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

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Abstract

New technologies and new work practices has 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 compared to 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 (arrived as adults). Furthermore, the negative relationships are especially strong for low skilled non-western immigrants. These results may add support to 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

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1. Introduction

Since the beginning of the 1980s, the immigrants' share of the total population in Norway has increased from approximately 2 per cent to almost 8 per cent. During the same period, the composition of the immigrant population has changed, from being dominated by immigrants from western and Nordic countries to at present being dominated by immigrants from so-called non-western countries. In 2004, almost 75 per cent of the immigrants were non-western immigrants, compared to approximately 25 per cent in 1980 (Statistics Norway 2004).

Non-western immigrants have a weak position in the Norwegian labour market. They are characterised by low labour force participation and high unemployment rates compared to natives. Even though the level of unemployment does respond to business cycles, the level 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, with immigrants from Africa (20 percent) and Asia (14 per cent) at the upper end of the distribution.

In this paper we analyse if there are some features of "the new economy" that may help to explain the persistent difficult labour market situation of immigrants. Introduction of new technologies and introduction of new work practices are two characteristics of "the new economy". The nature of these processes varies considerably, but some features are easy to recognize. These features include an increased importance of job rotation, team work, reductions in management levels and decentralization of responsibility within firms (Lindbeck and Snower 2000).

Previous research seems to agree on these changes have increased the demand for skilled labour, i.e., 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). The key point within this framework is that development of new technologies has increased the need for new forms of work organisation, including teamwork, decentralisation of responsibility and more autonomy to the workers. Evidence of skill-biased technological change has also been found in the Norwegian labour market (see e.g., Salvanes and Førre 2003). Moreover, recent results in Røed and Nordberg (2004) suggest that the relative employment opportunities for workers in the lower end of the wage distribution –

conditional on the level of education and work experience – has worsened significantly in Norway during the 1990s.

In this paper we study a related topic; whether new technology and new work practices are biased against immigrant workers. New technologies and new work practices has been introduced and implemented on a broad range in the production process in most advanced industrialised countries during the last two decades. These new forms of work organisation have to some extent replaced the old rigid and hierarchal forms of work organisation. OECD (1999) examines the evidence for the changes in work organisation across countries. One result from the study is that new forms of work practices are widespread in the Scandinavian countries (Sweden and Denmark are included in the study).

The starting point for the introduction of these changes has been the firms' wish for more effective means of production. The empirical evidence of this is somewhat mixed, reporting both positive and negative effects on the introduction of new work practices on firm performance, while the majority of studies seem to report positive effects (see for instance Black and Lynch 2000, 2001). While, these changes may be beneficial for firms and different groups of workers, it may have an adverse effect on other groups of workers, like immigrants. New work organisation practices like team organisation and job rotation involve increased responsibility and handling of more uncertainty for the workers. They also require interpersonal communication to a larger extent compared to 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. Low levels of these types of communication or informal human capital skills will probably reduce the levels of productivity in jobs where communication and interpersonal cooperation is important. New technologies and new forms of work organisation have probably increased the return to communication skills. Since communication is a skill that contains a large element of country specific skills, this development may increase the competence deficit among groups of immigrants.

Of course, immigrants are not a homogenous group of workers, the increased demand for interpersonal communication should be especially difficult for non-western immigrants and immigrants 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 employ analyses differencing between workers at different skill levels.

Our study is a natural follow up from Rosholm et al. (2001). They analyse male immigrant experience in Sweden and Denmark from 1985 to 1995. Their results show that immigrants in Sweden and Denmark experienced both declines in employment prospects in this period, despite quite different developments of aggregate labour market conditions. Their explanation is that the changing organisational structure – towards more flexible work organisation – has resulted in a decrease in the attractiveness of immigrant employees due to increasing importance of country-specific skills and informal human capital.

Our study is also a natural follow up from two Norwegian studies; Barth et al. (2004) and Bratsberg et al. (2003). Barth et al. (2004) analyse labour market assimilation for different cohorts of immigrants (from pre-1965 arrivals to 1990-1994). They conclude that early cohorts have higher earnings than recent cohorts, suggesting that labour market assimilation for immigrants has been more difficult over time. Bratsberg et al. (2003) analyse lifecycle employment and earnings of labour migrants who arrived in Norway from developing countries during the early 1970s. They find important differences in labour market progress between immigrants from western and non-western countries. While employment and earnings profiles of western immigrants converge towards those of natives, profiles of non-western immigrants diverge after age 35 resulting in growing labour market differences between natives and immigrants over the lifecycle. The divergence is particularly dramatic for employment. Between the age of 35 and 50 the predicted employment rate fell from 92 per cent to 61 per cent. One candidate the authors puts 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 […] ".

With 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, we can perform a more direct test of these hypotheses.

The remainder of the paper proceeds as follows: Section 2 presents the econometric framework for estimating the relationship between technology, work organisation practices and the structure of the workforce. Section 3 presents 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. We derive the estimated equation from a simple translog cost function (Christensen et al. 1971, 1973). 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 immigrant arrived as children,
(3) Western immigrants arrived as adults,
(4) Non-western immigrant arrived as children, and
(5) Non-western immigrants arrived as adults.

2.1 Wage cost shares

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:

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

where j denotes wages for the five different groups of workers. C are the variable costs. The α parameters reflect own price effect, K is physical capital, Q is technological and organizational capital, and W is the wage rate of each factor. 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 assumed to be 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 shares equations of the familiar form:

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

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 have the following econometric specification of (2):

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

where u_{ijt} is the 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. If new technology and new forms of work practices are communication biased by reducing the demand for non-western immigrants, we would expect a negative relationship between the indicators of technology, new work practices and the share of non-western immigrants wage costs in total wage costs, i.e., $\beta_{jQ} < 0 \; and \; \beta_{jO} < 0$, where j = 4, 5, i.e., non-western immigrants arrived as children and non-western immigrants arrived as adults respectively. Furthermore, if we believe that the communication-biased effects of new technologies and new work practices are especially biased towards those immigrants who are not raised in Norway, we expect it to be more negative for non-western immigrants arrived as adults.

There are several problems related to estimating equation (3). Firstly, the dependent variables are censored. A large fraction of firms do not have any of the groups of immigrants in their labour force. For example, approximately 50 per cent of the firms do not have any non-western immigrants arrived as adults in their wage cots, and 53 per cent of the firms do not have any non-western immigrants arrived as children in their wage costs. The corresponding percentages for western immigrants are 47 percent and 25 percent respectively. Standard ordinary least square (OLS) will produce inconsistent results in such cases. Estimation techniques should be applied that take account for this censoring. We estimate the factor demand equations by a Tobit maximum likelihood procedure. Furthermore, since the data material is organised as a panel, we estimate random effect Tobit models.

In general, the true underlying dependent variable y*, is a function of a set of independent variables Z, as well as a random effect ε_i :

$$(3) \quad y^*_{it} = \delta Z_{it} + \varepsilon_i + \upsilon_{it} \qquad \varepsilon_i, \upsilon_{it} \sim N(0,0,\sigma^2_\varepsilon \sigma^2_\upsilon)$$

while the actual observed value of the dependent variable is given by :

$$y_{it} = \begin{cases} L & y^*_{it} \le L \\ y^*_{it} = \delta Z_{it} + \varepsilon_i + \upsilon_{it} & L < y^*_{it} \end{cases}$$

y* is only observed for values of y* that exceed the lower censoring bound (L). If both the residual and the random effect are identically and normally distributed, equation (3) can be estimated consistently by a random Tobit maximum likelihood procedure. However, if these stochastic restrictions do not hold, then the results from the random effect Tobit procedure will be biased.[1]

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. In addition, since this may be driven by a non-random selection process, it is likely this would cause a severe selection bias problem. We deal with this problem by including relative wage measures at the regional level (county level). We have individual wage information. Combined with information on working time, we construct individual hourly wages, which in turn is 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.

Thirdly, since large shares of firms do not employ immigrant workers at all, one could argue that the demand for immigrants should be estimated in two stages; first the decision to employ immigrants or not, and secondly, the share of immigrant wage costs in total wage costs among those firms who have immigrant workers, controlled for selection. In the empirical section, we do this by estimating a standard two stage Heckman selection model.

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[1] Semi-parametric estimation procedures, which relaxes some of the strong distributional assumptions of the random effects Tobit model, including a fixed effect version of the censored regression model that exploits the longitudinal structure of data material to account for unobserved fixed differences between individuals, have been introduced by some authors. (e.g., Falk and Seim, 2000)

2.2. Hirings and separations

The wage costs shares will be a result of earlier hirings and separations. To see whether any of the differences in wage share costs can be explained by the pattern of hirings and separations from recent years, we include as an additional exercise an analysis of hirings and separations. For each of the five groups of workers, we have individual time specific information on hirings and separations.[2] This information is aggregated up at the firm level to generate firm level hiring and separations shares. We estimate the following equations:

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

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

where $Hire_{ijt}$ is worker group j's share of total number of new hires at firm i at time t, and $Separation_{ijt}$ is worker group j's share of total number of separations at firm i at time t. The shares of hirings and separations sum up to unity for each firm. We use information on hirings and separation from the three pre-years, which is 1995, 1996 and 1997 for the 1997 observation year, and 2001, 2002, and 2003 for the 2003 observation year. As for the wage share costs, the relative wage variables are measured at the regional level (county level), and the models are estimated using random effect Tobit.

3. Data and variables

The data comes from a employer-employee panel data set, consisting of both survey- and register information. The starting point is an establishment level survey for 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. The net sample used in the empirical analyses consists of 1088 observations (544 establishments, 1088 year-establishment observations).

[2] Unfortunately, from the register data, we cannot distinguish between voluntary and involuntary separations.

To the survey establishment's 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 up at the firm level for each group of workers. All analyses are restricted to workers (male and females) between 20-60 years of age.

The dependent variable is the *share of wage costs in total wage costs* at the firm in the five categories of workers: Natives, western immigrant arrived as children, western immigrants arrived as adults, non-western immigrant arrived as children, and non-western immigrants arrived as adults. Western countries include the Nordic countries, countries in Western Europe, USA, Canada, New Zeeland 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 (arrived as children) and those who are not (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:

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

To measure the impact of *technology* we use a measure of the percentage of workers using *personal computers*, based on answers the following question: "How large share of the employees use PC or other computer in their daily work?" (named PC). The share varies from 0 to 1. 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 different binary dummy variables measuring job rotation, use of teams, 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 opportunities. From this we construct a binary indicator of autonomy at the workplace, taking the value one if the firm answer "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 work groups (non-western immigrants arrived as adults, non-western immigrants arrived as children, western immigrants arrived as adults, and western immigrants arrived as children) 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). 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, 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 other factors 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 is western immigrants arrived as children (3.8 per cent) followed by non-western immigrants arrived as adults (2.8 per cent).

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									
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.

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 largest immigrant group is low skilled western immigrants arrived as children (2.6 per cent).

Approximately 46 per cent of the workers use PC in their daily work. Six out of ten firms use teams, while four out of ten firms use job rotation. One out of 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 technology, new work practices and the wage cost structure of the workforce.[4] All models are estimated by random Tobit maximum likelihood procedure.

[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.

Table 4.2. Wage bill shares for natives and immigrants. Dependent variable: Wage bill shares. Random effect Tobit maximum likelihood procedure

	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	0.028***	0.010	-0.054***	0.011	-0.008	0.005	0.003	0.006	0.016***	0.005
Teams	0.014***	0.006	-0.002	0.006	-0.003	0.003	0.001	0.003	-0.004	0.003
Autonomy	0.001	0.006	-0.011*	0.007	-0.011***	0.004	0.008***	0.003	-0.002	0.003
Multitasking	-0.004	0.007	-0.003	0.008	0.009**	0.004	0.004	0.004	-0.004	0.004
Job rotation	0.0001	0.006	-0.001	0.006	0.001	0.003	-0.003	0.003	0.001	0.003
Log output	-0.004	0.004	0.012***	0.004	0.002	0.002	0.010***	0.002	0.001	0.002
Log Capital	0.0001	0.002	0.001	0.003	0.005***	0.001	0.0001	0.001	0.001	0.001
Downsizing	0.013*	0.007	-0.011	0.007	0.002	0.004	-0.003	0.004	-0.009***	0.003
Censored obs.	147		542		581		508		271	
Log lik.	826.0		357.3		644.4		732.2		1206.9	
ρ	0.549	0.003	0.665	0.037	0.469	0.045	0.566	0.038	0.440	0.039
N	1088		1088		1088		1088		1088	

Note: ρ measures the percent contribution to the overall variance from the panel-level variance component. 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, ** per cent, * 10 per cent.

The share of workers using *PC* is positively related to the share of natives in total wage costs.[5] Increasing the share of workers using a PC by 1 percentage points increases the share of natives wage costs in total wage costs by approximately 2.4 percentage points.[6] The share of workers using PC is also positively related to the share of western immigrants arriving as children. The only significant *negative* relationships between PC and the share of wage costs is found for non-western immigrants arrived to Norway as adults. Increasing the share of workers using a PC by 1 percentage points *decreases* the share of adult non-western immigrants in total wage costs by approximately 2.7 percentage points. This result may add support to hypothesis saying that new technologies – by increasing the need for interpersonal communication in a broad sense - are biased against immigrant workers who are not well endowed with these kinds of skills.

Regarding the indicators of new work practices, we find a positive relationship between use of *teams* and the share of natives in total wage costs. This result is in line with a hypothesis that use of teams, by demanding interpersonal communication, may favour natives. The relationship between teams and wage costs are not significant for any of the immigrant groups.

Firms that give their employees lot of *autonomy* employ fewer non-western immigrants. This result applies for both adult and child immigrants. This result is in line with a hypothesis saying that that new work practices – by increasing the importance of communication and informal human capital – may harm non-western immigrant workers. It is only among non-western immigrants that the relationship between teams and wage costs are negative and significant. Among western immigrants, the relationship is positive for adult immigrants and non-significant for child immigrants.

Regarding the downsizing variable; firms that have reduced the number of workers during the last five years have a lower share of western immigrants arrived as children, and a higher share of native workers. For non-western immigrants, the relationship is not significant. These results do not suggest that the burdens of downsizing are disproportionally borne by non-western immigrants.

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[5] Censored observations for the native group are right censored observations, i.e., 148 firms have only native workers. For the other groups, there are only left censored observations.

[6] The estimated coefficients in table 4.2 measure the marginal impact on the underlying and unobserved dependent variable. In order to get an approximate measure of the average marginal effect on the observed variable, we must multiply the estimated coefficient with the share of non-censored observations in the material. For natives, this equals 0.86 (941/1088 = 0.86).

Finally, the regional relative wage measures (not shown) are negative, but generally not significant (with exception for western immigrants arrived as adults). Division bias is one candidate for explaining the lack of significant wage effects. Hourly wages – as one of the right hand side variables – is also used to calculate the wage share costs.

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 cots 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).

Table 4.3. Wage bill shares for natives and immigrants. Low and high skilled. Dependent variable: Wage bill shares. Random effect Tobit maximum likelihood procedure

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	-0.078***	0.014	-0.059***	0.011	-0.006	0.005	-0.013**	0.006	-0.005	0.004
Teams	0.005	0.007	0.0001	0.006	-0.004	0.003	-0.003	0.004	-0.002	0.003
Autonomy	-0.010	0.008	-0.015***	0.007	0.003	0.003	-0.004	0.004	-0.002	0.003
Multi Tasking	-0.003	0.010	-0.009	0.008	0.007*	0.004	0.0001	0.005	-0.005	0.003
Job rotation	0.004	0.008	0.002	0.006	-0.002	0.003	0.003	0.004	0.000	0.003
Log output	-0.019***	0.006	0.010**	0.004	0.005**	0.002	0.008***	0.002	0.002	0.002
Log Capital	-0.005	0.004	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001
Down Sizing	0.018**	0.009	-0.006	0.007	0.0001	0.003	-0.009**	0.004	-0.005*	0.003
Censored obs.	37		594		704		507		352	
Log L	602.9		291.3		504.8		675.1		1111.3	
ρ	0.789	0.022	0.656	0.039	0.511	0.048	0.065		0.434	0.041
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	Coeff.	Std.err
PC	0.074***	0.015	-0.012**	0.005	0.013***	0.004	0.011**	0.005	0.039***	0.005
Teams	0.006	0.007	0.003	0.003	0.002	0.003	0.007**	0.003	-0.004	0.003
Autonomy	0.006	0.008	-0.001	0.004	-0.009***	0.003	0.003	0.003	-0.002	0.003
Multi Tasking	-0.003	0.009	0.0001	0.004	0.009**	0.004	0.006	0.004	-0.002	0.004
Job rotation	-0.006	0.007	-0.006*	0.003	0.001	0.003	-0.005*	0.003	0.003	0.003
Log output	0.015**	0.008	0.010	0.002	0.004**	0.001	0.011***	0.002	0.007***	0.002
Log Capital	0.006	0.004	0.0001	0.001	0.002**	0.001	0.0001	0.001	0.002	0.001
Down Sizing	-0.004	0.008	-0.005	0.004	0.006*	0.003	0.002	0.003	-0.009	0.003
Censored obs.	93		857		848		859		624	
Log L	581.2		268.7		314.2		280.2		610.3	
ρ	0.815	0.021	0.032		0.027		0.644	0.055	0.581	0.041
N	1088		1088		1088		1088		1088	

Note: ρ measures the percent contribution to the overall variance from the panel-level variance component.. 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, ** per cent, * 10 per cent.

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. Regarding the negative relationship between autonomy and the demand for non-western immigrants arriving as adults reported in table 4.2, this 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 might suggest that formal education

increases communicative skills among non-western adult immigrant. However, to some surprise, among non-western immigrants arriving as children, we find the opposite result. Among this group, a negative relationship between autonomy and the share of the groups wage costs in total wage costs is only found among high skilled workers.

The results for technology indicator (PC) show that the negative relationship for non-western immigrants adult immigrants reported in table 4.2, to a large extent is explained by a negative relationship among 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 decrease by approximately 2.7 percentage points. 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. For instance, for native workers, the PC variable is positive and significant for the high skilled workers and negative and significant for the low skilled workers. Increasing the share of workers using PC increases (decreases) the share of high (low) skilled natives by approximately 6.8 (7.5) percentage points. These results are in line with hypothesis and results from the skilled biased technological change literature (e.g., Berman et al. 1994, Machin 1996).

A two step estimation procedure

In this section we analyse the demand for immigrant workers in two steps: First, we estimate the probability of having immigrant workers or not using a binary probit procedure. From this we construct the inverse Mills ratios. Second, we estimate the wage shares of immigrant workers in total wage costs for those firms that employ immigrants, including the Mills ratios from step 1 as one of the explanatory variables.[7] Since all firms employ native workers, this group is left out in the following analyses.

Table 4.4 presents results from the estimations. The upper half presents first step estimates. The lower half includes second step estimates.

The probit estimates shows that the probability of employing non-western immigrants arrived as adults is lower for firms that use PC's intensively and for firms that give their workers a lot of autonomy. These results are supportive of the communication-biased technological change hypothesis. As the probit model is a nonlinear regression model, the parameters cannot be interpreted as marginal effects on the probability of employing the

[7] Ideally we should have one explanatory variable included in step 1, not included in step 2. However, it is generally hard to find a variable that affects the probability of employing immigrants, but not affects the share of immigrants in total wage costs. Therefore, we rely on structural form identification.

different work groups. To receive a measure on the marginal effects on the probability we must multiply the estimated parameter with ϕ; the standard normal density, evaluated at the mean of the sample. Taking the autonomy parameter for non-western adult immigrants as an example (-0.215); the belonging marginal probability coefficient equals approximately -0.10. This means that, a firm that gives a lot of autonomy to their employees (autonomy variable = 1) has approximately 10 percentage points lower probability of employing non-western adult immigrants compared to a firm that do not give their employee a lot of autonomy (autonomy variable =0).

Table 4.4. The demand for immigrant workers. Two step estimation procedure

	The probability of employing immigrants							
	Non-Western immigrants				Western immigrants			
	Adults		Children		Adults		Children	
	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err
PC	-0.608***	0.144	-0.105	0.142	-0.005	0.139	0.268*	0.153
Teams	-0.017	0.096	0.142	0.095	0.109	0.094	-0.057	0.102
Autonomy	-0.215**	0.104	-0.201**	0.104	0.145*	0.104	-0.210**	0.109
Multitasking	-0.108	0.119	0.204**	0.121	-0.038	0.118	-0.080	0.130
Job rotation	0.019	0.094	-0.053	0.095	-0.095	0.094	-0.225**	0.103
Log output	0.405***	0.051	0.296***	0.049	0.471***	0.051	0.374***	0.057
Log Capital	0.029	0.032	0.117***	0.031	0.022	0.032	0.097***	0.035
N	1088		1088		1088		1088	
	Wage shares							
	Non-Western immigrants				Western immigrants			
	Adults		Children		Adults		Children	
	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err
PC	-0.110***	0.019	-0.010*	0.006	0.013**	0.005	0.025***	0.006
Teams	-0.001	0.008	-0.009	0.004	-0.006	0.004	-0.002	0.004
Autonomy	-0.003	0.011	-0.010**	0.005	0.006*	0.004	-0.004	0.004
Multitasking	0.000	0.011	0.009*	0.006	0.008*	0.005	-0.003	0.005
Job rotation	-0.004	0.008	0.005	0.004	-0.004	0.004	0.0001	0.004
Log output	0.012	0.009	-0.001	0.004	0.007*	0.004	-0.001	0.003
Log Capital	-0.002	0.003	0.003	0.002	-0.004***	0.001	0.0001	0.001
λ	0.082***	0.041	0.041***	0.018	0.036***	0.015	0.052***	0.015
N	546		507		580		817	

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, ** per cent, * 10 per cent.

The Heckman lambdas' suggest that selection of workers to firms are characterised by systematic selection. All lambdas' are statistically significant. The second step estimates shows that the PC-variable is still negative and significant for non-western immigrants arrived as adults. However, the autonomy variable, albeit negative, is no longer statically significant. Regarding the non-western immigrants arrived as children, the second step estimates reveal

negative relationships between PC, autonomy and the share of wage costs. The latter relationship is in line with results in table 4.2.

The results in table 4.4 for non-western immigrants suggest that the binary employment-no employment decision in step 1 is important to understand the demand process for this group of workers. Firms relying on a decentralised structure of production (much autonomy) are less likely to employ non-western adult immigrants in the first place.

Hirings and separations

The wage shares are results of previous hirings and separations. In this section we analyse whether any of the observed wage share patterns can be explained by recent hirings or separations of different groups of workers. If part of the effect of new forms of work organisation goes through reduced hiring opportunities for non-western immigrants, the hirings shares of non-western immigrants should be systematically lower. On the other hand, if part of the effect goes through separations, we should expect the separation shares among non-western immigrants to be systematically higher. Based on the previous results that downsizing does seem to be of vital importance, this would come as somewhat of a surprise.

From the register data we have individual information on the timing of hirings and separations, and to which firm they belong. This information is used to construct hirings and separations shares at the firm level. We use information of hirings and separation from the previous three years (1995, 1996 and 1997 for the 1997 observation point, and 2001, 2002 and 2003 for the 2003 observation point).

The analyses in the following are limited to firms that are registered with hirings (N=1038) and separations (N=1062) during this period. Table 4.5 presents means values for hirings and separations for the five different worker groups.

Table 4.5. Descriptive statistics. Hirings and separations. Share of total number of hirings and separations. 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
Hirings (N=1038)	0.874	0.152	0.035	0.089	0.023	0.059	0.022	0.048	0.044	0.078
Separations (N=1062)	0.890	0.129	0.027	0.075	0.022	0.053	0.019	0.042	0.040	0.060

Note: The descriptives are limited to firms that are registered with hirings (N=1038) and separations (N=1062) during the last three years.

Natives constitute 87.7 per cent of the hirings and 89.2 per cent of the separations. All immigrant groups have larger shares among hirings than among separations. The difference is especially large for non-western adult immigrants.

Table 4.6 presents estimated coefficients from a random effect Tobit maximum likelihood procedure. The dependent variable is the share of new hires and separations in the specific work groups of all new hires and separations (the shares sum up to unity). The upper half of the table presents estimates of hirings. The bottom half presents estimates of separations.

The level of technology (measured by PC) affects positively the share of hired natives and negatives the share of all groups of immigrants (except western immigrants arrived as children). The same directions apply for separations. For native workers, the effect on hires seems to dominate. This will contributes to the observed positive relationship between PC and the wage cost share of natives reported in table 4.2. For non-western immigrants arrived as adults, the effect on hirings seems to be approximately of the same size as the effect on separations. For non-western immigrants arrived as children and western immigrants arrived as adults, the negative effect on hirings dominates the negative effect on separations.

Table 4.6. Hirings and separations for natives and immigrants. Random effect Tobit. Maximum likelihood procedure

	Hirings									
	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	0.109***	0.020	-0.162***	0.023	-0.055***	0.017	-0.039***	0.014	0.016	0.015
Teams	0.012	0.013	-0.003	0.015	-0.003	0.011	-0.008	0.009	0.0001	0.010
Autonomy	0.001	0.014	-0.028*	0.017	-0.056***	0.013	0.014	0.010	-0.012	0.011
Multi Tasking	0.011	0.016	-0.027	0.018	0.024*	0.014	0.014	0.011	-0.040***	0.013
Job rotation	-0.001	0.013	0.020	0.014	-0.001	0.011	-0.027***	0.009	0.020**	0.010
Log output	-0.015***	0.007	0.031***	0.008	0.007	0.006	0.027***	0.005	0.009*	0.005
Log Capital	-0.005	0.004	-0.009*	0.005	0.012***	0.004	-0.001	0.003	0.008***	0.003
Left cens obs.	3		705		729		698		531	
Right cens obs	332		1		0		0		2	
Log L	-24.10		-131.8		-38.9		-4.2		-21.8	
N	1038		1038		1038		1038		1038	
	Separations									
	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	0.071***	0.015	-0.152***	0.019	-0.028***	0.013	-0.013	0.011	0.004	0.010
Teams	0.001	0.010	-0.006	0.012	0.0001	0.008	-0.002	0.007	0.006	0.007
Autonomy	0.004	0.011	-0.025*	0.014	-0.035***	0.010	0.013*	0.008	-0.005	0.007
Multi Tasking	-0.022*	0.012	0.007	0.015	0.003	0.011	0.003	0.009	0.005	0.008
Job rotation	-0.007	0.010	0.013	0.012	0.007	0.008	0.001	0.007	0.009	0.007
Log output	-0.011**	0.005	0.041***	0.007	-0.002	0.004	0.026***	0.004	0.001	0.003
Log Capital	0.001	0.003	-0.015***	0.004	0.010***	0.003	-0.003	0.002	0.006***	0.002
Left cens obs.	1		733		693		677		462	
Right cens obs	302		0		0		0		0	
Log L	214.61		-27.1		58.3		142.73		317.2	
N	1062		1062		1062		1062		1062	

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, ** per cent, * 10 per cent.

Regarding the indicators of new work practices, for non-western child immigrants, we find a significant negative relationship between autonomy and hirings. The relationship for separations is also negative, but somewhat smaller. This result may partly explain the observed negative relationship between PC and the wage share costs of non-western child immigrants in table 4.2. New work practices (measured by the degree of autonomy) seem to affect non-western adult immigrants through reduced hiring opportunities.

5. Conclusions

Non-western immigrants have a weak position in the Norwegian labour market. The 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 immigrant arrived as children, western immigrants arrived as adults, non-western immigrants arrived as children, and non-western immigrants 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 costs 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 (arrived as adults). These results may add support to hypothesis that new technologies and some new work practices are biased against immigrant workers.

The skill-biased technological and organisational literature has presented results that suggest 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 immigrant, and protects against negative effects from new work practices. The result for 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 hypothesis saying 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. (2000). 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.

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