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ABSTRACT

Occupational Gender Composition and Wages in Sweden*

We estimate the relationship between wages and occupational gender segregation in Sweden. Because of high wage equality in Sweden compared to the U.S., we expect a lower wage penalty of job femaleness in Sweden than in the U.S. Our results supports this hypothesis. We also investigate how the unexplained gender wage gap vary across occupations and find that this gap is smallest in male dominated jobs and largest in female dominated jobs. Finally, we investigate whether the female wage-experience profiles are different across occupations. Our results indicate that women have flatter wage-experience profiles in female dominated occupations than in male dominated occupations.

JEL Classification: J31, J71

Keywords**:** occupational segregation, gender wage gap

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1 Introduction

A well-established result in the empirical literature on the gender wage gap is that a significant portion of this gap results from employer discrimination. This is a result that has been documented for most countries, see Blau and Kahn (1992 and 1996) for surveys. Most of the existing studies that try to estimate the unexplained portion of the gender wage gap are based on a sample of male and female workers and attempt to explain their wages by their observable characteristics, such as accumulated human capital (years of schooling and years of work experience) and other factors (such as marital status and labor supply) believed to influence wages. A common result is that these characteristics explain about half of the differences in wages between women and men. The remaining portion of the wage gap is then often attributed to employer discrimination.

One natural candidate for explaining at least part of the unobserved difference in wages across gender is occupational segregation. There exist a general understanding that occupational segregation is present and that females are gathered disproportionally in occupations with lower earnings. However, there is no agreement on the cause of these outcomes and two contradicted theories have been given in the literature. The first line argues that females are gathered disproportional in occupations with low earnings due to market discrimination and the second line argues that it is due to a self-sorting mechanism. Unfortunately, it has proven very difficult to empirically test these two competing theories.[1]

Even if it is difficult to establish the reasons for occupational segregation by gender, it may still be important to assess the impact of this kind of segregation on both wages and wage gaps. Recently, there have been a large number of studies devoted to empirically determining the impact of the density of females (FEM) in a certain occupation on individual wages, see for instance Bayard et al (1999), Macpherson and Hirsch (1995), Sorensen (1990), Sorensen (1989), England et al (1988) and Johnson and Solon (1986)

[1] The problem is similar to the one of the existence of dual labor markets. Dickens and Lang (1985) presents a model, which they argue is able to test the human capital theory against the dual labor market theory. However, there is no general agreement on the validity of their claim. Their model is able to test difference in wage distributions between a primary and a secondary labor market but not the reasons for the presence of this difference.

for applications on U.S. data, Baker and Fortin (1999) using Canadian data, Miller (1987) using data from the U.K. and le Grand (1991) using Swedish data. The results from these studies are mixed but most of them suggest that there is a significant and negative relationship between proportion of females in an occupation and wages.[2]

The objectives with this paper are as follows. First, we will obtain estimates of the effect of occupational segregation on male and female wages in Sweden and we will also compare our estimates with those reported in previous studies. Secondly, we will address the question of endogeneity of the FEM-variable. This issue has received little attention in the previous literature. Third, we will test whether the returns to accumulated work experience for women differ across occupations. Fourth, we are interested in analyzing what fraction of the observed gender wage gap is due to differences in endowments (usually referred to as the "explained" gender wage gap), occupational segregation and unobserved factors (of which labor market discrimination might be one).

A potential problem with most of the previous studies in this area is that they assume that occupational attainment can be treated as exogenous, i.e. there is no correlation between the density of females in an occupation and the error term in the wage equation.[3] As argued by Macpherson and Hirsch (1995), there exist at least two reasons for why the exogeneity assumption may be false. First, if men and women with higher unmeasured skills (captured by the error term in the wage equation) are more likely to be sorted into male jobs and those with lower skills into female jobs, then the exogeneity assumption will obviously be violated.[4] Second, the error term may also capture unobserved taste differences among workers. To illustrate this point, some female workers may foresee future work interruptions due to childbearing and thus prefer part-time jobs or jobs where the wage "penalty" for absence from work is low. Based on this argument, we would observe

[2] A problem which is neglected in many of these studies (i.e. in Bayard et al (1999), Sorensen (1990), le Grand (1991), Miller (1987) and Johnson and Solon (1986)) is the fact that the standard errors from OLS estimation are biased since the error term is correlated across workers within occupations, see Moulton (1990). It is therefore difficult to assess the significance of the results in these studies.

[3] Exceptions include Macpherson and Hirsch (1995), Sorensen (1989) and England et al (1988).

[4] Note that this kind of sorting may result from employer discrimination.

a concentration of female workers in these types of jobs, which may also pay lower wages. It is again clear that the assumption of no correlation between the density of females in an occupation and the error term can be violated. To avoid the potential problem with endogeneity, Macpherson and Hirsch (1995) use longitudinal data covering the period 1983 to 1993 and apply a fixed-effects estimator.[5] The advantage with such a procedure is that it differences out any time-invariant unobserved (and observed) variables. Under the assumption that only the time-invariant portion of the error terms are correlated with FEM, this procedure yields unbiased estimates of the effect of FEM on wages. A serious problem with this approach, however, is the fact that few workers change their occupational status over time and only a small subsample of occupational movers identify the coefficient. Further, the movers may constitute a non-representative portion of the sample, they may for example be younger and clustered in low-skill jobs.

Bearing in mind the potential problems with the usage of panel data in this type of study, we instead suggest the use of a different approach. We aggregate the FEM-variable into three categories depending on the proportion of women in the occupation: male dominated (less than 33 percent females), intermediate (between 33 and 66 percent females) and female dominated (more than 66 percent females). Non-random selection into an occupation is controlled for by estimating an ordered probit model in the first stage and including a selection correction term in the second stage wage equations.[6] The main advantage with this approach is that it allows us not only to estimate the wage effect of female density in any given occupation, but it also enables us to estimate the unexplained gender wage gap within a given occupation and how this gap varies across occupations. In addition, we can also test whether the returns to accumulated human capital differ across both gender and occupations. For example, if most female workers choose occupations where the wage "penalty" for work absence is low, we may expect flatter age-earnings profiles for women in female dominated jobs. The main problems with our approach are finding valid instruments for occupational choices and

[5] England et al (1988) apply a similar strategy on a sample taken from the National Longitudinal Survey.

[6] This approach is an extension of the approach taken in Sorensen (1989), who rely on a bivariate probit approach. Our approach allow us to disaggregate the FEM-variable to any desired level, while this is not possible in Sorensen's approach and her results may be sensitive towards this aggregation.

the importance of aggregation. Concerning the first problem, it is in general difficult to obtain observable characteristics that influence occupational choice while at the same time have no impact on wages. In this paper, we use information on the number of children and age as instruments.[7] The second concern is how sensitive our results are towards the degree of aggregation we pursue. In order to assess this point, we provide estimates from two different specifications that differ only in the number of occupational groups.

Our main results can be summarized as follows. We find that FEM has a significant and negative effect on female wages in Sweden, but only a small and insignificant effect on male wages. The negative effect that we find for Swedish females is about half of what Macpherson and Hirsch (1995) found for U.S. data. Hence, the results confirm the hypothesis that the higher wage equality in Sweden compared to the U.S. implies a lower wage penalty of job femaleness in Sweden than in the U.S. We also found support for the hypothesis that workers self-select themselves into different occupations, as the inclusion of the correction terms for self-selection has a significant impact on the results. We also found evidence of substantial heterogeneity in the gender wage gap. For example, in male dominated occupations, the unexplained wage gap is about 0.018 (and not significant). This is significantly smaller than the estimate (0.121) obtained in female dominated occupations. The results also show that the female coefficient for work experience is about 60 percent higher in male dominated occupations compared to female dominated occupations. The experience-earnings profiles for women in these two occupational groups shows a much steeper earnings profile for women in male dominated occupations. This result is in line with one of the competing theories explaining occupational segregation, which argues that individuals

[7] We expect that number of children is a more valid instrument for women since they are more likely to base their occupational choice on expected number of children than men. This implicitly assumes that there is a strong correlation between expected and actual number of children and that number of children has no impact on wages, conditional upon occupation. We believe that these assumptions are valid. Concerning the use of age as an instrument, we note that, once control for actual work experience is included in the wage equation, there is nothing in human capital theory that predicts age to be a determinant of wages. Overidentification tests reported in the result section suggests that our choice of instruments appear to be valid. It should also be noted that Sorensen (1989) does not provide a discussion about choice of instruments and her exclusion restrictions seem quite arbitrary. She relies on job characteristics such as work conditions and type of education required to perform the job.

who expect labor force intermittence will choose occupations in which the penalty for intermittence is lowest. Finally, we showed that ignoring occupational di¤erences in labor market may substantially overestimate the unexplained gender wage gap, as much of this di¤erences can be explained by wage di¤erences across occupations jointly with occupational segregation.

Section 2 of this paper provides a discussion of theories on occupational segregation used in the empirical literature trying to explain occupational segregation and the gender wage gap. Section 3 describes the data and sample used in this study. The empirical speci…cation is presented in Section 4 while the results are presented in section 5. A …nal section contains a summary of the paper.

2 Theories on Occupational Segregation

In the empirical literature there is a general understanding that occupational segregation is present and that females are gathered disproportional in occupations with low earnings. However, there is no agreement on the cause of these outcomes and two contradicted theories have been given in the literature. The …rst line argues that females are gathered disproportional in occupations with low earnings due to market discrimination and the second line argues that it is due to a self-sorting mechanism.

One theoretical explanation of market discrimination is sometimes referred to as the crowding hypothesis, Bergman (1974). The crowding model states that employer's discriminate against females by excluding them from occupations considered being male jobs. These jobs are reserved for males and few women have the opportunity to get a work in these jobs. Females are crowded into other occupations, referred as female jobs. Wages in these jobs are lower because of an increasing supply of women in the labor market and because there are few female jobs. The model assumes that females and males have the same characteristics and without discrimination they would be paid equally. Thus, because of discrimination males and females are segregated into di¤erent occupations. Occupations considered being primarily female occupation pay less than occupations considered being primarily male occupation despite the fact that all workers are quali…ed for both types of occupations.

The quality sorting hypothesis, Macpherson and Hirsch (1995), is another explanation of market discrimination used in the literature. If females but not males are crowded into low earnings jobs only due to discrimination, then the gender composition of a job becomes an index of labor quality for males and, to a smaller degree, for females. Males who are relatively less productive accept low earnings work in primarily female occupations. Over time, low earnings occupations, crowded by females, would attract relatively less productive males and loose high productive females. Thus, over time we should observe workers with lower productivity and wages in these occupations.

For the non-discriminating line, Polachek (1981 and 1985) argue that individuals who expect labor force intermittence will choose occupations in which the penalty for intermittence, atrophy or depreciation of human capital, is lowest. These occupations will have high starting wages and ‡at earnings pro…les.

Other explanations for occupational segregation that have appeared in the literature includes among others Becker (1985) who argues that females who expect to spend a lot of time at home choose a job that demands relatively less e¤ort. Other authors, such as Murray and Atkinson (1981), Forgionne and Peters (1982) and Filer (1985), have shown that females have a preference for non-economically working conditions while males thinks more in economic terms.

3 Data

The data used in the empirical analysis is drawn from a cross-section of the Swedish Household Income Survey (HINK) complemented with information on occupational segregation taken from the 1996 Labor Force Survey. Both of these data sources are supplied by Statistics Sweden. HINK provides information on labor market activities and incomes for a random sample of Swedish households, and approximately 7,000 households are interviewed each year. In this paper we use data from the 1997 survey. An interesting feature of this data set is the possibility of matching individual records with wage information provided by employers. The hourly wage rates obtained in this fashion correspond to the workers' contracted wages and do not su¤er from the usual measurement errors which are common in self-reported wages.

The wage information is available for all publicly employed workers as well as for the majority of privately employed workers.[8]

We limit the analysis to individuals aged 18 to 65 and to those individuals who are not self-employed. After these selections we are left with 3,995 females and 3,625 males.

To construct the FEM-variable which measures the proportion of workers who are women in a given occupation, we used information from the Labor Force Survey. In HINK we have information about the individuals' occupation at a two-digit level, and we can distinguish between 38 different occupations in the data.[9] In the second part of the empirical analysis where we estimate models controlling for self-selection into occupations, we split occupations into male dominated, female dominated and integrated following the convention in the literature, see Hakim (1998) and Jacobs (1995). Specifically, we define occupations with less than 33 percent women as being male dominated occupations and occupations with less than 33 percent men form the female dominated category. The remaining occupations form the integrated occupations category.

Explanatory variables used in the empirical analysis include information on: the highest educational degree each person has obtained, actual years of work experience, area of living (urban areas, medium-sized cities or the countryside), marital status and hours of work. In addition to these variables, we included information on number of children and age, acting as instruments, in the ordered probit model.

In Table 1 we present descriptive statistics for females and males by occupational type. For women, we observe higher average wage rates in male dominated and intermediate occupations than in female dominated occupations. Despite this, women in the latter occupational group have on average

[8] Since wages were not available for all privately employed workers, our sample contains a higher concentration of publicly employed workers than what is observed in the population. To test if our results were sensitive towards this, we estimated models with and without sample weights. We found that there were virtually no difference in the regression estimates and we are therefore confident that our results are not driven by the non-representative nature of our sample.

[9] Details about type of occupation and the proportion of women in each occupation is provided in Table A3 in Appendix.

higher education. We also observe a significant difference in the proportion of women working full-time. Among females in male dominated occupations, 77 percent work full-time (more than 1,500 hours per year). Among females in female dominated occupations, this figure is only 48 percent. It is interesting to note that this pattern cannot be observed for male workers confirming the traditional view that male labor supply is less flexible than female labor supply. Finally, we also see from Table 1 that males in female dominated occupations are highly educated as 50 percent has a college/university degree, compared to only 8 percent in male dominated occupations.

4 Econometric Specification

The relationship between wages and gender composition can be estimated by

$$\ln w_i = \beta^w X_i + \Theta^w FEM_i + (\upsilon_k^w + \varepsilon_i^w) \qquad \forall i \in W \tag{1a}$$

$$\ln w_i = \beta^m X_i + \Theta^m FEM_i + (\upsilon_k^m + \varepsilon_i^m) \qquad \forall i \in M \tag{1b}$$

where W denotes the set of women in the sample and M denotes the set of men. Further, $i = 1, ..., N^w$ for women and $i = 1, ..., N^m$ for men. Subindex i denotes individuals and subindex k denotes occupations. The last two terms of the above relationships concerns the error structure of the model. Unobserved occupational-specific effects are assumed to be captured in υ_k, while ε_i is an individual-specific disturbance term, reflecting effects of unobservable variables that vary across individuals. It is assumed that: (1) the sequence $\{\varepsilon_i\}$ consists of normal i.i.d. random variables with mean zero and a constant variance σ_ε^2; (2) υ_k is normally distributed with mean zero and a homoscedastic variance σ_k^2. Further, $\ln w_i$ is the natural log of hourly earnings for individual i and X_i includes controls for highest education attained, work experience, marital status, area of living and labor supply; FEM_i is the concentration of women in worker i's occupation. As argued by Moulton (1990), Macpherson and Hirsch (1995) and Baker and Fortin (1999), estimating the above equations with OLS yields biased standard errors since a part of the error term (υ_k) is correlated across workers within occupations. To obtain correct standard errors we apply a random effects estimator to the model in equations (1a) and (1b).

However, as was argued in the introduction, there exists plausible reasons for assuming that FEM is endogenously determined. If this is the case, the estimates from equations (1a) and (1b) are not valid. The approach that we adopt in this paper, which controls for this type of potential misspecification, is to estimate a version of Heckman's two-step estimator. In the first stage, we estimate an ordered probit model that determines the probability of choosing a specific type of occupation (that is, male dominated, female dominated or an intermediate occupation). The parameters from the ordered probit are then used to form a selection correction term (similar to Heckman's lambda) that is added to the regression equation in the second stage. Formally, the model can be specified as follows:

$$\begin{aligned} FEM^{*}_{ij} &= \gamma_j Z_{ij} + \eta_{ij} \\ FEM_{ij} &= k \quad \text{if} \quad \mu_{k-1} < FEM^{*}_{ij} \leq \mu_k, \\ \text{where } k &= 0, 1, 2 \text{ and } \mu_{k-1} < \mu_k. \end{aligned}$$

$$\hat{\lambda}_{ijk} = \frac{\phi\left(\hat{\mu}_{k-1} - \hat{\gamma}_j Z_{ij}\right) - \phi\left(\hat{\mu}_k - \hat{\gamma}_j Z_{ij}\right)}{\Phi\left(\hat{\mu}_k - \hat{\gamma}_j Z_{ij}\right) - \Phi\left(\hat{\mu}_{k-1} - \hat{\gamma}_j Z_{ij}\right)} \tag{1}$$

$$\ln w_{ijk} = \beta_{jk} X_{ijk} + \theta_{jk} \hat{\lambda}_{ijk} + \varepsilon_{ijk} \tag{2}$$

$$\begin{aligned} \varepsilon_{ijk} &\sim i.i.d.\ N(0, \sigma^2_{\varepsilon}) \\ \eta_{ij} &\sim i.i.d.\ N(0,1) \end{aligned}$$

where subindex j denotes gender ($j = w$ or m). Further, ϕ and Φ are the standard normal probability density function and distribution function, respectively. The μ's are unknown parameters to be estimated jointly with γ, and reflect threshold values for moving through the occupational choice decision. It is further assumed that ε_{ijk} and η_{ij} are correlated with correlation coefficient ρ. As is the case in a standard Heckman model, the standard errors of the estimates equation (2) needs to be adjusted.

5 Empirical Results

This section is divided into two subsections. In the first, we present results based on equations (1a) and (1b) above. In the second subsection, we present results based on equation (2), which are corrected for self-selection.

5.1 Results without controlling for self-selection

The results from estimation of equations (1a) and (1b) above are presented in Table 2. In the first column we present estimates of the effect of FEM on male and female wages without including any other controls. The results show a negative but not significant effect of FEM on female wages (-0.102) and a positive effect on male wages (0.061). The results for males can to a certain extent be explained by the fact that males in female dominated occupations have on average much higher education than males in male dominated occupations (see Table 1). For females, there is a negative effect, despite the fact that female workers in female dominated occupations also have higher education. One likely explanation for the negative effect however is the fact that 77 percent of women in male dominated occupations work full-time while this figure is only 48 percent in female occupations. A larger negative effect of FEM on wages for females than for males was also found in Macpherson and Hirsh (1995).[10]

In column two of Table 2 we report estimates of a version of equations (1a) and (1b) above when we include controls for observable individual characteristics. When we add these controls, the negative effect on female wages drop to -0.091, but it is now significant (the p-value equals 0.076). For males, the coefficient is also negative, -0.013, but not significantly different from zero. These results indicates that the negative effect on wages from female concentration in occupations, which has been shown to exist in the U.S., also exists in Sweden but the effect is smaller.[11] As was argued earlier, this is an expected result, in part due to the compressed Swedish wage distribution.

[10] Their estimates (without any controls) were -0.2305 and -0.0375 for females and males, respectively.

[11] Macpherson and Hirsh (1995) report that the effect in their "base" specification, which is the one most similar to ours, is -0.172 for females and -0.139 for males (Table 5, page 445).

5.2 Results with controls for self-selection

In Table 3 we present results from the ordered probit. The entries in the first two columns refer to the results for males, while the last two columns show results for females. The results show that education and occupational choice is strongly correlated and that the probability of working in a female dominated occupation is higher for those with higher education. This results holds for both males and females. As expected, the effect of work experience is the opposite of that of education. However, it is only significant for males. Males living in urban areas (i.e. Stockholm, Göteborg or Malmö) have a higher probability of working in female dominated occupations than other men. For women, we observe the opposite, namely that women who lives in urban areas are more likely to work in male dominated occupations. This suggests that occupational segregation is more significant in the countryside, perhaps because (occupational) traditions are more important there than in larger cities. Marital status does not have any significant impact on either male or female occupational choice. Finally, we note that labor supply has no impact on occupational choice among men, but a significant effect on females' choices. The negative coefficient implies that women who work full-time are more likely to work in a male dominated occupation.

Regarding the effects of the instruments on occupational choice, we see that number of children has a negative effect for males and a positive effect for females. The estimate for males has a p-value of about 0.13, and implies that, everything else held constant, males with many children are more likely to hold a job in a male dominated occupation. For females, the estimate in column three implies the opposite, namely that females with many children are more likely to hold a job in a female dominated occupation. These results are not surprising. For instance, assuming that the age-earnings profile for women is flatter in female dominated occupations, the wage penalty of work absence is lower in these jobs. We would then expect women with many children (and therefore with more work absence) to prefer these types of jobs rather than jobs where the wage penalty is bigger (as in male dominated jobs). As a second instrument we include age. The reason for including this variable is the assumption that occupational segregation is more pronounced among older cohorts than among younger ones. This is also confirmed in Table 3, which shows that men and women from older cohorts are more likely to possess jobs in segregated occupations. In the very last portion of

Table 3, we report values of likelihood-ratio tests, which clearly reject the null hypothesis that the instruments have no significant impact on occupational choice.

Table 4 contains the wage estimates for females. The results in the first two columns refer to male dominated occupations, while columns three and four show the results for integrated occupations and the last two columns show estimates for females working in female dominated occupations. For all categories, the estimates regarding highest educational attainment (i.e. high-school degree or a college/university degree) are all insignificant. This suggests that, everything else equal, wages among women with a high-school degree (or a college degree) are not significantly different from wages among women with less schooling.

One of the competing theories explaining occupational segregation argues that individuals who expect labor force intermittence will choose occupations in which the penalty for intermittence is lowest (see for instance Polachek (1981 and 1985)). These occupations will have high starting wages and flat earnings profiles. An implication of this theory is that women (who expect more frequent labor force intermittence) choose female dominated occupations because the penalty for intermittence is lower in these occupations than in male dominated occupations. Whether the earnings profiles are indeed flatter in female dominated occupations is an empirical matter. The results in Table 4 lends some support for this hypothesis since the coefficient for work experience is about 60 percent higher in male dominated occupations compared to female dominated occupations. The experience-earnings profiles for women in these two occupational groups are shown in Figure 1, which clearly shows a much steeper earnings profile for women in male dominated occupations.

Concerning the remaining covariates in the wage equations, we find that women in urban areas (Stockholm, Göteborg and Malmö) have on average higher wages. There is a significant wage premium to marriage and of working full-time for women in integrated occupations. Finally, the selection correction variable, lambda, is not significant suggesting no support for the hypothesis that women self-select themselves into different occupations. Hence, we cannot reject the hypothesis that women are randomly allocated into different occupations.

Table 5 contains the wage estimates for males. Overall, most of the results are in accordance with our prior expectations. The results regarding the effects of human capital imply higher return to education in male dominated occupations and higher return to work experience in female dominated occupations. Further, there is a significant, negative wage effect of being single in integrated occupations and a significant, positive effect of working full-time. However, contrary to the results for females, we find that the selection correction variable is significant, suggesting that men self-select themselves into different occupations.

To test whether our choice of instruments is valid, we report the p-values for these variables when they were included in the wage equation. To achieve identification (without relying on the non-linear nature of the model), we included them separately. For women, the p-values for age strongly suggest that age can serve as an instrument. However, regarding number of children, the p-values are high in both male dominated and female dominated occupations, but not so in intermediate occupations (where the p-value equals 0.039). This may suggest that part of our identification does not rely on a proper set of instruments. Perhaps as a consequence of poor instruments, none of the selection correction terms are significant for females and our results are not sensitive to the inclusion of these terms. For males however, both age and number of children appear to be valid instruments.

The entries in Table 6 shows observed, explained and unexplained (log) wage gaps across occupations and gender. The first two rows show the difference in log-wages for females in male dominated versus female dominated occupations. The observed difference is 7.3 percent. However, as shown in the second column, the explained gap is negative, -0.057. This means that women in female dominated occupations have, on average, more accumulated human capital and that, based on this, the wage gap should be negative. This also means that the part of the wage difference that is unexplained is larger than the observed one. The unexplained gap is estimated to equal 0.131, implying a wage penalty of working in female dominated occupations for women of about 13 percent.

The figures for male workers are presented in the second set of rows in Table 6. As was shown in Table 1, male wages are higher in female occupations compared to male occupations, mostly due to differences in educational levels between the two groups. This is also shown in Table 6, which states that a large fraction (about 85 percent) of the observed wage di¤erence can be explained by di¤erences in observable characteristics.

In the last set of results in Table 6, we present observed, explained and unexplained gender wage di¤erentials in the three occupational groups. The observed gender wage gap is smallest (2.6 percent) in male dominated occupations and largest in female dominated occupations (16.7 percent). As is shown in the last column, most of the observed wage di¤erence is attributed to unobserved factors (of which labor market discrimination may be one). In both male and female dominated occupations, about 30 percent of the observed wage gap can be "explained" by di¤erences in observable characteristics (such as accumulated human capital and labor supply) and about 70 percent remains unexplained. It is interesting to observe that there exists substantial heterogeneity in the gender wage di¤erentials across occupational groups. This is an observation that, surprisingly, has received little attention in the literature. Another interesting implication of our results on the gender wage gap is that the unexplained portion of this gap is not smallest in occupations with an equal gender distribution. This would suggest that policies such as a¢rmative action would have only limited e¤ect on the unexplained wage gap.

5.3 Decomposing the gender wage gap

Using our approach to estimate the gender wage gap enables us to decompose this gap into three mutually exclusive parts: di¤erences in endowments, differences in occupational structure and di¤erences in rewards to endowments. Formally, this can be written as:

$$
\begin{aligned}
\overline{\ln w_m} - \overline{\ln w_w} = & \sum_{i \in J} \pi_i^m \cdot (\overline{Z_i^m} - \overline{Z_i^w}) \cdot \hat{\beta}^m + \\
& \sum_{i \in J} (\pi_i^m - \pi_i^w) \cdot \overline{Z_i^w} \cdot \hat{\beta}^w + \\
& \sum_{i \in J} \pi_i^m \cdot \overline{Z_i^w} \cdot (\hat{\beta}^m - \hat{\beta}^w)
\end{aligned}
$$

where the …rst term on the right hand side measures di¤erences in endowments $(\overline{Z_i^m} - \overline{Z_i^w})$, the second measures di¤erences in occupational structure

$(\pi_i^m - \pi_i^w)$ and the last one measures the gap due to unexplained factors $(\hat{b}^m - \hat{b}^w)$. The π_i's are proportions of workers (men or women) in occupation i, and there is a total of J different occupations.

The results of this decomposition is reported in Table 7 for four different specifications. In the first column, we show the results from a model (estimated by OLS) which does not allow occupational structure to affect wages. In this case, 30 percent of the observed (log) wage gap between men and women can be explained by differences in endowents (primarily education and experience) and 70 percent of the gap is left unexplained and in much previous work, this is attributed to labor market discrimination. In coulmn two, we show how false that conclusion is. The entries in this column are obtained by estimating separate wage regressions for three occupational groups. The results from this shows that the gap which is due to unexplained factors drop substantially, from 70 percent to about 40 percent. We can further infer from the results that about 40 percent of what was earlier attributed to unexplained factors (discrimination) is simply due to differences in occupational structure.[12] Hence, it is important to control for occupational differences when making inference about the gender wage gap, and neglecting to do so might yield overestimated unexplained wage gaps. Columns three and four shows results when non-random selection into occupations are controlled for and they show a simlar picture as the results in column two.

5.4 Robustness of the results

In an attempt to explore the robustness of our results towards the assumption of aggregation of the FEM-variable we have estimated a model in which we aggregated the FEM-variable into four groups instead of three.[13] The results from this sensitivity analysis are found in Table A2 in appendix. It would also have been interesting to test how sensitive our results are towards different assumptions regarding the set of instruments. However, due to

[12] Note however that part of the occupational structure may be the outcome of a discriminatory process.

[13] Specifically, we define occupations with less than 25 percent women as being male dominated occupations and occupations with less than 25 percent men form the female dominated category. The remaining occupations form two "semi-integrated" occupations, one consisting of occupations with 25-50 percent men and one consisting of 25-50 percent women.

limited information on individual, observable characteristics included in the data, we are unfortunately restricted in our ability to rigorously test these assumptions.

In Table A2 we present observed, explained and unexplained (log) wage gaps across occupations and gender. The entries in this table should be compared to the ones in Table 6. We find a larger wage gap between male and female dominated occupations for women. Given the construction of the groups, this is not surprising. For males, we find a smaller observed wage gap between male and female dominated occupations, but the unexplained gap is similar to that reported in Table 6. Regarding the gender pay gap, the entries in Table A2 show the same pattern as in Table 6. The wage gap is smallest in male dominated occupations and largest in female dominated occupations. Overall, the results in Table A2 are of similar magnitudes as the ones in Table 6 suggesting that our results in Table 6 are robust towards aggregation of the FEM-variable.

6 Conclusions

The purpose of this paper has been to study if there exists any wage penalty for working in occupations which are characterized by a high concentration of female workers in Sweden. The negative effect for women is however lower than what has been reported for the U.S., a result which is expected given the high degree of wage equality in Sweden compared to the U.S. We have also extended previous work in this area by estimating a framework that accounts for workers self-selection into different occupations. The inclusion of correction terms for self-selection was shown to have a significant impact on the results. Within this framework, we found that the unexplained wage gap for females between male and female jobs is about 13 percent. For males, we found evidence of a small and insignificant gap.

Our results also showed that the female coefficient for work experience is about 60 percent higher in male dominated occupations compared to female dominated occupations. The experience-earnings profiles for women in these two occupational groups shows a much steeper earnings profile for women in male dominated occupations. This result is in line with one of the competing theories explaining occupational segregation, which argues that individuals who expect labor force intermittence will choose occupations in which the penalty for intermittence is lowest.

Finally, we used our model to investigate how the gender wage gap differs across occupational groups, and found strong indications of a small and insignificant (2.6 percent) gender wage gap in male dominated occupations and a significant gap (16.7 percent) in female dominated occupations. Most of the observed wage difference across all occupational groups is attributed to unobserved factors (of which labor market discrimination may be one). In both male and female dominated occupations, about 30 percent of the observed wage gap can be "explained" by differences in observable characteristics (such as accumulated human capital and labor supply) and about 70 percent remains unexplained. The heterogeneity in the gender wage differentials across occupational groups which we find support for in this paper suggests that affirmative action policies will only have limited effect on the unexplained wage gap.

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Table 1. Descriptive Statistics by Occupational Type.

Women

Characteristics	Male Dominated Occupation Mean	Male Dominated Occupation Std	Intermediate Occupation Mean	Intermediate Occupation Std	Female Dominated Occupation Mean	Female Dominated Occupation Std
Wage per hour (1997 SEK)	107.7	28.4	106.1	31.6	99.3	22.2
High-School	0.53	-	0.60	-	0.67	-
College/University	0.13	-	0.16	-	0.20	-
Work experience	18.9	10.1	21.3	10.6	20.4	10.1
Living in urban areas	0.31	-	0.39	-	0.29	-
Living in medium-sized cities	0.37	-	0.37	-	0.39	-
Prop. single	0.18	-	0.15	-	0.15	-
Prop. working full-time	0.77	-	0.67	-	0.48	-
Number of children	0.8	1.0	0.7	1.0	0.9	1.1
Age	40.3	10.7	43.1	10.8	42.5	10.8
Number of observations	332		1650		2013	

Men

Characteristics	Male Dominated Occupation Mean	Male Dominated Occupation Std	Intermediate Occupation Mean	Intermediate Occupation Std	Female Dominated Occupation Mean	Female Dominated Occupation Std
Wage per hour (1997 SEK)	111.0	32.2	124.8	49.2	121.5	46.9
High-School	0.65	-	0.58	-	0.42	-
College/University	0.08	-	0.24	-	0.50	-
Work experience	23.2	12.2	22.5	11.9	21.1	11.3
Living in urban areas	0.27	-	0.43	-	0.34	-
Living in medium-sized cities	0.41	-	0.37	-	0.40	-
Prop. single	0.14	-	0.13	-	0.19	-
Prop. working full-time	0.76	-	0.82	-	0.78	-
Number of children	0.8	1.1	0.8	1.0	0.8	1.0
Age	41.8	11.0	42.8	10.8	43.1	11.1
Number of observations	2073		1155		397	

Table 2. The E¤ect of Occupational Segregation on Wages.

Variable	Speci…cation 1 Est.	Speci…cation 1 Std.err.	Speci…cation 2 Est.	Speci…cation 2 Std.err.
Female density in occupation	-0.102	0.078	-0.091	0.051
Male indicator interacted with female densitity in occupation	0.163	0.029	0.078	0.027
Male	0.014	0.016	-0.109	0.026

Notes: Speci…cation 1 includes no controls for observable characteristics. Speci…cation 2 includes controls for education, work experience, area of living, marital status and labor supply. All these controls are interacted with the Male indicator.

Table 3. Ordered Probit Estimates.

Variable	Males		Females	
	Est.	Std.err.	Est.	Std.err.
Constant	-1.548	0.159	1.131	0.123
High-School	0.215	0.053	0.506	0.048
College/University	0.919	0.072	0.686	0.063
Experience	-0.040	0.009	-0.003	0.009
Experience^2/100	-0.005	0.015	0.002	0.017
Living in urban areas	0.148	0.053	-0.142	0.048
Living in medium-sized cities	0.048	0.051	-0.024	0.047
Single	-0.071	0.062	0.014	0.053
Working full time	-0.033	0.050	-0.536	0.040
Number of children	-0.033	0.022	0.050	0.021
Age	0.047	0.006	0.006	0.004
$^{1}{}_{1}$	1.165	0.030	1.459	0.031
N	3,625		3,995	
Ave. Log-Likelihood	0.8576		0.8730	
LR-test[1]	63.0 (0.0001)		6.8 (0.033)	

Notes: The dependent variable takes on three values: 0 if male dominated occupation, 1 if intermediate and 2 if female dominated.
LR-test[1]: value of the LR-statistic when testing the instruments in the selection equation, p-value in parenthesis (truncated for males).

Table 4. Wage Equation Estimates for Females, by Occupation.

Variable	Male dominated Est.	Male dominated Std.err.	Intermediate Est.	Intermediate Std.err.	Female dominated Est.	Female dominated Std.err.
Constant	4.737	0.737	4.170	0.160	4.650	0.298
High-School	0.082	0.172	-0.086	0.133	-0.042	0.107
College/University	0.339	0.245	0.071	0.187	0.109	0.146
Experience	0.015	0.007	0.009	0.005	0.009	0.004
$Experience^2/100$	-0.027	0.016	-0.016	0.010	-0.015	0.009
Living in urban areas	0.101	0.065	0.133	0.049	0.054	0.039
Living in medium-sized cities	0.040	0.041	0.012	0.033	0.010	0.025
Single	-0.097	0.045	-0.048	0.034	-0.027	0.029
Working full time	-0.048	0.193	0.280	0.146	0.138	0.110
Lambda	0.178	0.412	-0.313	0.308	-0.350	0.322
Adj. R^2	0.220		0.269		0.273	
S"	0.257		0.353		0.326	
P-value for number of children[a]	0.946		0.039		0.874	
P-value for age[b]	0.972		0.347		0.646	

Note: The dependent variable equals the logarithm of hourly wage rates. [a]: P-value when number of children was included in the wage equations. [a]: P-value when age was included.

Table 5. Wage Equation Estimates for Males, by Occupation.

Variable	Male dominated Est.	Male dominated Std.err.	Intermediate Est.	Intermediate Std.err.	Female dominated Est.	Female dominated Std.err.
Constant	4.214	0.063	4.532	0.132	4.882	0.391
High-School	0.038	0.025	0.014	0.046	-0.013	0.096
College/University	0.163	0.084	0.011	0.117	0.061	0.185
Experience	0.010	0.003	0.016	0.005	0.015	0.007
$Experience^2/100$	-0.015	0.006	-0.025	0.010	-0.020	0.016
Living in urban areas	0.013	0.026	0.061	0.044	0.012	0.063
Living in medium-sized cities	0.020	0.022	0.007	0.041	-0.016	0.055
Single	-0.009	0.028	-0.092	0.046	-0.071	0.060
Working full time	0.136	0.022	0.231	0.039	0.090	0.056
Lambda	-0.294	0.104	-0.288	0.106	-0.275	0.170
Adj. R^2	0.265		0.279		0.387	
S"	0.320		0.388		0.354	
P-value for number of children[a]	0.531		0.579		0.540	
P-value for age[b]	0.181		0.308		0.587	

Note: The dependent variable equals the logarithm of hourly wage rates. [a]: P-value when number of children was included in the wage equations. [a]: P-value when age was included.

Table 6. Observed, Explained and Unexplained (log) Wage Gaps.

Variable	Observed Gap	Explained Gap	Unexplained Gap
Females:			
Male vs Female Dominated	0.073	-0.057	0.131
	(0.013)	(0.058)	(0.061)
Males:			
Male vs Female Dominated	-0.068	-0.058	-0.011
	(0.016)	(0.066)	(0.070)
Male-Female Wage Gaps:			
Male Dominated	0.026	0.008	0.018
	(0.013)	(0.016)	(0.025)
Intermediate	0.136	0.037	0.099
	(0.011)	(0.013)	(0.023)
Female Dominated	0.167	0.047	0.121
	(0.016)	(0.013)	(0.023)

Note: Standard errors are reported in brackets.
The explained wage gap is calculated as: $(\bar{X}_{md} - \bar{X}_{fd})\hat{\beta}_{fd}$ where $\bar{X}_{md}$ equals average characteristics in male dominated occupations, and $\bar{X}_{fd}$ equals average characteristics in male dominated occupations.

Table 7. Decomposing the Gender (log) Wage Gap.

	OLS[1]	OLS[2]	Selection Corrected (3 groups)	Selection Corrected (4 groups)
Observed log wage gap	0.107	0.107	0.107	0.107
Gap due to di¤erences in endowments	0.032 (30%)	0.031 (29%)	0.021 (20%)	0.040 (37%)
Gap due to occupational segregation	-	0.031 (29%)	0.031 (29%)	0.021 (20%)
Gap due to unobserved factors	0.075 (70%)	0.045 (42%)	0.055 (51%)	0.046 (43%)

OLS[1]: Includes no control for occupational segregation.
OLS[2]: Includes control for occupational segregation.

Appendix A:

Table A1. Observed, Explained and Unexplained (log) Wage Gaps (OLS).

Variable	Observed Gap	Explained Gap	Unexplained Gap
Females:			
Male vs Female Dominated	0.073	-0.015	0.089
	(0.013)	(0.003)	(0.012)
Males:			
Male vs Female Dominated	-0.068	-0.139	0.071
	(0.016)	(0.013)	(0.019)
Male-Female Wage Gaps:			
Male Dominated	0.026	0.002	0.024
	(0.013)	(0.008)	(0.014)
Intermediate	0.136	0.056	0.080
	(0.011)	(0.002)	(0.010
Female Dominated	0.167	0.111	0.056
	(0.016)	(0.002)	(0.010)

Note: Standard errors are reported in brackets.
The explained wage gap is calculated as: $(\bar{X}_{md} - \bar{X}_{fd})\hat{\beta}_{fd}$ where $\bar{X}_{md}$ equals average characteristics in male dominated occupations, and $\bar{X}_{fd}$ equals average characteristics in male dominated occupations.

Table A2. Observed, Explained and Unexplained (log) Wage Gaps.

Variable	Observed Gap	Explained Gap	Unexplained Gap
Females:			
Male vs Female Dominated	0.122 (0.017)	-0.064 (0.095)	0.186 (0.103)
Males:			
Male vs Female Dominated	-0.020 (0.030)	-0.005 (0.107)	-0.015 (0.122)
Male-Female wage gaps:			
Male Dominated (0-25% women)	0.005 (0.017)	0.012 (0.023)	-0.007 (0.047)
Intermediate I (25-50% women)	0.123 (0.015)	0.012 (0.023)	0.111 (0.037)
Intermediate II (50-75% women)	0.110 (0.011)	0.036 (0.017)	0.074 (0.023)
Female Dominated (75-100% women)	0.147 (0.030)	0.060 (0.078)	0.087 (0.098)

Note: These figures are estimates based on a model with FEM divided into four different groups. The explained wage gap is calculated as: $(\bar{X}_{md} - \bar{X}_{fd})\hat{\beta}_{md}$ $\bar{X}_{md}$ equals average characteristics in male dominated occupations, and $\bar{X}_{fd}$ equals average characteristics in male dominated occupations

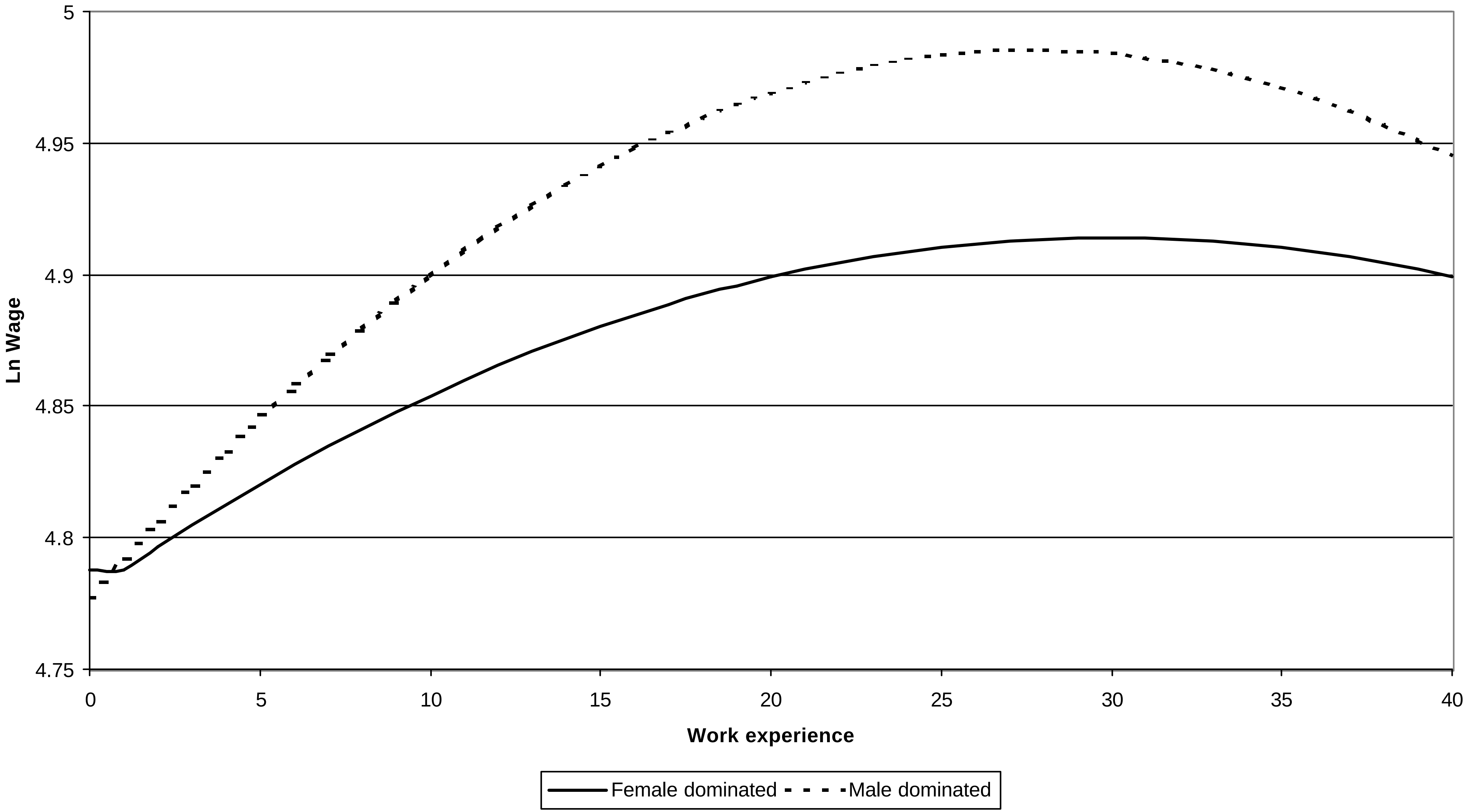
Table A3. Occupational Speci…cation and Proportion of Women in each Occupation.

Occupation	Prop. of women
Science: Technical	0.111
Science: Chemical and Biological	0.612
Medicine, Health and Nursing	0.880
Education	0.703
Law	0.299
Religion, Journalist, Artist	0.581
Administration: Government and Business	0.465
Administration: Accounting, Clerical	0.906
Administration: Other	0.448
Sales: (business services, purchase, goods)	0.385
Sales: Other	0.542
Agriculture, Horticulture, Forestry: Management	0.117
Agriculture, Horticulture, Forestry: Workers	0.295
Wildlife Protection, Hunting and Fishing	0.038
Mining	0.027
Transport and Communication: Air, Sea, Other	0.189
Transport and Communication: Drivers, Delivery	0.077
Transport and Communication: Postal Servcie, Telecommunication	0.579
Manufacturing: Textile	0.658
Manufacturing: Iron and Metal	0.071
Manufacturing: Precision-tool	0.400
Manufacturing: Workshop and Construction	0.104
Manufacturing: Electrical	0.147
Manufacturing: Wood	0.146
Manufacturing: Painting and Varnishing	0.027
Manufacturing: Other Construction and Building	0.003

Table A3. Continued.

Occuaption	Prop. of women
Manufacturing: Graphics	0.262
Manufacturing: Glass, Pottery, Tile	0.292
Manufacturing: Dairy	0.286
Manufacturing: Chemical Processing	0.256
Manufacturing: Material Handling	0.049
Manufacturing: Packing and Storage	0.296
Manufacturing: Other	0.317
Services: Civilian Protection	0.182
Services: Lodging and Catering	0.767
Services: Caretaking and Cleaning	0.603
Services: Military	0.037
Services: Other	0.677

Figure 1. Experience-earnings profiles for women in female and male dominated occupations.



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