Are New Work Practices and New Technologies Biased against Immigrant Workers?

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February 2006

Abstract

New technologies and new work practices have been introduced and implemented on a broad range in the production process in most advanced industrialised countries during the last two decades. New work organisation practices like team organisation and job rotation require interpersonal communication to a larger extent than the traditional assembly line types of production. In addition to handling the formal language, communication in this respect includes country specific skills related to understanding social and cultural codes, unwritten rules, implicit communication, norms etc. In this paper we analyse whether these developments – by increasing the importance of communication and informal human capital - have had a negative effect on employment opportunities of immigrants. The results show that firms that use PC's intensively and firms that give their employees lot of autonomy employ fewer Non-Western immigrants not raised in Norway. Furthermore, the negative relationships are especially strong for low skilled Non-Western immigrants. These results adds support to a hypothesis saying that new technologies and (some) new work practices are biased against Non-Western immigrant workers, and especially against those with low formal skills.

Keywords: Immigrants, employment, new work practices, new technology

JEL classification: J61, J71

Acknowledgement: We are grateful to Peter Mueser University of Missouri-Columbia and seminar participants at The Institute for Social Research, as well as conference participants at ZEW's 5th ICT Conference in Mannheim July 2005 and conference participants at the 2nd IZA Migration Meeting in Chicago September 2005 for valuable comments to an earlier draft.

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1. Introduction

In this study we investigate whether, and to what extent, changing organizational structures at the work places and the use of new technology in the production process aggravate the problems of immigrants in the Norwegian labour market. The main argument is that new technologies, combined with new organisation practices, require interpersonal communication to a larger extent than the traditional assembly line type of production. In addition to handling the formal language, good communication demands the understanding of social and cultural codes, unwritten rules, implicit communication, norms etc. This kinds of skill and abilities are clearly country specific. Thus, a communication bias in new technology and new organisational practises may put immigrants at a competitive disadvantage, which could be increasing over time. Or with other words, the new forms of production may be biased against immigrant workers.

Since the beginning of the 1980s, immigrants' share of the total population in Norway has increased from 2 per cent to almost 8 per cent. During the same period, the composition of the immigrant population has changed, from having been dominated by immigrants from Western and Nordic countries to currently being dominated by immigrants from Non-Western countries. By 2004, almost 75 per cent of the immigrants in Norway were Non-Western immigrants compared to 25 per cent in 1980 (Statistics Norway 2004).

Non-Western immigrants occupy a weak position in the Norwegian labour market. They have low labour force participation rates and high unemployment rates compared to natives. By the third quarter of 2004, the unemployment rate among immigrants in Norway was 11 per cent (Statistics Norway 2004), almost three times as high as that of natives. It is especially high among Non-Western immigrants, with immigrants from Africa (20 percent) and Asia (14 per cent) at the upper end of the distribution. Many empirical studies show that similar patterns are found in Sweden and Denmark with regards to the labour market integration of Non-Western immigrants (see e.g., Pedersen and Smith 2002).

Empirical studies from Scandinavia indicate that the labour market problems of Non-Western immigrants have aggravated during the last decades. Barth et al. (2004) analyse labour market assimilation for different cohorts of immigrants in Norway (from pre-1965 arrivals to 1990-1994). After controlling for time since immigration and a host of human capital and other background variables they conclude that early cohorts have higher earnings than more recent cohorts. This finding suggests that labour market assimilation for

immigrants has become more difficult over time. Rosholm et al. (2006) analyse male immigrant experience in Sweden and Denmark from 1985 to 1995. Their results show that immigrants in both Sweden and Denmark experienced similar declines in employment prospects during this period, despite diverging business cycles. Their interpretation of these results is that changing organisational structures – towards more flexible work organisation – has resulted in a decreased attractiveness of immigrant employees due to increasing returns to communication related skills.

Bratsberg et al. (2003) analyse lifecycle employment profiles of labour immigrants who arrived in Norway during the early 1970s. They find important differences in labour market progress between immigrants from Western and Non-Western countries. While employment profiles of Western immigrants converge towards those of natives, profiles of Non-Western immigrants diverge after age 35. While the employment rate of native men is more or less stable between the age of 35 and 50 the predicted rate of Non–Western labour immigrants fell from 92 per cent to 61 per cent. One candidate the authors put forward to explain the declining employment rates among immigrants is changing structures of labour demand:
"*Technological change and flatter organizational structures at the workplace may have brought a greater dependency on communication skills and teamwork, and such developments may have hurt employment prospects of Non-Western immigrants …* ".

The importance of communicative skills for explaining relative employment and wage developments between natives and immigrants has also received international research attention. Moss and Tilly (1996) analyse changes in skill requirements and the impact of these changes on Black men's access to entry-level jobs by using face-to-face interviews with managers at 56 US firms. Managers in this study report that "soft" skills – particularly motivation and ability to interact with customers and co-workers – are becoming increasingly important and many managers view Black men as lacking in these soft skills. This may, according to the authors, help explain Black men's disadvantage in the labour market. Fan et al. (2005) derives a theoretical model that predicts that the more intensively "soft"/non-cognitive skills are used in an occupation, the greater is the black/white pay differential in that occupation. Using US survey data, they find consistent empirical evidence to support the theoretical prediction.

Introduction of new technologies and of new work practices are two characteristics of "the new economy" which has emerged in advanced industrialised countries during the past decades. Such organizational changes comprise a move away from traditional assembly line organisational structures towards multi-tasking, job rotation, teamwork, the use of computers,

reductions in management levels and decentralization of responsibility (Lindbeck and Snower 2000). A study from OECD (1999) shows that these kinds of organizational changes seem to be widespread in Sweden and Denmark (Norway is not included in this OECD study).

These work organisation practices involve increased responsibility and handling of more uncertainty for the workers. They also require increased interpersonal cooperation on problem solving and imply more frequent contacts between individual employees. Thus, the importance of communicative capacity - to "grease the wheels" of the production process - probably increases as new technologies and new organisational structures are introduced. Low levels of communicative skills will reduce productivity in jobs where communication and interpersonal cooperation is important. Since communicative skills to a large extent are country specific, this development may increase the competence deficit of immigrants. This problem may increase with the geographical and cultural distance between home and host country and may be particularly grave in a small language area like the Scandinavian.

Previous research seems to agree that these kinds of changes in the production process have raised the demand for skilled labour, i.e., that new technologies and new work practices are skill biased (see e.g., Berman et al. 1994, 1998, Machin 1996, and Katz and Autor 1999, Caroli and Van Reenen 2001, Caroli 2001). A key point in this literature is that technological innovations and new forms of work organisation have increased the demand for more educated workers.

Evidence of skill-biased technological changes has also been found in the Norwegian labour market (Salvanes and Førre 2003), measured by increased job creation rates for high skilled workers in firms with new vintages of capital. However, results in Røed and Nordberg (2004) suggest that changes in relative employment opportunities have also arisen between workers at the same skill level. Their results show that relative employment opportunities for workers in the lower end of the wage distribution – *conditional on the level of education and work experience* – have worsened significantly in Norway during the 1990s. This result suggests that the weaker parts of *all* skill groups have experienced less favourable labour market opportunities, i.e., this development has also taken place in the high skilled segment of the labour market.

In this paper we shed some light on this matter by estimating factor demand equations both within and between different skill groups. Our main focus is on the importance of what we call communication-biased technological and organisational change. Specifically, we test the hypothesis that new technology and new work practises are biased against immigrant workers, and to what extent this bias arise within or between skill level groups. We employ a

matched employer-employee data set from a (panel) survey of firms conducted in Norway. A set of translog cost share functions, which are modified to take into account the panel aspect of the data and the occurrence of many zeros for the dependent variable, is estimated.

Of course, immigrants are not a homogenous group of workers, and we hypothesize that the increased demand for communicative abilities should be particularly difficult to honour for Non-Western immigrants, particularly for those who are not raised in Norway. To capture these differences in the empirical analyses, we distinguish between different groups of immigrants. Furthermore, as mentioned above, the skill-biased and organisational-biased empirical literature have shown that introduction of new technologies and new work practices are biased in favour of high skilled workers. Therefore, we also perform analyses distinguishing between workers at different skill levels. In this way we may also shed some light on the result in Røed and Nordberg (2004), reporting a steady detoriation of employment prospects for persons with low abilities, in *all* skill groups. Within each skill group (high and low skill) we analyse relative demand for different groups of workers (defined by their country of origin and the length of stay in Norway). Our matched panel employer-employee data material - containing survey information on the use of different forms of new work practices and indicators of new technology, together with individual register information on wages, education and country of origin - allows us to perform a rigorous analysis of these differences.

The remainder of the paper proceeds as follows: Section 2 proposes an econometric framework for estimating the relationship between technology, work organisation practices and the structure of the workforce. Section 3 describes the data, the sample, and the variables used. Section 4 presents the results, and section 5 concludes.

2. Empirical specification

We analyse the relationship between firm-level indicators of technological adaptation and the firm's workforce structure within a factor demand framework. The estimated equation is derived from a simple quasi-fixed translog cost function (Christensen et al. 1971, 1973; Brown and Christensen 1981). We assume that the firm minimises the cost function given an output constraint. The cost function contains both variable and quasi-fixed inputs. The only variable inputs are related to five types of workers:

(1) Natives,

(2) Western immigrants who arrived as children,

(3) Western immigrants who arrived as adults,

(4) Non-Western immigrants who arrived as children, and

(5) Non-Western immigrants who arrived as adults.

The definition of Western and Non-Western immigrants and the distinction between children and adults are explained in the next section.

Consider the following translog cost function for firm *i* at time *t*:

$$(1)\quad LnC_{it} = \beta_0 + \sum_j \alpha_j \ln W_{ijt} + \sum_{j,k}\sum_{j\neq k} \beta_{jk}^{w} \ln W_{ijt} \ln W_{ikt} + \beta_K \ln K_{it} + \sum_j \beta_{jK} \ln W_{ijt} \ln K_{it} + \beta_Y \ln Y_{ji} + \sum_j \beta_{jY} \ln W_{ijt} \ln Y_{it} + \beta_Q \ln Q_{it} + \sum_j \beta_{jQ} \ln W_{ijt} \ln Q_{it}$$

where *j* refers to one of the five different groups of workers and W_{ijt} is the wage rate of group *j* in firm *i* at time *t*. *C* signifies the variable costs. The α parameters reflect own price effects, *K* is physical capital, and *Q* is technological and organizational capital. Firm output, *Y* is included to capture any non-homotheticity. If costs are independent of the output level, the production technology is homothetic.

By assuming that costs are homogenous of degree one in prices, we can impose the standard restrictions, and using Shepard's lemma we can generate a series of *j* variable wage cost share equations of the familiar form:

$$(2)\quad S_{ijt} = \frac{\partial \ln C}{\partial \ln W_j} = \alpha_j + \sum_{k=2,3,4,5} \beta_{jk}^{w} \ln\left(\frac{W_{ikt}}{W_{i1t}}\right) + \beta_{jK} \ln K_{it} + \beta_{jY} \ln Y_{it} + \beta_{jQ} Q_{it}$$

where S_{ijt} is the wage cost share of worker group *j (j = 1, 2, 3, 4, 5)* in firm *i* at time *t*. W_{ikt}/W_{i1t} are average wages for group *k (k = 2, 3, 4, 5)* divided by the average wage for group *1* (natives). Including a vector with firm-specific control variables (*X*), specifying the firm's technological capital and new work organisation practices, and adding an error term, we get the following econometric specification of (2):

$$(3)\quad S_{ijt} = \alpha_j + \sum_{k=2,3,4,5} \beta_{jk}^{w} \ln\left(\frac{W_{ikt}}{W_{i1t}}\right) + \beta_{jK} \ln K_{it} + \beta_{jY} \ln Y_{it} + \beta_{jQ} PC_{it} + \beta_{jO} ORG_{it} + \beta_{jX} X_{it} + u_{ijt}$$

where u_{ijt} is a stochastic error term. The measure of technological capital (*PC*) is the share of workers using personal computer, and *ORG* is a set of binary variables measuring new work

organisation practices. Restrictions are imposed upon the model from the structural equations. *Symmetry* implies the following restrictions:

$$\text{i)}\ \beta^{w}_{jk} = \beta^{w}_{kj},$$

and *homogeneity* implies two cross equation restrictions:

$$\text{ii)}\ \sum_{j=1}^{5} \alpha_j = 1,\ \ \sum_{j=1}^{5} \beta_{jm} = 0$$

and one within equation restriction:

$$\text{iii)}\ \sum_{m \in M} \beta_{jm} = 0$$

.

Where *m* refers to each independent variable in equation (3) and *M* is the total number of variables.

If new technology and new forms of work practices are biased against immigrant workers we would expect a negative relationship between the indicators of technology, new work practices and the share of immigrants wage costs in total wage costs. We have assumed that the main mechanism generating this bias is that the use of the PC technology and the organizational practises increase the return to communicative capacity. Thus, we expect the negative relationships to be reinforced with the geographical and cultural distance between Norway and the home country of the immigrants and to be weakened by the time the immigrants have lived in Norway. The implications of these expectations in the formal context of equation (3) are that the *PC* variable and *ORG* variables have a more negative influence on the wage cost share for Non-Western - compared to Western - immigrants., i.e., $\beta_{2Q} > \beta_{4Q}$, and $\beta_{3Q} > \beta_{5Q}$ (and the same ranking with regard to the β_{jO}). Furthermore, that the negative communication-bias is stronger towards those immigrants who are not raised in Norway, i.e., $\beta_{2Q} > \beta_{3Q}$, and $\beta_{4Q} > \beta_{5Q}$ (and the same ranking with respect to the β_{jO}).

There are some problems related to estimating equation (3). Firstly, the dependent variables are censored. Secondly, introducing the relative wage measure at the firm level as on of the explanatory variables would reduce the number of observations considerably, since a large share of the firms do not employ immigrant workers. Thirdly, there is the issue of endogeneity. To make a causal statement regarding the effect of organisational and technological changes on labour demand we must discuss the possibility of reverse causality. In the rest of this section we discuss how to handle these problems in an orderly fashion.

First, we tackle the problem of censoring: A large fraction of firms do not have any (or some) of the groups of immigrants in their labour force. For example, approximately 50 per cent of the firms do not employ any Non-Western immigrants who arrived as adults. The same is true for 53 per cent of the firms with regard to Non-Western immigrants who arrived as children. The corresponding percentages for Western immigrants are 47 per cent and 25 per cent, respectively. Standard ordinary least square (OLS) will produce inconsistent results in such cases. Estimation techniques should be applied that take account of this censoring. Thus, we estimate the factor demand equations by a simultaneous Tobit maximum likelihood procedure. Furthermore, since the data material is organised as a panel, we estimate random effect Tobit models. One advantage related to this approach is that we can take into account all restrictions implied by the structural cost equations. Another advantage is that exploitation of the panel structure improves the efficiency of the estimator, and in a non-linear model it also restores consistency.[1] A disadvantage related to this approach is, as we show below, that the restrictions implied by the structural cost equations become quite complex in this non-linear setup, and hence, recovery of the left-out parameters of the model becomes cumbersome.

We assume in the following that the cost shares reflect an underlying tendency, Y_{ijt}, to employ immigrants belonging to each of the four types of immigrant workers. The relationship between this underlying latent tendency and the cost shares is described in (4):

$$(4)\quad Y_{ijt} = \alpha_j + \sum_{k=2,3,4,5} b^w_{jk} \ln\left(\frac{W_{ikt}}{W_{i1t}}\right) + b_{jK} \ln K_{it} + b_{jY} Y_{it} + b_{jQ} PC_{it} + b_{jO} ORG_{it} + b_{jX} X_{it} + e_{ijt}$$

$$S_{ijt} = \begin{cases} Y_{ijt} & \text{if } Y_{ijt} > 0 \\ 0 & \text{otherwise} \end{cases}$$

Where the error term is specified as an error component model, that is, we assume that : $e_{ijt} = \varepsilon_{ijt} + \eta_{ij}$, $\varepsilon_{ijt} \sim N(0, \sigma^2_{ijt})$ and the random effect follows a discrete distribution. In each equation we allow for up to three different support points, and the correlation of the random effect between equations is completely flexible.

We believe that (4) reflects a plausible assumption. When employing the tobit approach we estimate the parameters of the latent index. For these parameters, the restrictions imposed by the assumptions of *homogeneity* and symmetry are quite complicated: What we estimate are the *b*'s, but the restrictions are in terms of the β's, which are also the parameters of interest.

[1] In a non-linear setup, neglect of the panel structure in the data leads to inconsistent estimates.

However, the parameters of the actual cost shares, the β's, can be expressed as a *function* of the parameters of the latent index. The relations between the two sets of parameters (illustrated for the capital variable) are the following:

$$(5) \quad \beta_{jK} = \frac{1}{n}\sum_i \partial S_{ijt} / \partial \ln K_{it} = b_{jK} \cdot \frac{1}{n}\sum P(Y_{ijt} > 0), \\ = b_{jK} \cdot \overline{P(Y_{ijt} > 0)}$$

or at least this is the case if we think of β as the average influence of a variable on the outcome, which is what the parameter captures in the linear case. The parameter restrictions, which in the translog cost function model were just parameter restrictions, are now slightly more complex, in the sense that they also depend on the fractions of uncensored observations.

However, the cross equation restriction in ii) on the α's and β's (and the singularity of the error covariance matrix) can be ignored by leaving out one equation, the first, from the estimations, while the within equation restriction, in iii), is circumvented by the division with one of the price variables (here, the wages of natives), in each equation.

The only restriction left is thus the symmetry restriction, in i). It is now important to note that the symmetry restriction does not imply that $b_{jk}=b_{kj}$, but rather, that

$$(6) \quad b^w_{jk}\overline{P(Y_{ijt} > 0)} = b^w_{kj}\overline{P(Y_{ikt} > 0)}$$

so, that $$b^w_{jk} = b^w_{kj}\frac{\overline{P(Y_{ikt} > 0)}}{\overline{P(Y_{ijt})}}$$

These restrictions are incorporated directly in the estimation process. Then we turn to the problem of missing relative wage observations. To measure the relative wages at the firm level would reduce the number of observations considerably. The reason is that a large share of the firms does not employ immigrant workers. The employment of immigrants is probably driven by a non-random selection process. Thus, it is likely this procedure would cause a severe selection bias problem as well. We deal with this problem by including relative wage measures at the regional (county) level. The regional group specific wage measures are calculated from information on individual wage, place of residence, country of birth and time in Norway. Combined with information about the same individuals working hours we construct individual hourly wages, which in turn are aggregated up at county level. Still, it is likely that identification of the wage effect may be difficult, because differences in wages do

not only reflect exogenous movements in the price of labour, but also differences due to unobserved differences between workers.

Finally, to what extent will we be able to make causal statements about how the use of new technology and work practises affect the demand for immigrant workers? That is, can we rule out the case of reverse causality, i.e., that firms which hire many immigrant workers change their technology and form of work practices in response to workers and skills available. This issue of endogeneity is not easily addressed, as it is difficult to find good instrument variables for the *PC* and *ORG* variables, that is, variables which affect the use of this technology and these organisational practises, but at the same time do not affect the wage costs shares. However, observing that the fraction of immigrants from Non-Western countries is on average 5 per cent, and that only in 1/16 of all firms is it above 20 per cent, it seems unlikely that the firm would adapt its production technology to this part of the work force. Rather, we would expect the firm to do the opposite; namely, to adapt its work force to its production technology, which is what we study in this paper. A crude estimation strategy, estimating a fixed effect (first differenced) model of wages cost shares regressed on all time-varying variables yield results that are qualitatively the same as those we find here, although the size of the parameters are not readily comparable. These results are available upon request.

3. Data and variables

The data comes from an employer-employee panel data set, consisting of both survey and register information. The starting point is an establishment level survey of a representative sample of Norwegian establishments conducted by the Institute for Social Research and Statistics Norway in 1997. The sample of establishments is representative for private and public establishments in Norway with more than 10 employees. In 2003, the survey was repeated. All firms participating in 1997 were asked to participate again.

In this paper we limit the analyses to private sector firms present in both 1997 and 2003, that is, we have a balanced sample of private sector firms. The net sample used in the empirical analyses consists of 1088 observations, or 544 firms.

To the survey of establishments Statistics Norway has linked register information from several public administrative registers, including both employee and employer level information. We have employee level information on country of origin, level of education,

and wages, all taken from public registers. The rest of the variables are from the employer level. The two periods of registration used in the paper is 1997 and 2003.

Information on wages is based on individual register information from the tax authorities. Each individual's wage information is linked to an employer. This enables us to aggregate wage information at the firm level for each type of worker. All analyses are restricted to workers between 20-60 years of age.

The dependent variable is the *share of wage costs in total wage costs* at the firm for each of the five categories of workers: Natives, Western immigrant who arrived as children, Western immigrants who arrived as adults, Non-Western immigrant who arrived as children, and Non-Western immigrants who arrived as adults. Western countries include the Nordic countries, countries in Western Europe, USA, Canada, New Zealand and Australia. Non-western countries include: Asia (including Turkey), Africa, Southern and Central America and Eastern Europe.

To distinguish between immigrants who are raised in Norway (i.e. who arrived as children) and those who are not (who arrived as adults) we exploit information on age when arriving to Norway (Age_N) and number of years of education after mandatory education (Education). We define:

$$\text{Child immigrant if : } Age_N \leq 16 + \text{Education}$$
$$\text{Adult immigrant if : } Age_N > 16 + \text{Education}$$

where the right hand side is supposed to proxy the age of entry into the labour market.

To measure the impact of *technology* we use a measure of the percentage of workers using *personal computers*, based on answers to the following question: "How large a share of the employees use PC or other computer in their daily work?" (named PC). The percentage of workers using PC is of course a crude measure of the level of technology at the firm. PC's are used to accomplish a vide variety of tasks, which differ greatly in complexity. On the other hand, this measure has the advantage of being widely used in different studies across countries. This eases the possibilities of comparison of results between studies.

To measure the impact of *new work practices* we use four dummy variables measuring job rotation, use of teamwork, multitasking, and the degree of autonomy given to the workers. Information on *Job rotation* is taken from answers to the following question: "Are any of the employees involved in job rotation?" yes/no. Information on *teams* is taken from the following question: "Are any of the employees organised in work teams?" yes/no. Information on *multitasking* is taken from the following question: "Are employees given training so that they

can cover (be responsible for) several work areas?" yes/no. Finally, the degree of *autonomy* at the workplace is taken from answers to the following question: "How are the opportunities for employees to make their own choices as to finding the best way to accomplish their assignments?" The alternatives were: Full opportunities; Quite good opportunities; Some good opportunities; and None. From this we construct a binary indicator of autonomy at the workplace, taking the value one if the firm answers "Full opportunities", and zero otherwise.

We use the level of education to distinguish between workers at different skill levels. Two skill levels are used: Low skill (compulsory school and secondary school) and high skill (university or college degree).

As control variables we include information on relative wages, output, capital, region, industry, recruitment problems and downsizing. Relative wages measures the relative difference in mean hourly wages between the different worker types relative to native workers. Hourly wages is constructed from individual information on total wages, duration of the working relationship, and working time. The mean hourly wages is measured at a regional level (county).[2] Output is measured by firm sales. Capital is measured by the sum of equity and debt. The firm's location is measured by 19 regional dummy variables (counties), industry is measured by 18 dummy variables based on two digit NACE codes. Information on recruitment problems is based on how difficult it is to recruit qualified personnel. If the firm answers very difficult, the variable is given value one, zero otherwise. Information on downsizing is based on a question whether any major organisational changes have taken place during the last five years. If yes, the firm is asked whether this led to a reduction in the number of employees. If the firm answers yes, the variable is given the value one, and zero otherwise. Information on recruitment problems and downsizing is included to control for the possibility that the employment structure at the firm is the result of factors other than changes in technology or new work practices.

4. Results

Table 4.1 presents descriptive statistics for the dependent and some of the independent variables. The first row shows that, in the average firm, approximately 90 per cent of the firm's total wage costs go to natives. The largest immigrant group in this sample is Western immigrants who arrived as children (3.9 per cent) followed by Non-Western immigrants who arrived as adults (2.9 per cent).

[2] There are 19 counties in Norway.

[Table 4.1 about here]

The next two rows shows mean share of total wage costs for low skilled and high skilled workers.[3] Approximately 70 per cent of the firms' wage costs go to low skilled natives. Approximately 20 per cent go to high skilled natives. The immigrant groups with the largest wage share are low skilled Non-Western immigrants who arrived as adults, and low skilled Western immigrants who arrived as children, both with 2.6 per cent..

The average share of PC users (in their daily job) in a firm in this sample is 46 per cent. Six out of ten firms use teams, while four in ten firms use job rotation. One in four firms give their workers much autonomy, while more than four out of five firms give training to their workers so that they can cover several work areas (multitasking).

Table 4.2 presents estimates of the relationship between the wage cost structure of the workforce, and technology and new work practices.[4] All models are estimated using the simultaneous dependent Tobit system of equations presented in section 2. The left-out equation is the natives' equation.

[Table 4.2 about here]

Increasing the fraction of workers in the firm using a PC by 1 percentage point decreases the share of wage costs in total wage costs by 2.9 percentage points for Non-Western immigrants arriving to Norway as adults.[5] For Non-Western immigrants who arrived as children, the coefficient is close to zero. The fraction of workers in the firm using a PC is positively related to the share of Western immigrants who arrived as children, while the impact is close to zero for Western immigrants who came as adults. These results may add support to hypothesis saying that new technologies – by increasing the need for interpersonal communication in a broad sense - are biased against Non-Western immigrants who arrived as adults.

[3] The wage shares sum to unity for all workers and for low- and high skilled workers together.

[4] The dependent variable in all the models is the share of wages in the firm's total wage costs. We have run regressions using employment shares as the dependent variable instead. The results are not sensitive to the choice of the dependent variable.

[5] The estimated coefficients in table 4.2 measure the (intra-marginal) impact on the underlying and unobserved dependent variable. In order to get an approximate measure of the *average* effect on the observed variable, we must multiply the estimated coefficient with the share of non-censored observations in the material.

Regarding the indicators of new work practices, we do not find any significant relations between use of *teams* and the share of any of the immigrant groups in total wage costs. Firms that give their employees lot of *autonomy* employ fewer Non-Western immigrants, although the result is only statistically significant for those who arrived as children. The results for immigrants from Western countries are not statistically significant. This result for the autonomy variable agrees with a hypothesis saying that new work practices – by increasing the importance of communication and informal human capital – may harm Non-Western immigrant workers, the group which is perceived to possess low levels of these human capital components.

In firms where *multi-tasking* is an important feature in daily work, Non-Western immigrants who arrived as children have a *higher* share of total wages. This result is at some odds with the hypothesis of new work practices being biased against Non-Western immigrants, but it may be explained by some firms' need – for instance due to requirements from the production technology side – for upgrading the skills of their workforce, i.e. it may measure training rather than multi-tasking. The coefficient is not statistically significant for any of the other groups. Finally, in firms involved in job-rotation schemes, the fraction of immigrant wage costs in total wage costs is not significantly different from that in firms not involved in such schemes.

Regarding the output variable, this is significant for natives and Western immigrants arrived as adults. This is evidence of non-homothetic production technology. Finally, for the downsizing variable; firms that have reduced the number of workers during the last five years have a lower share of immigrants, but the effect is only significant for Western immigrants who arrived as children. These results, thus, do not suggest that the burdens of downsizing are disproportionally borne by Non-Western immigrants.

Communication bias across skill groups

As mentioned earlier, evidence in the empirical literature suggests that new technologies and new work practices are biased in favour of workers in higher skill groups. A natural follow up from table 4.2 is to check whether the relationship between new technologies, new work practices and the share of immigrants in total wage costs are uniform across skill groups. Are high skilled Non-Western immigrants (by for instance having more communicative skills than low skilled Non-Western immigrants) protected against negative effects from the increasing importance of communication and informal human capital? Table 4.3 presents estimates for

wage bill shares for the five different groups by level of skills. We distinguish between low skilled workers (compulsory school and secondary school) and high skilled workers (college or university degree). The model is once again estimated with a nine-equation simultaneous panel Tobit model similar to the one specified in Section 2 (high skilled natives are the left-out equation).

[Table 4.3 about here]

Estimates for low skilled workers are shown in the upper half of the table, while estimates for high skilled workers are shown in the lower half. The results for the intensity of *PC* use show that the negative relationship for Non-Western adult immigrants reported in table 4.2 to a large extent is explained by a strong negative effect on the low skilled workers in this group. If the share of workers using PC increases with 1 percentage point, the share of adult low-skilled Non-Western immigrants decreases by approximately 3.6 percentage points (again, the impact is found by multiplying the coefficient in Table 4.3 with the fraction of uncensored observations). For all groups of workers, the relationship between PC and the wage cost share is more positive for high skilled workers than for low skilled workers, and it is statistically significant for all low skilled groups. At first glance it might appear that the intensity of PC use has an adverse effect on low skilled natives that is larger than the negative impact on the group of low skilled Non-Western immigrants who arrived as adults (approximately 16 percentage points versus 3.6 percentage points). However, note that the effects are measured in percentage *points*. Measured as relative changes from the group's average per cent of the firm's total wage costs, reported in Table 4.1 (70.2 per cent for low skilled natives and 2.6 percent for low skilled Non-Western immigrants arrived as adults) we see that the relative negative effect of increasing the PC share is much larger for low skilled Non-Western immigrants arrived as adults than for low skilled natives. Overall, the results for the PC variable are in line with hypotheses and results from the 'skill biased technological change' literature (e.g., Berman *et al.* 1994, Machin 1996).

Regarding the negative relationship between *autonomy* and the demand for immigrants who arrived as children, reported in table 4.2, this result is not statistically significant when splitting into skill groups. The opposite is true for Non-Western immigrants who arrived as adults. The autonomy coefficient for this group was not significant in Table 4.2. When splitting the groups we find a negative relationship between autonomy and demand for low skilled Non-Western immigrants who arrived as adults, and a non-significant relationship

between autonomy and the demand for Non-Western immigrants who arrived as children. This finding is in line with a hypothesis that some new features of the new work practices reduce the demand for Non-Western immigrants not raised in Norway. Finally, *multitasking*, *work teams* or *job rotation* do not appear to strongly affect the wage cost shares across skill groups.

Summing up, we find that firms where new technologies are used more intensively, and firms that employ new work practices more, tend to have lower wage cost shares of immigrants in general, but especially low skilled immigrants from Non-Western countries who did not follow any basic schooling in Norway, that is, those who arrived as adults. These results would suggest that new technology and new work practices are biased against immigrant workers. Of course we cannot completely rule out the possibility of problems related to endogeneity, however, we argue in section 2 that this problem is not critical in our study. We therefore have confidence that what we measure is indeed the causal effect of – admittedly, crudely measured - new technologies and new work practices on the tendency for firms to employ different groups of workers. And we have thus argued that these new technologies and new work practices are biased against immigrant workers, especially those from Non-Western countries without formal and informal skills.

5. Conclusions

Non-Western immigrants have a weak position in the Norwegian labour market. Their level of unemployment is consistently higher than the unemployment rates of natives. By the third quarter of 2004, the level of unemployment among immigrants in Norway was 11 per cent (Statistics Norway 2004), almost three times as high compared to the level for natives. The level of unemployment is especially high among Non-Western immigrants.

In this paper we have analyse if there are some features of the "new economy" that may help to explain the difficult labour market situation of immigrants. Introduction of new technologies and introduction of new work practices are two characteristics of the new economy. We have analysed whether these developments – by increasing the importance of interpersonal communication and informal human capital - have had a negative effect on employment opportunities of immigrants. We distinguish between four groups of immigrants: Western immigrants who arrived as children, Western immigrants who arrived as adults, Non-

Western immigrants who arrived as children, and Non-Western immigrants who arrived as adults.

To analyse the relationship between indicators of new technology, new work practices and the demand for immigrant workers we use representative firm level panel data containing both employer and employee level information. We estimate factor demand equations where the dependent variable is the immigrant wage cost share of total wage costs in the firm.

The results show that firms that use PC's intensively and firms that give their employees lot autonomy employ fewer Non-Western immigrants. These relationships are especially prevalent for Non-Western immigrants who are not raised in Norway. These results may add support to the hypothesis that new technologies and some new work practices are biased against immigrant workers.

The literature on skill-biased technological and organisational change has presented results suggesting that both new technologies and new organisation practices are skill-biased, by increasing the demand for high skilled workers. In the paper, we check whether the relationship between new technologies, new work practices and the share of immigrants in total wage cots are uniform across skill groups. The results show that the negative relationship between autonomy and the demand for Non-Western immigrants not raised in Norway is explained by a negative relationship among the low skilled workers. Among the high skilled workers we find no significant relationship between autonomy and the share of Non-Western immigrants in total wage costs. This result may add support to a hypothesis that education increases communicative skills among Non-Western adult immigrants and protects against negative effects from new work practices. The result for the technology indicator (PC) reveals that the negative relationship for Non-Western adult immigrants to a large extent is explained by a negative relationship among the low skilled workers in this group.

In summary, our results do give some support to the hypothesis that new work practices and new technologies are biased against immigrant workers, and especially against immigrant workers who are not raised in Norway. Our result seems to be in line with findings in Rosholm et al. (2005). They report negative employment developments among immigrants in Sweden and Denmark from 1985 to 1995, and interpret this as effect of increased importance of interpersonal communication due to changes in work practices. Future work is desired to confirm the results obtained in this study. Especially, access to data with reliable instrument variables for technology and new work practices would be helpful.

Still, a preliminary discussion of policy implications of these findings may be warranted. Our results would tend to favour integration policies which aim at providing

language training combined with general information about the destination country intensively to immigrants. Once a certain basic communicative level is achieved, we would suggest intense use of temporary employment subsidies combined with on-the-job language training courses sponsored by the public sector in order to neutralise the negative impacts of lacking communicative abilities.

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Table 4.1. Descriptive statistics. Mean values and standard errors

	Natives		Non-western immigrants				Western immigrants			
			Adults		Children		Adults		Children	
	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev
Wage shares										
-All workers	0.896	0.116	0.029	0.073	0.014	0.031	0.019	0.033	0.039	0.040
-Low skilled	0.702	0.218	0.026	0.068	0.007	0.018	0.018	0.034	0.026	0.032
-High skilled	0.195	0.187	0.004	0.012	0.004	0.001	0.004	0.012	0.013	0.026

	All	
	Mean	Std.dev
PC	0.461	0.361
Teams	0.616	0.486
Autonomy	0.267	0.443
Multitasking	0.812	0.387
Job rotation	0.439	0.496

Note: For definitions of non-western and western immigrants, as well as definitions of adult and children immigrants, see section 3.

Table 4.2. Demand for immigrant workers. Dependent variable: Wage bill shares. Simultaneous panel Tobit model

	Non-Western immigrants				Western immigrants			
	Adults		Children		Adults		Children	
	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err
PC	-0.058***	0.008	-0.007	0.005	0.003	0.006	0.018***	0.005
Teams	-0.003	0.005	-0.003	0.003	-0.001	0.004	-0.002	0.003
Autonomy	-0.008	0.006	-0.012***	0.004	0.007*	0.004	-0.006*	0.003
Multitasking	-0.007	0.007	0.009**	0.005	0.005	0.005	-0.003	0.004
Job rotation	0.001	0.005	0.002	0.003	-0.004	0.004	-0.001	0.003
Log output	0.014***	0.003	0.002	0.002	0.012***	0.002	0.001	0.002
Log Capital	-0.001	0.002	0.004***	0.001	-0.002	0.001	0.001	0.001
Downsizing	-0.005	0.007	0.002	0.004	-0.003	0.004	-0.012***	0.004
Censored observations	546		507		580		817	
N	1088		1088		1088		1088	

Note: Additional control variables include a year dummy, a regional relative wage measure, 18 industry dummies, 19 county dummies, a dummy variable measuring recruitment problems, and a variable measuring the main occupational group's share of the total number of workers. Level of significance: *** 1 per cent, ** 5 per cent, * 10 per cent. One equation has been left out; the equation for natives.

Table 4.3. Demand for native and immigrant workers. Low skilled and high skilled workers. Dependent variable: Wage bill shares. Simultaneous panel Tobit model

	Low skilled									
	Natives		Non-western immigrants				Western immigrants			
			Adults		Children		Adults		Children	
	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err
PC	-0.160***	0.015	-0.079***	0.012	-0.009*	0.005	-0.014**	0.007	-0.009*	0.005
Teams	-0.029***	0.012	0.012	0.008	-0.002	0.004	-0.003	0.005	-0.001	0.003
Autonomy	-0.025**	0.013	-0.015*	0.009	0.002	0.004	-0.005	0.005	-0.007*	0.004
Multi Tasking	-0.002	0.018	-0.014	0.010	0.005	0.006	-0.005	0.007	-0.005	0.005
Job rotation	0.013	0.012	0.004	0.009	-0.002	0.004	0.003	0.005	-0.002	0.004
Log output	-0.027***	0.005	0.012***	0.004	0.006***	0.002	0.008***	0.002	0.003	0.002
Log Capital	-0.001	0.003	0.001	0.003	0.001	0.001	0.001	0.001	-0.000	0.001
Down Sizing	0.010	0.015	-0.008	0.011	0.001	0.005	-0.007	0.007	-0.002	0.005
Censored at 0	2		594		704		507		352	

Censored at 1	35	0		0		0		0	
N	1088	1088		1088		1088		1088	
				High skilled					
	Natives	Non-western immigrants				Western immigrants			
		Adults		Children		Adults		Children	
		Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err
PC		-0.011*	0.006	0.011**	0.005	0.007	0.006	0.032***	0.006
Teams		0.006	0.004	0.004	0.004	0.009*	0.005	0.002	0.004
Autonomy		-0.001	0.005	-0.008	0.005	0.003	0.005	-0.005	0.004
Multi Tasking		-0.005	0.006	0.002	0.005	0.002	0.007	-0.006	0.004
Job rotation		-0.004	0.005	0.002	0.004	-0.004	0.005	0.002	0.004
Log output		0.011***	0.003	0.004**	0.002	0.014***	0.003	0.009***	0.003
Log Capital		0.000	0.001	0.001	0.001	-0.003	0.002	0.001	0.002
Down Sizing		-0.004	0.005	0.006	0.005	0.002	0.005	-0.009	0.007
Censored at 0		857		848		859		624	
Censored at 1		0		0		0		0	
N		1088		1088		1088		1088	

Note: Additional control variables include a year dummy, a regional relative wage measure, , a dummy variable measuring recruitment problems, and a variable measuring the main occupational group's share of the total number of workers. Level of significance: *** 1 per cent, ** per cent, * 10 per cent. One equation has been left out; the equation for high-skilled natives