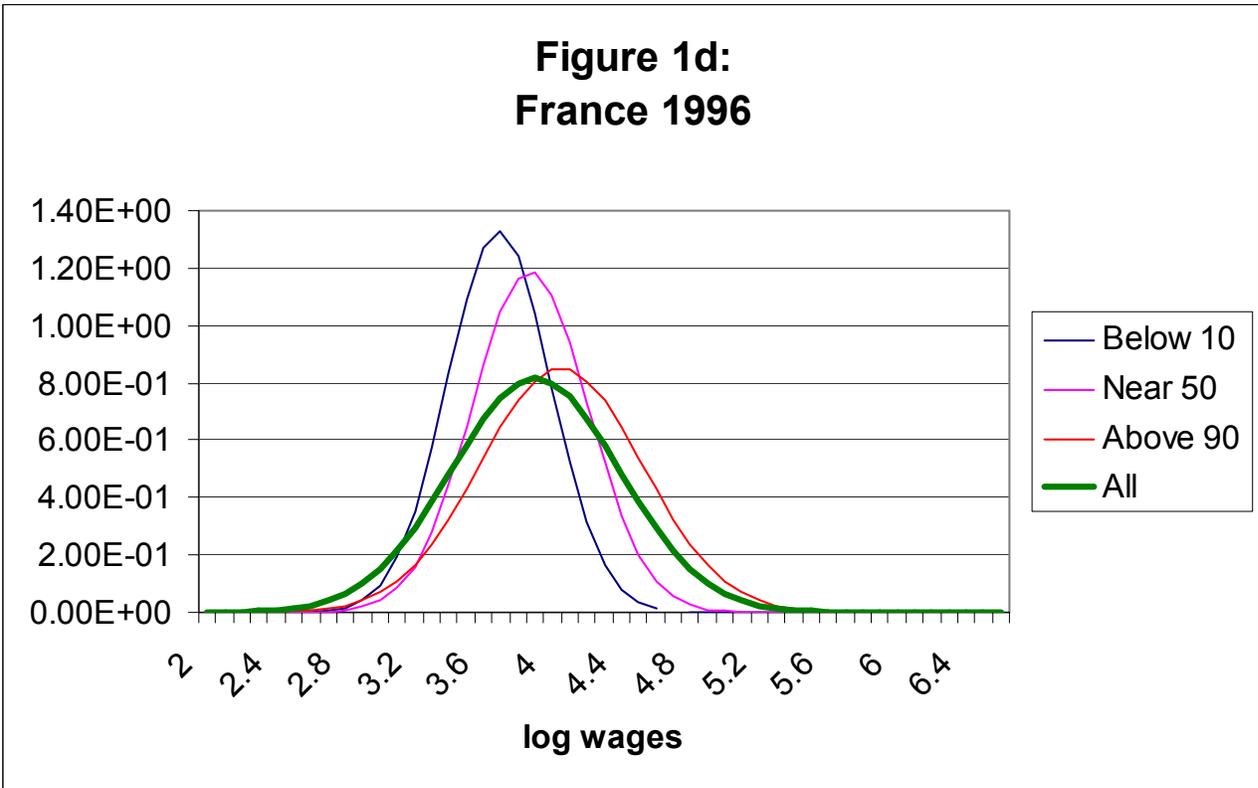


Figure 1d



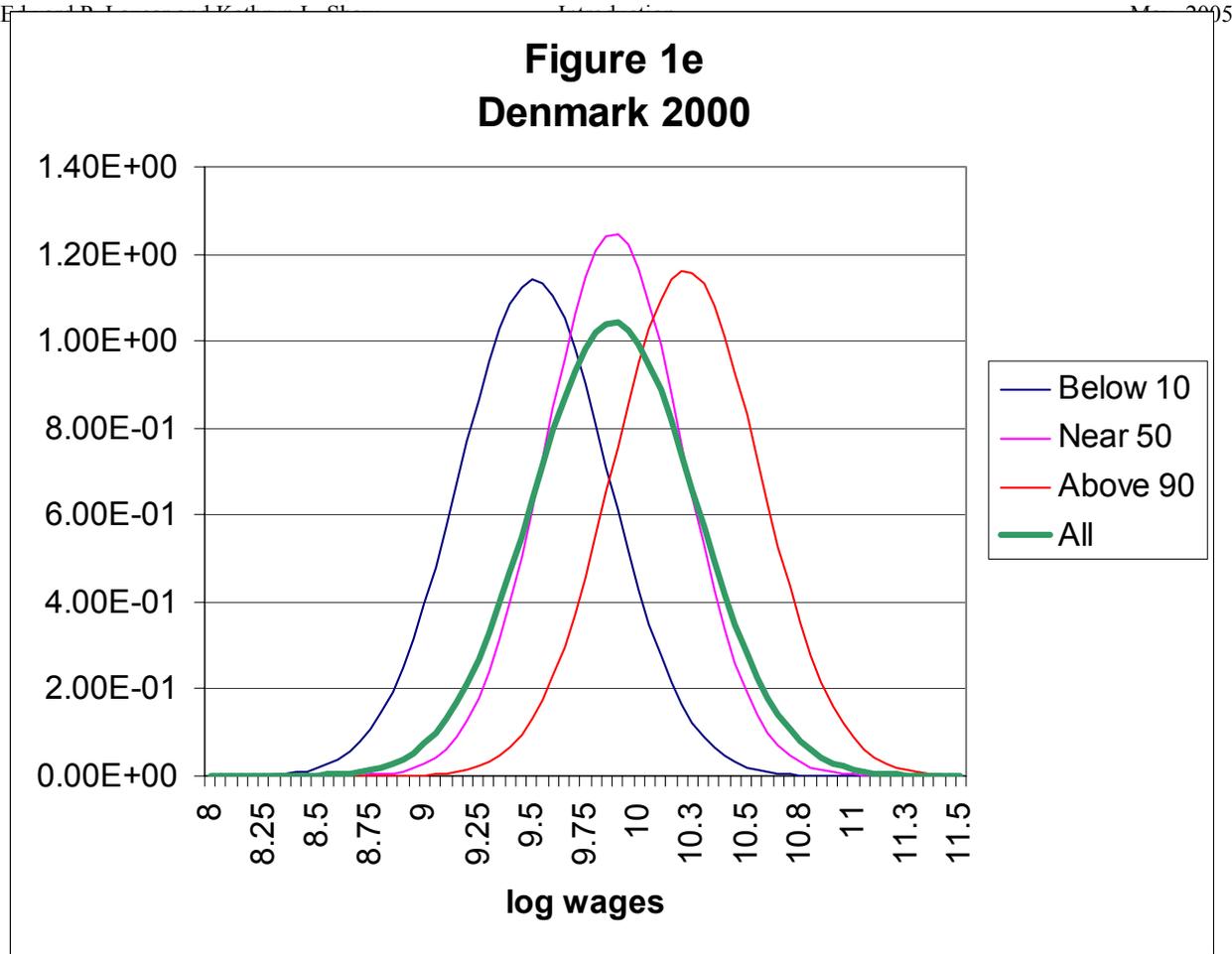
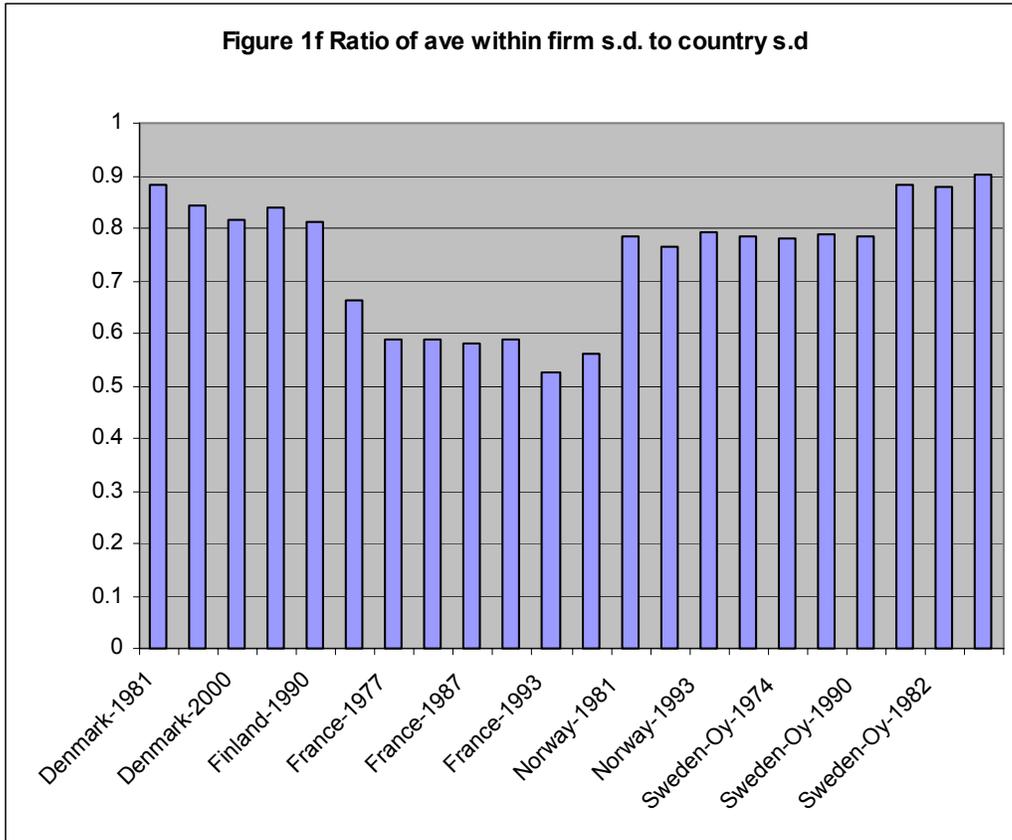
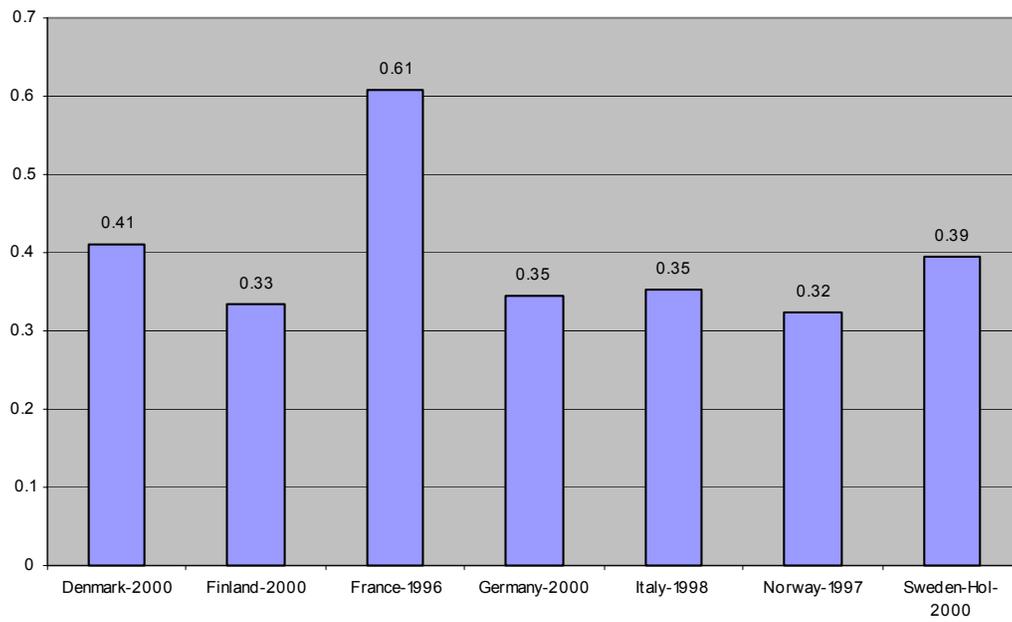


Figure 1f



## Figure 2

Country Coefficient of Variation (Individual Data)



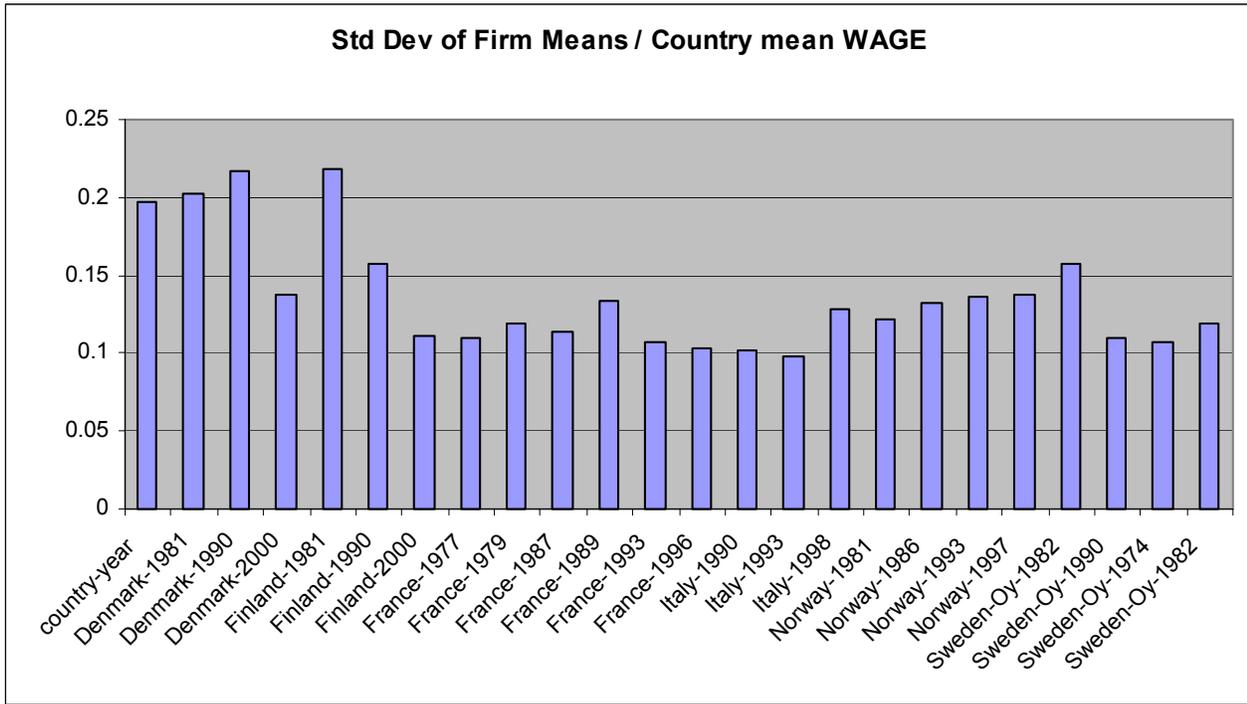
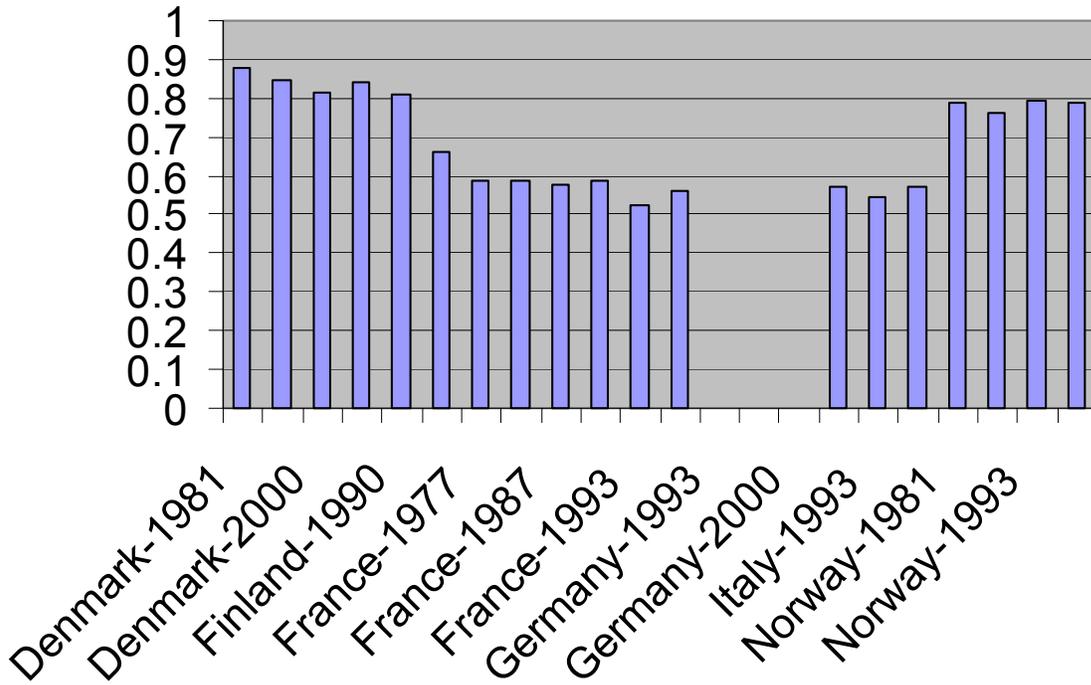


Figure 3

**Figure 4**  
**Ratio of s.d. wages within firm to s.d. wage for country**



**Chart 6: The Distribution of the Coefficient of Variation of Wages Within Firms  
Finland and Italy=90/10 percentiles  
All other=75/25 percentiles**

Constructed using firm-specific averages: The Mean of the (within-firm coefficient of variation), and the 90% and 10% tile of the within-firm CV) row 26:row 28/row 29)

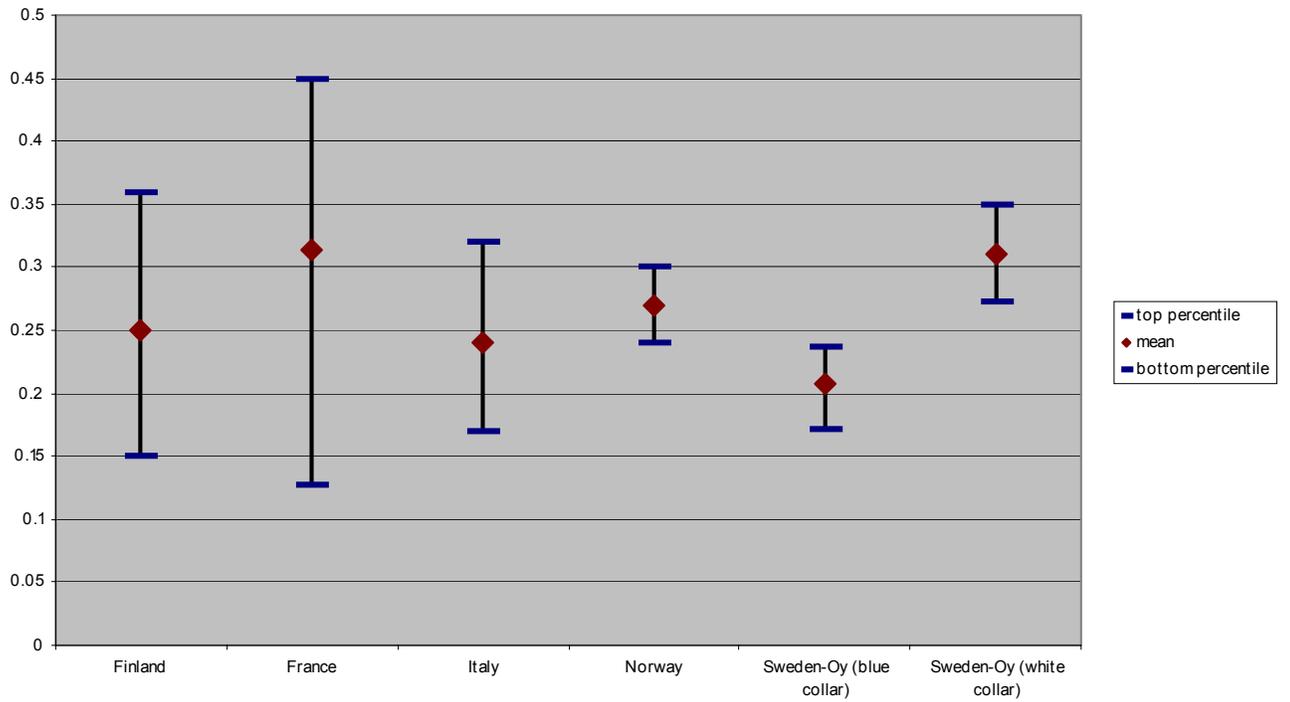


Figure 5

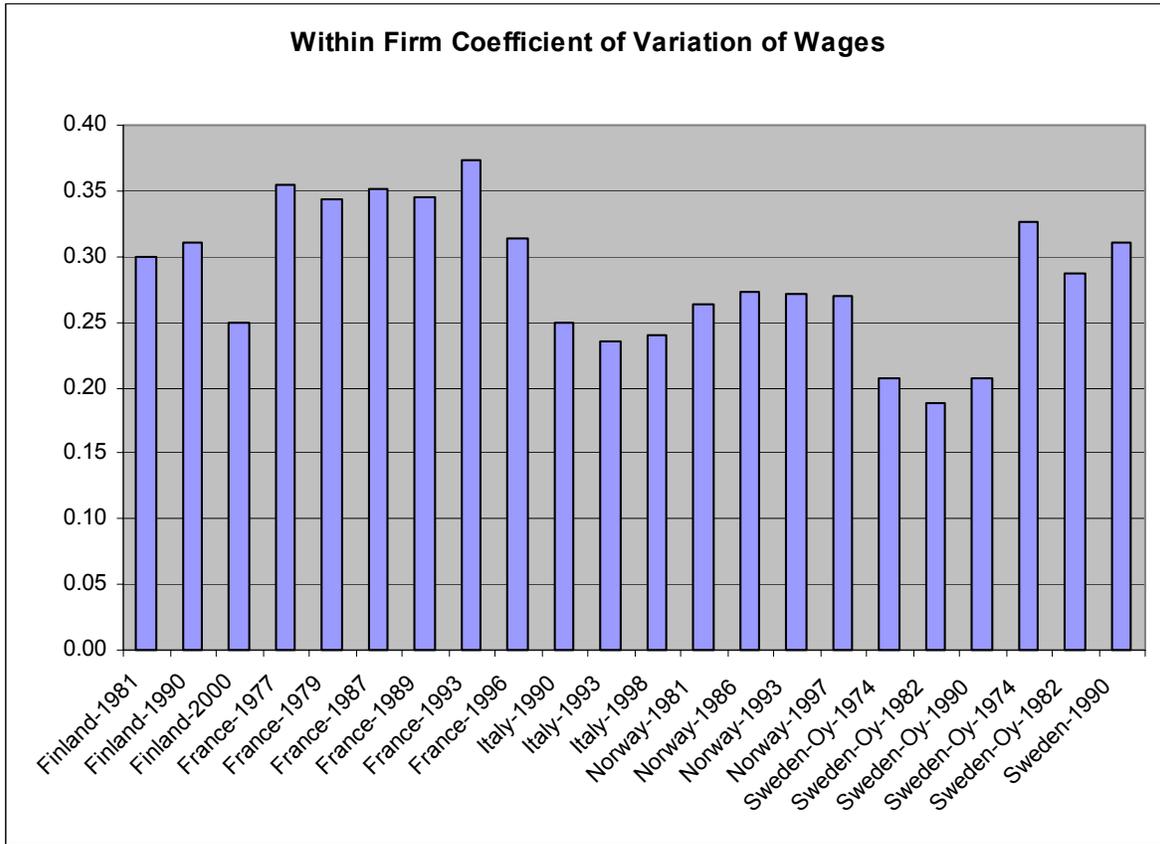
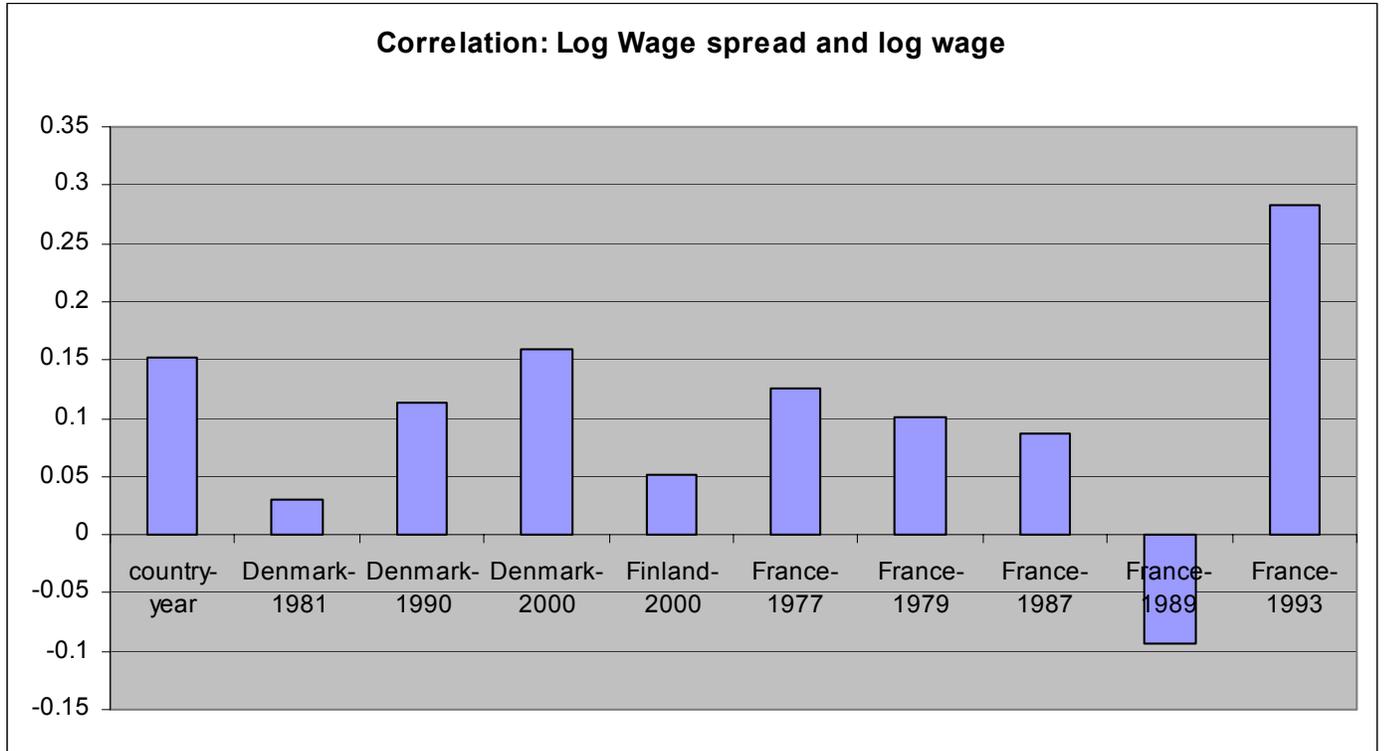


Figure 5, replaced

Figure 6



{Need to fix this.}





Figure 7

Figure 8

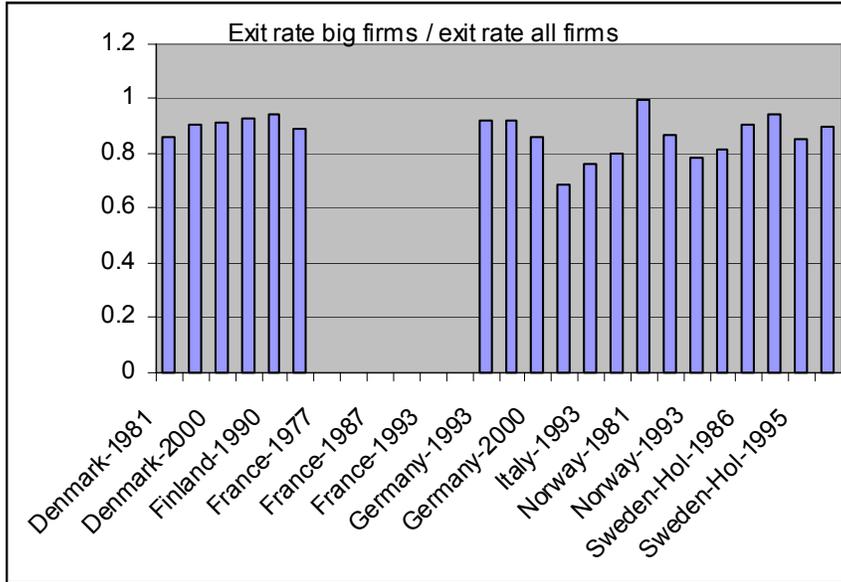


Figure 9

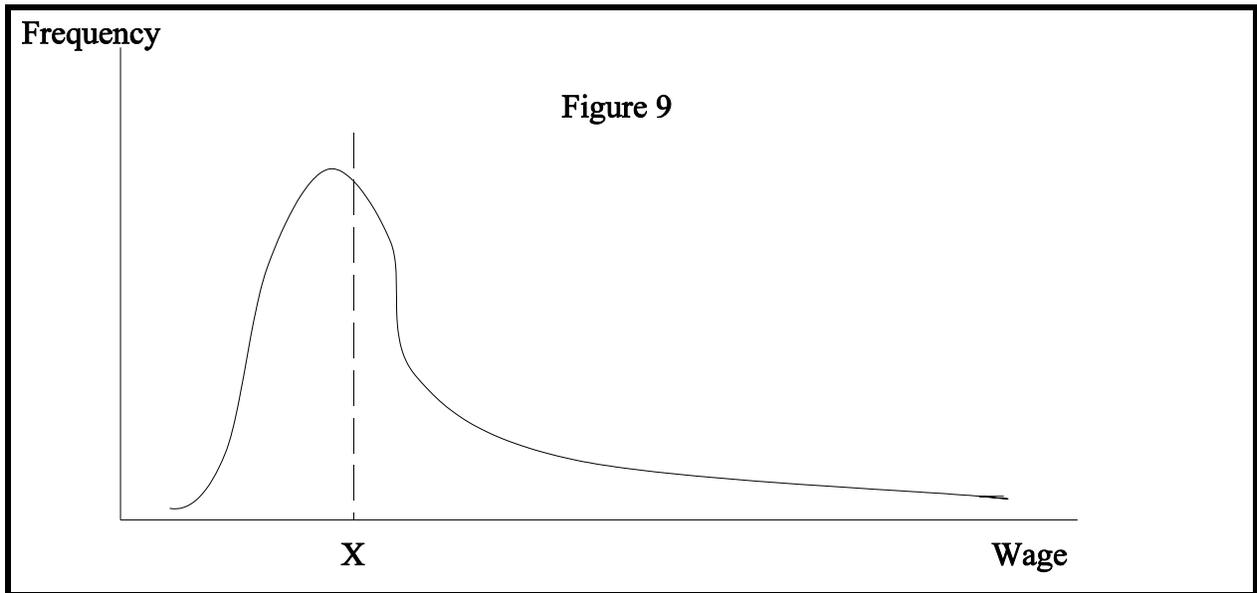




Figure 10

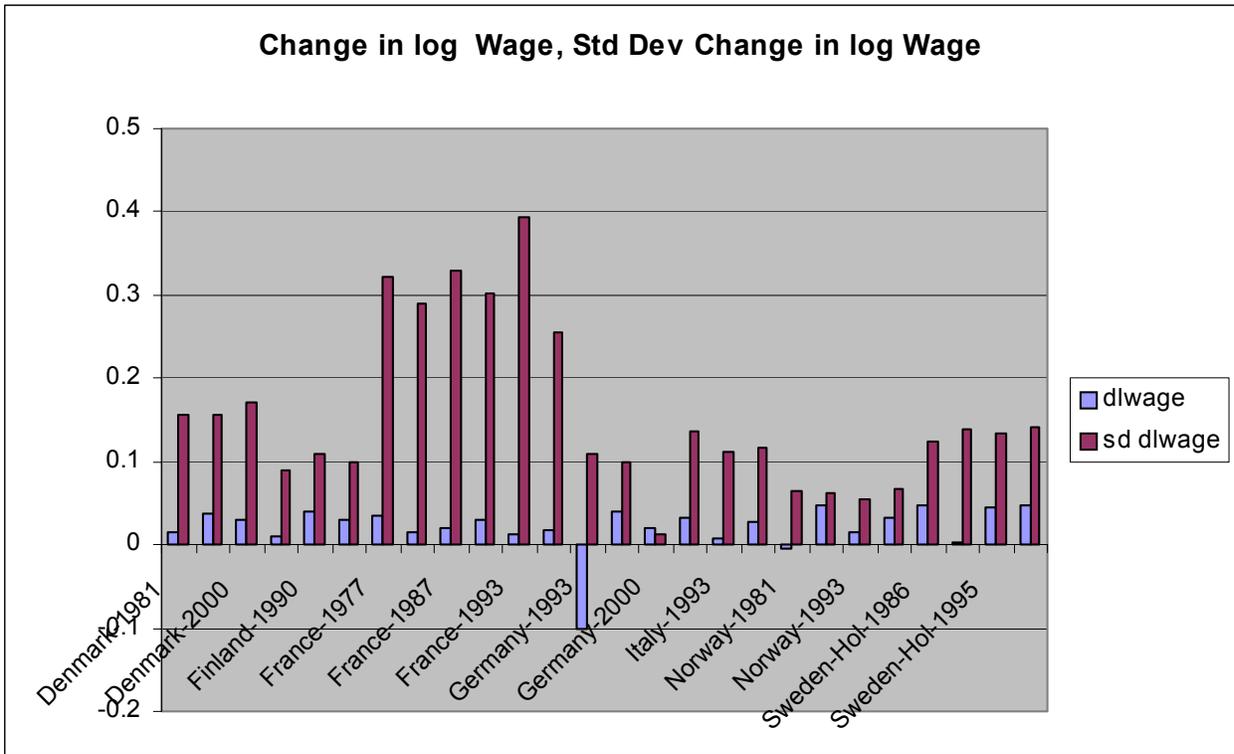
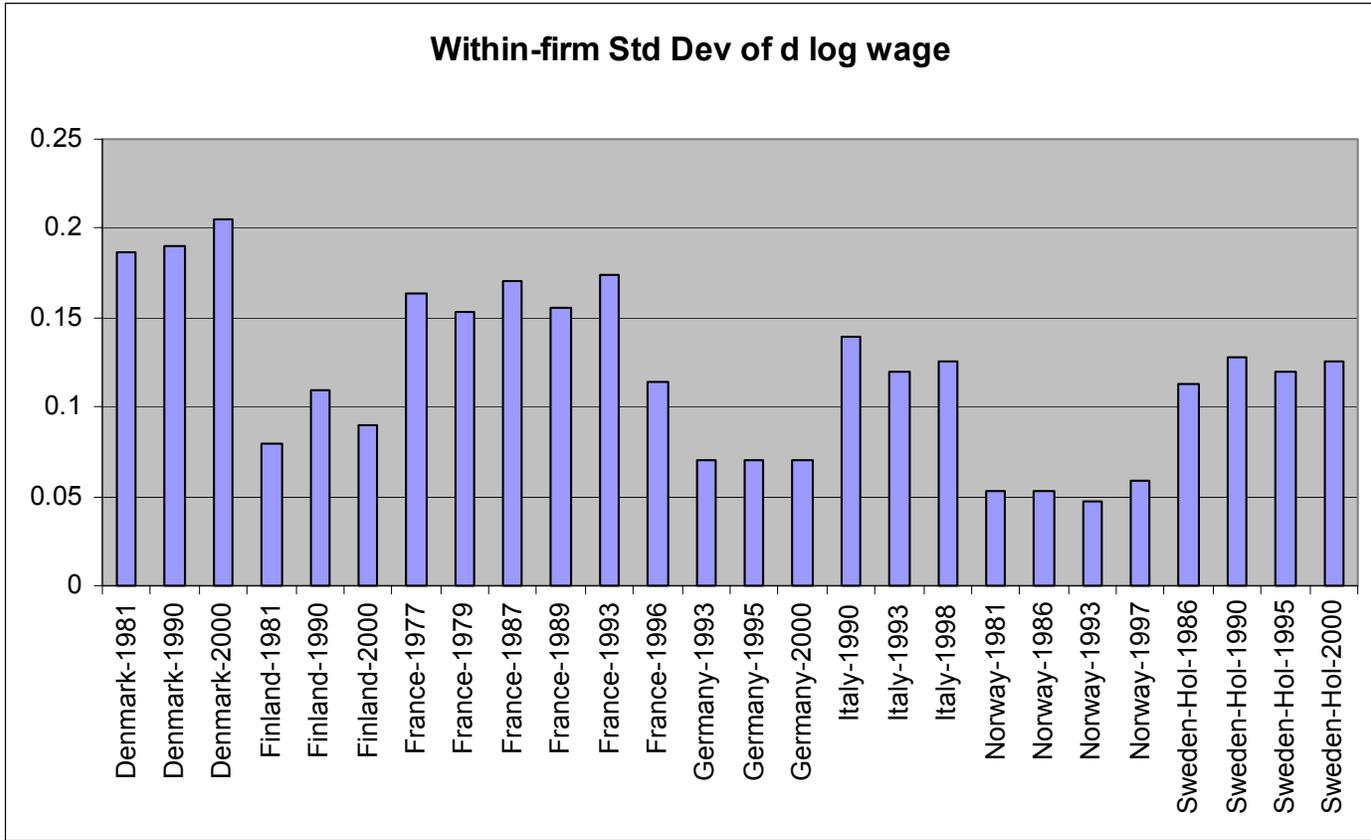


Figure 11



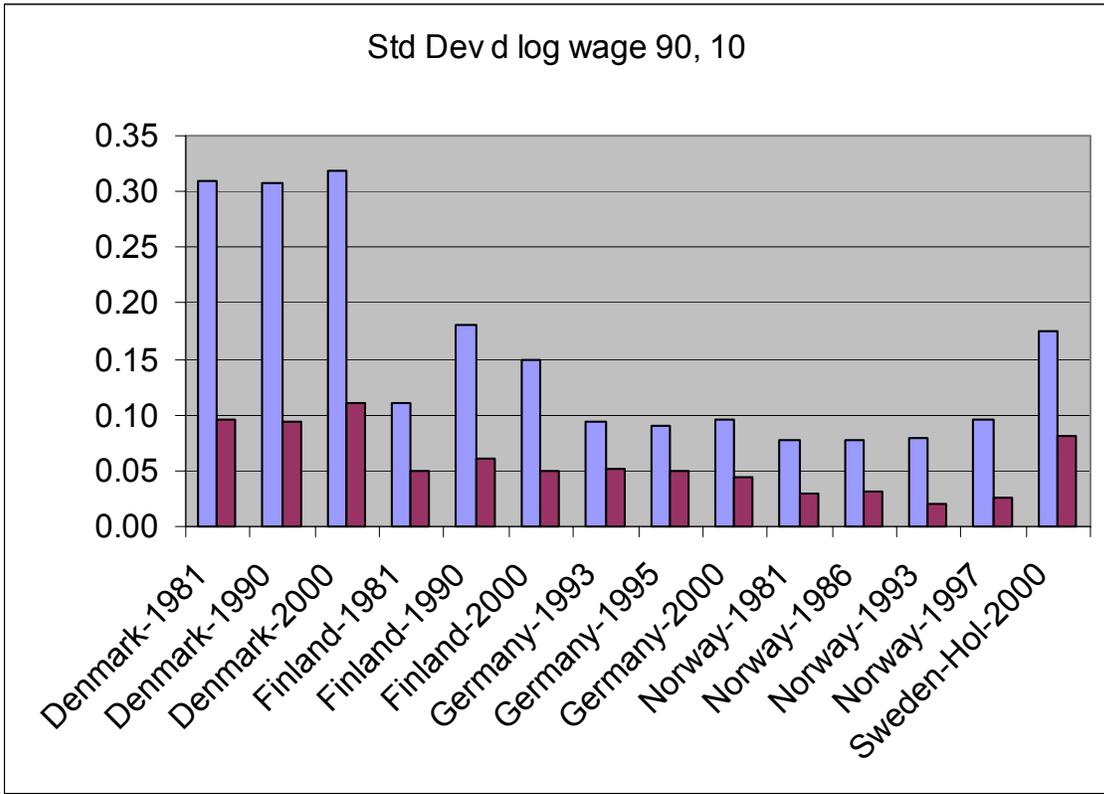


Figure 12

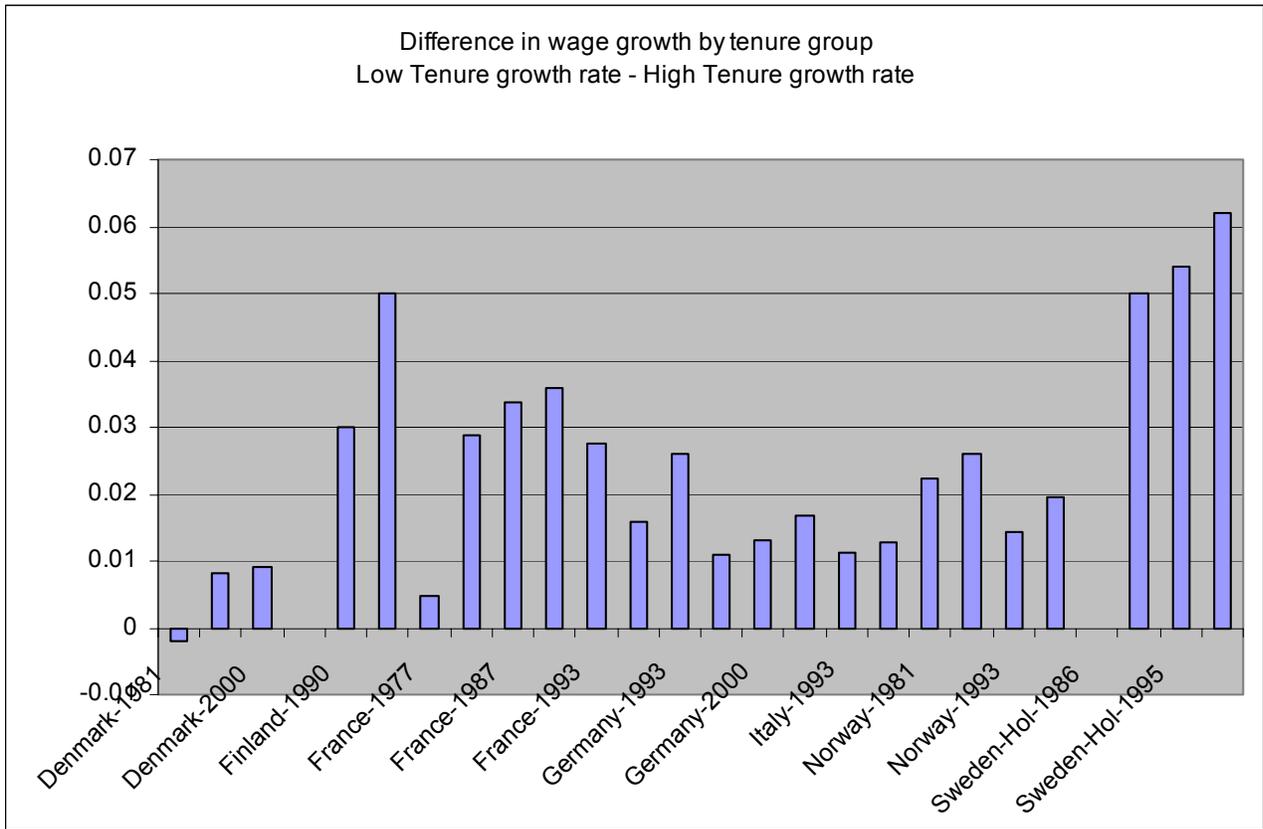


Figure 13

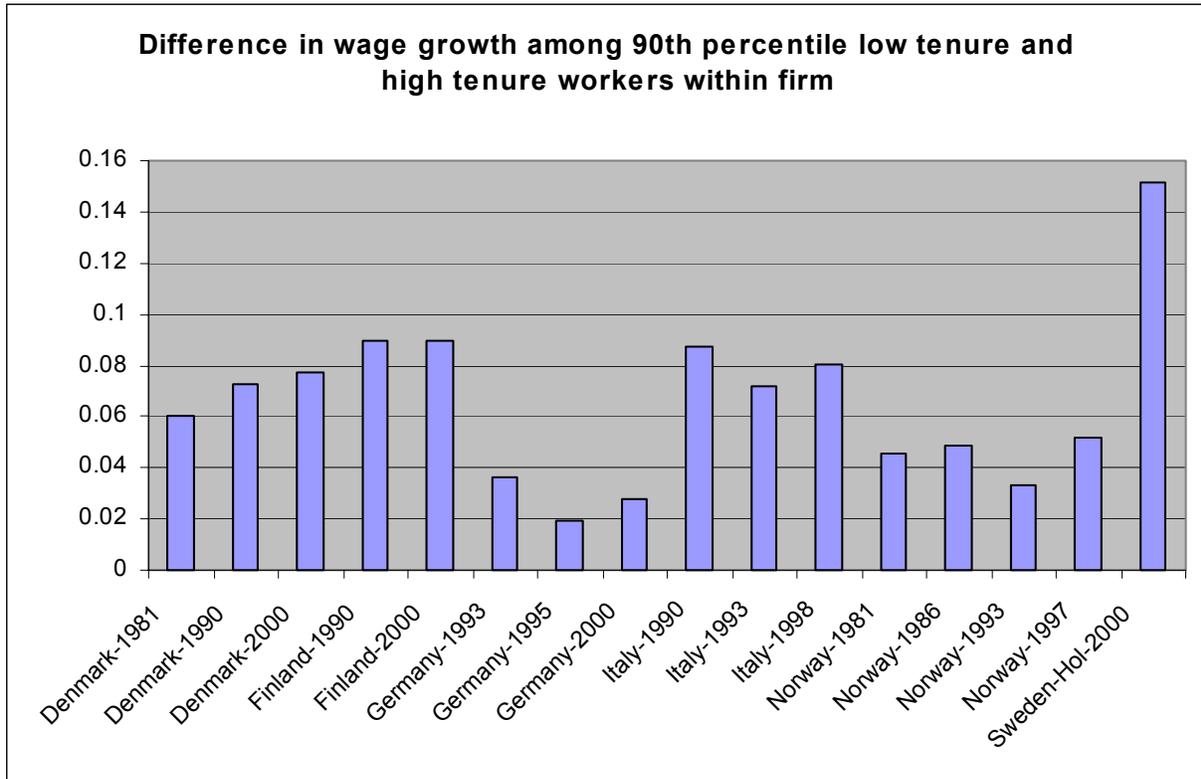


Figure 14



Figure 15a

Revised

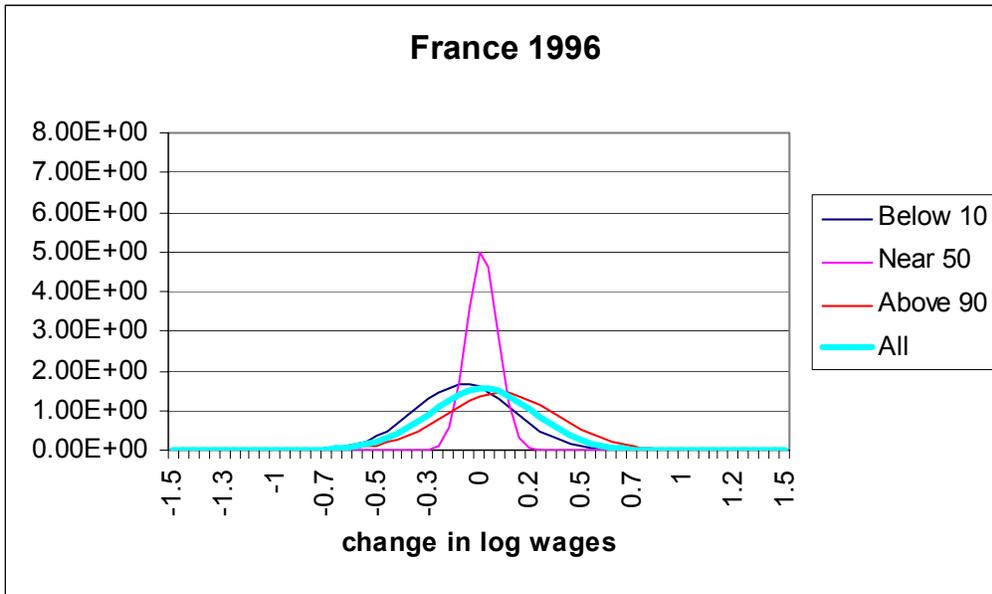
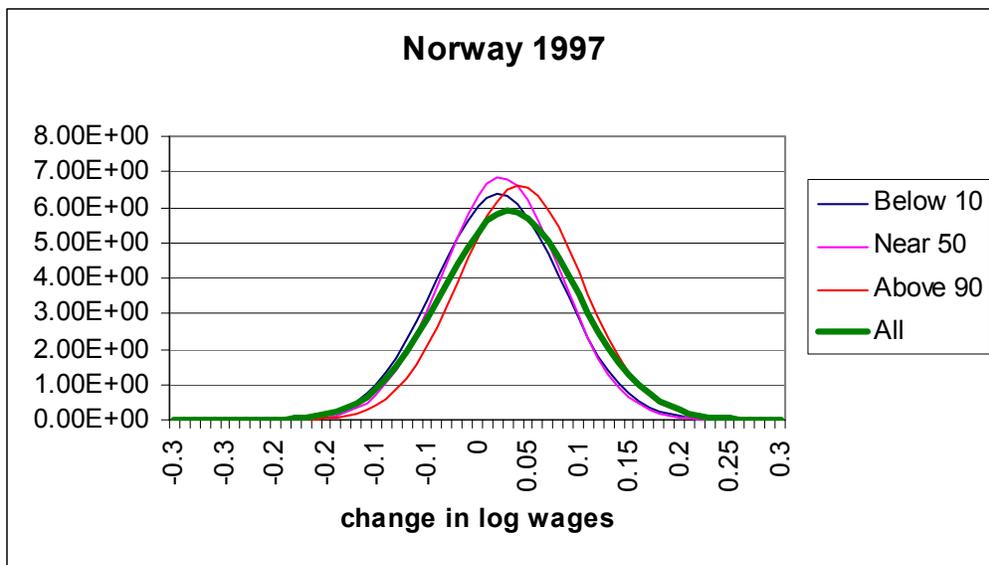


Figure 15b



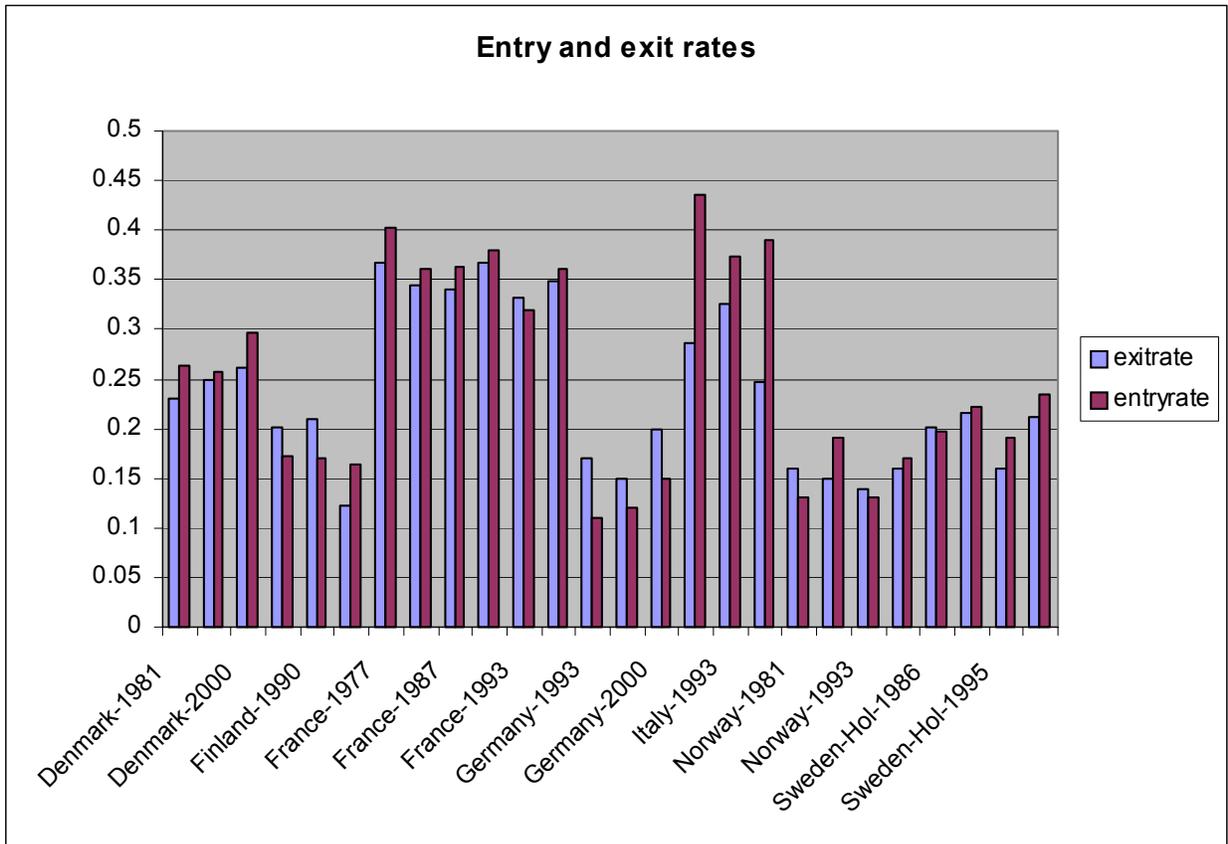


Figure 16



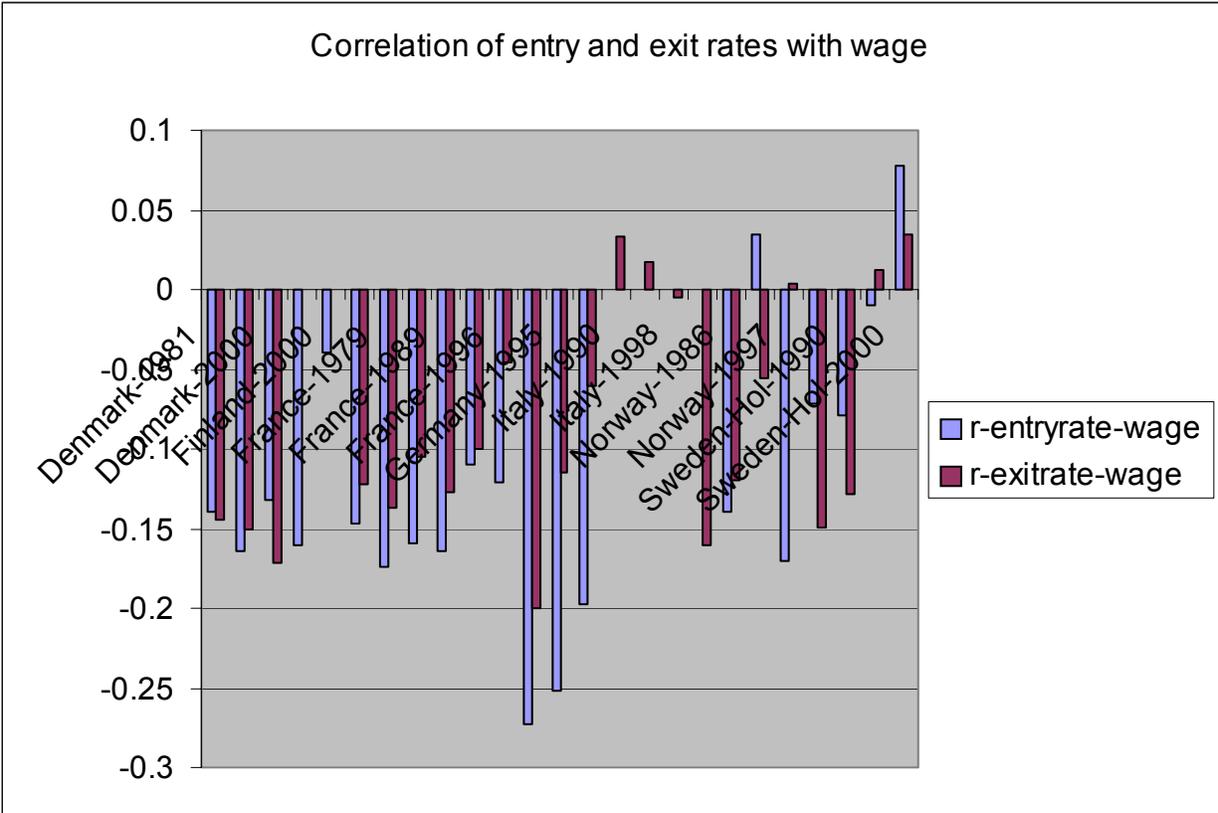
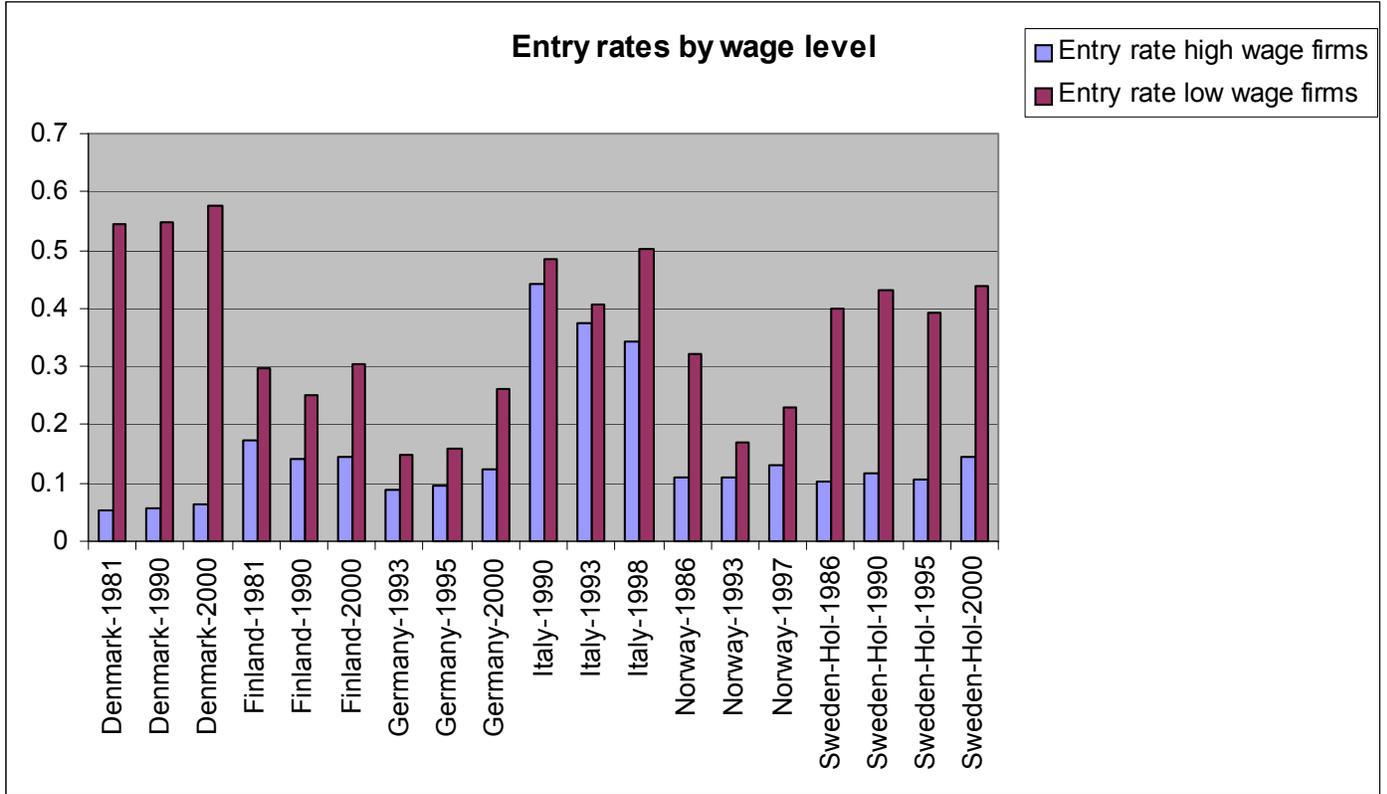


Figure 17

Figure 18



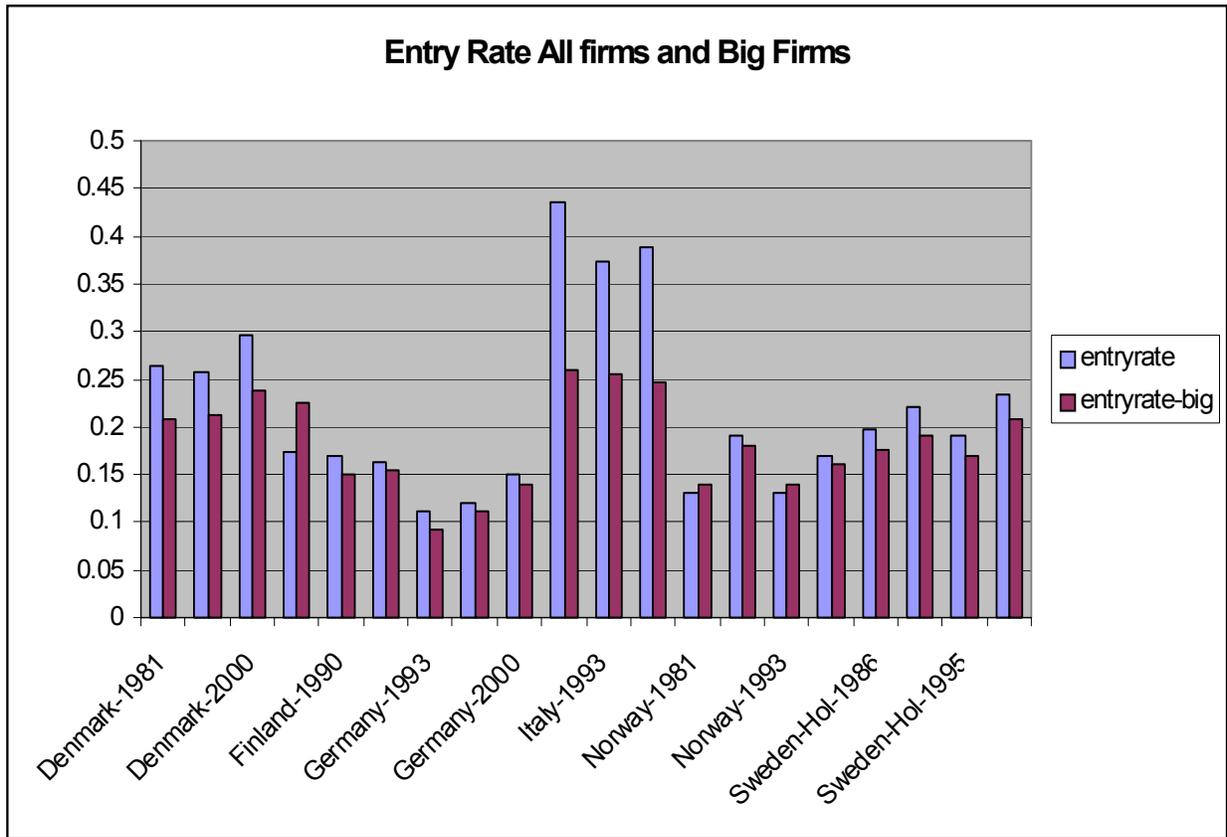


Figure 19

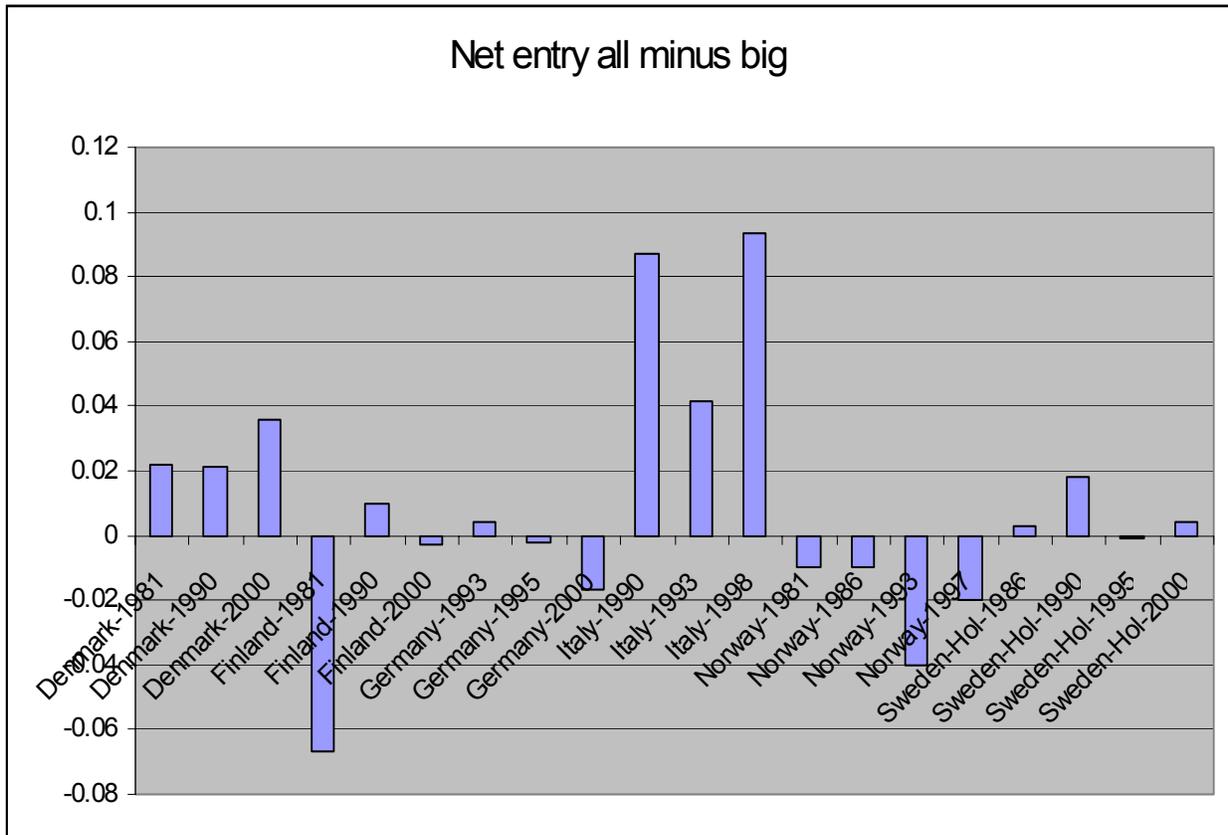


Figure 20

Figure 21

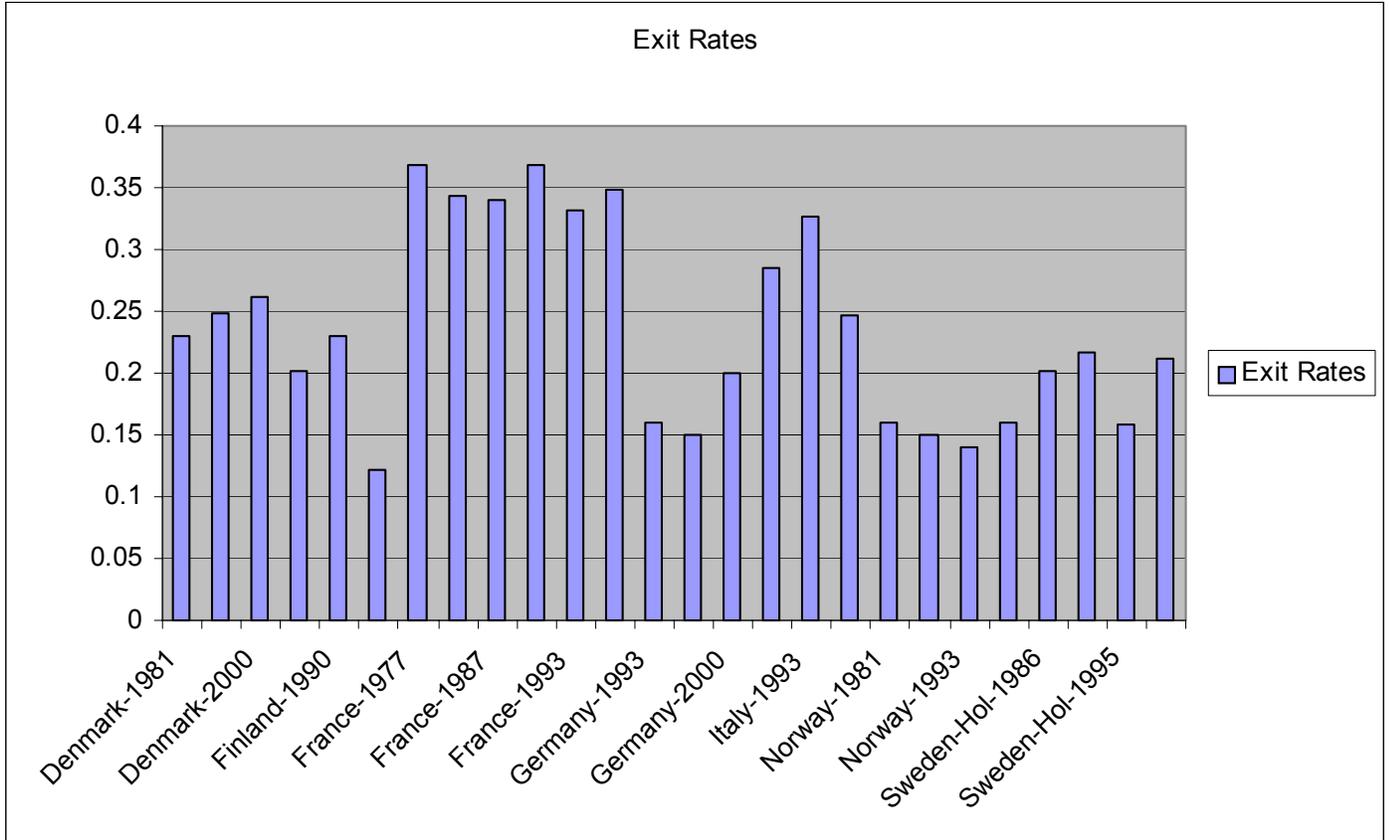




Figure 22

