Is mobility of labour a channel for spillovers from multinationals to local domestic firms?*

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Abstract

This paper documents the extent of labour mobility from multinationals (MNEs) to non-MNEs in Norwegian manufacturing during the 1990s. On average, each year around one percent of workers in MNEs move to non-MNEs. By the year 2000, 45 percent of the non-MNEs employed workers with experience from MNEs. These workers earned a wage premium of more than 3 percent compared to their new colleagues in the non-MNEs. I estimate a Cobb-Douglas production function for non-MNEs and include the share of workers with recent MNE experience. Consistent with mobility being a channel for knowledge diffusion, I find that these workers contribute 20-25 percent more to productivity than workers without experience from MNEs. The difference between the private returns to mobility and the productivity effect at the plant level suggests that labour mobility from MNEs to non-MNEs represents a true knowledge externality.

Keywords: spillovers, labour mobility, linked employer-employee data, wages

JEL Classification: D24, F23, J31, J60

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1 Introduction

The empirical literature on knowledge spillovers from foreign direct investment to host country firms, treats the channels through which such spillovers may occur as a black box. The labour mobility channel for spillovers has been highlighted both in theoretical models (Fosfuri et al., 2001; Glass and Saggi, 2002), and in the empirical literature (for recent surveys of the empirical spillover literature, see Saggi, 2002 and Görg and Greenaway, 2004). The general approach of the empirical spillover literature is to regress a measure of domestic plant productivity on a measure of foreign presence at the industry level. When measuring foreign presence at the industry level it is not possible to capture the fact that domestic firms may have different links with foreign-owned firms. The more contact domestic firms have with foreign-owned firms, the more likely they are to benefit from spillovers. One type of contact with foreign-owned firms is to hire workers from these firms. I use linked employer-employee data to construct plant-specific measures for the share of workers in domestic plants with recent experience from multinationals. By using this measure of an explicit link between domestic and multinational firms in a productivity regression, I am able to go beyond the 'black box'-treatment of spillovers in the existing empirical literature. To the best of my knowledge, this is the first paper to use extensive linked employer-employee data to estimate the productivity effect of labour mobility from foreign to domestic firms in a host country.

In order for labour mobility to be a channel for spillovers from foreign to domestic firms, we would expect to observe the following: First, foreign-owned firms should have a firm-specific advantage that could be the basis for spillovers. A firm-specific advantage would give rise to extra profits in these firms. If firms share rents with their workers, observing a wage premium for workers in foreign-owned firms would be consistent with a potential for spillovers. Second, we should be able to document a nontrivial magnitude of foreign to domestic labour mobility. Third, domestic plants that hire workers with previous experience from foreign firms should benefit in terms of increased productivity. Fourth, the foreign to domestic movers should benefit from mobility in terms of their own wages, and their experience from foreign-owned firms should be valued by their new firms. In this paper, I use linked employer-employee data to assess the evidence on all four points for Norwegian manufacturing during the 1990s.

The existence of a firm-specific advantage combined with evidence of actual mobility can only suggest that a potential for spillovers through labour mobility does exist, while a productivity benefit at the plant level due to mobility is consistent with labour mobility actually working as a channel for spillovers. To what extent such spillovers can be regarded as an externality, and not only as knowledge diffusion through market transactions, cannot be determined from a positive productivity effect alone.[1] An assessment of the size of the productivity benefit together with information about the wage increase obtained by the mobile workers may indicate to what extent a possible spillover is an externality. If the productivity benefit at the plant level is larger than the wage premium granted to workers with experience from MNEs, the evidence is consistent with a knowledge externality.

Foreign-owned firms are thought to be a relevant source of spillovers because they are part of MNEs with firm-specific assets that can be transferred across borders within the firm (Dunning, 1981; Markusen, 1995). It has recently been argued that the firm-specific advantage hypothesis, which is thought to be a reason for firms becoming multinational, should apply equally to domestic multinationals of the host country (Doms and Jensen, 1998; Bellak, 2004). The argument implies that the potential for spillovers should primarily go from multinationals to purely local firms, regardless of whether a multinational is foreign or domestically owned. The empirical analysis in this paper will distinguish mainly between multinationals and local domestic plants, hereafter called MNEs and non-MNEs respectively.

As a first exercise to assess the potential for knowledge spillovers from MNEs to non-MNEs in Norwegian manufacturing, I look for evidence of a multinational advantage by estimating individual wage equations for manufacturing workers. I find a foreign MNE premium of 2,5% relative to non-MNEs, while Norwegian MNEs seem to give a wage premium only to workers with high education. The results are consistent with a potential for spillovers from MNEs to non-MNEs.

Little is known about the extent and pattern of labour mobility between foreign and domestic firms in a developed country, despite the frequent claim that it is a potential channel for spillovers.[2] Martins (2006) is the first to provide such evidence for a developed country, using a large panel of linked employer-employee data that covers virtually all firms and their employees in Portugal from 1986 to 2000. He finds relatively small labour flows between foreign and domestic firms. In this paper I focus only on labour mobility within manufacturing. Partly because labour mobility between manufacturing and other sectors of the economy is likely to be lower than mobility within the manufacturing sector, and partly

[1] Møen (2005) argues that if the hiring firm pays wages according to the marginal productivity of the new employee, a productivity benefit in the hiring firms is not an externality.

[2] Some case study evidence of foreign to domestic mobility in developing countries exists, see references in Saggi (2002) and Görg and Strobl (2005).

because knowledge acquired in other sectors may be of limited relevance in manufacturing. I find that on average, each year around 1% of workers in MNEs leave to join a non-MNE. However, this translates into a growing percentage of workers in non-MNEs with experience from MNEs. In the year 2000 15% of workers in non-MNEs had experience from MNEs, while 45% of non-MNEs in 2000 employed one or more workers with MNE experience, up from 18% in 1995. Thus, from the perspective of non-MNEs, labour mobility from MNEs seems to be large enough to play a role as a channel for spillovers in Norway, at least during the second half of the 1990s.

Given the extent of mobility from MNEs to non-MNEs, I proceed to estimate the effect of this mobility on the productivity of non-MNEs. Previously, this has only been examined empirically by Görg and Strobl (2005), who use firm level data for a sample of manufacturing plants in Ghana. They find that firms whose entrepreneurs worked in multinationals in the same industry prior to joining or setting up their own firm are more productive than other firms, while experience from multinationals in a different industry has no effect on firm productivity. In contrast to the data from Ghana, I can determine the recent work history of all workers in non-MNEs. I include annual plant level measures of the share of workers with recent MNE experience in a Cobb-Douglas production function. Based on an interpretation provided by Griliches (1967, 1986), I find that workers with MNE experience contribute 20-25% more to total factor productivity than workers without experience from MNEs. This result is consistent with the idea that labour mobility from MNEs to non-MNEs is a channel for spillovers.

When looking at the wages of movers compared to colleagues with similar characteristics in their new plant, I find that movers from MNEs to non-MNEs with more than 3 years' experience from MNEs receive a wage premium of almost 5% compared to stayers in non-MNEs. Thus experience from MNEs is clearly valued in non-MNEs. For movers in the other direction there is no such wage premium. These results are consistent with mobility from MNEs to non-MNEs being a potential channel for spillovers. The difference in the private returns to mobility for movers from MNEs to non-MNEs and the productivity effect these movers have at the plant level, suggest that the hiring non-MNEs do not fully pay for the value of these workers to the firm. Hence, labour mobility from MNEs to non-MNEs seems to be a source of knowledge externality in Norwegian manufacturing.

The remainder of this paper is structured as follows. Section 2 presents the data sources, followed by the empirical results regarding multinational wage premia in Section 3. Section 4 contains descriptive evidence of labour mobility from MNEs to non-MNEs in Norwegian manufacturing and Section 5 investigates whether non-MNEs that hire workers with MNE experience benefit in terms of productivity. Section 6 asks whether movers benefit from mobility in terms of wages, while Section 7 concludes.

2 Data

I use four different annual data bases for the years 1990-2000, all of which are censuses that can be linked to each other by firm or plant identifiers. All the data sources are administered by Statistics Norway. The starting point is the Norwegian Manufacturing Statistics, which is collected at the plant level. From the Manufacturing Statistics, I use information about production, input use, investment and industry classification (ISIC Rev. 2). As the main aim of the paper is to include measures of labour mobility into a plant level productivity framework, plants with insufficient information to calculate a measure of total factor productivity are excluded from the analysis. After this cleaning the remaining data still contains around 90% of manufacturing output and employment.[3]

In order to classify plants as MNEs or non-MNEs, I combine information obtained from the record of foreign ownership of equity in Norwegian firms (the so-called SIFON-register), and information from the register of outgoing foreign direct investment (FDI) from Norway. Both registers can be linked to the Manufacturing Statistics with firm identifiers. The SIFON-register contains information about the value and shares of equity owned by foreign interests, as well as the nationality of the largest owners.[4] The register of outward FDI contains information about shares and votes in operations abroad controlled by Norwegian firms, country of operation and a number of financial transactions between the owner in Norway and the operation abroad.[5] For the purpose of classifying plants as MNEs or non-MNEs, I use the information on the shares of equity in Norwegian firms owned by foreigners from the SIFON-register, and the shares of equity in firms abroad owned by firms in Norway. I define a Norwegian MNE as a firm that is not itself majority owned from abroad, while it has direct ownership shares of more than 20% in operations abroad. A foreign MNE is more than 20% foreign owned and at the same time not classified as a Norwegian MNE.

[3]For more detailed descriptions of the Norwegian Manufacturing Statistics, see Halvorsen et al. (1991) and Møen (2004).

[4]See Simpson (1994) for more details about the SIFON-register.

[5]The register of outgoing FDI has hardly been used for research so far. Grünfeld (2005) uses this database to give an overview of foreign activities of firms based in Norway.

Finally, I link the administrative files containing the whole population of residents aged 16-74 to the plant level data. The administrative files contain, among other things, information on age, gender, identification of the current employer, weekly work-hours, annual earnings, start and end dates for the current employment spell and detailed education codes.[6] Weekly work-hours are recorded as a categorical variable in 4 groups, with the longest work-hours being 30 hours or more per week. I use only workers that are recorded as working 30 hours or more per week, and call these workers full-time workers (more than 90% of workers are full-time workers). As a proxy for wages, I use the recorded earnings variable in the data, where earnings are measured as annual taxable labour income.[7]

Table 1: Foreign and domestic plants and workers

	Number of plants			Mean empl.			Full-time workers		
	1	2	3	1	2	3	1	2	3
1990	5,211	249	216	27	83	179	141,435	20,634	38,719
1991	4,849	362	218	26	97	163	124,921	35,038	35,607
1992	4,739	390	240	25	96	161	119,181	37,474	38,677
1993	4,411	435	240	23	102	165	102,155	44,439	39,600
1994	4,455	497	219	24	92	177	106,481	45,742	38,815
1995	4,389	482	220	24	102	160	107,243	49,248	35,108
1996	4,296	512	203	24	103	151	101,375	52,715	30,651
1997	4,353	531	179	26	104	156	111,495	55,465	27,958
1998	4,282	639	159	26	94	179	111,109	60,254	28,384
1999	4,156	681	177	26	92	166	107,958	62,407	29,428
2000	3,923	689	215	26	88	128	100,231	60,615	27,421

Notes: 1=Non-MNE; 2=Foreign MNE; 3=Domestic MNE

Table 1 shows the total number of matched plants and full-time workers by type of plant. The total number of manufacturing plants decreased from 5 200 in 1990 to 3 900 in 2000, and the total number of full-time workers went down from around 200 000 in 1990 to below 190 000 in 2000. While the number of Norwegian MNEs and non-MNEs and the number of workers in these plants declined from 1990 to 2000, the number of foreign MNEs and the number of workers in foreign MNEs tripled during the same period. Plants of Norwegian MNEs are substantially larger in terms of the average number of workers

[6]See Salvanes and Førre (2003) for a general description of the Norwegian linked employer–employee data sets, see also Møen et al. (2004) for documentation.

[7]For the analysis of wages in Sections 3 and 6 I drop 135 000 individual observations (6% of the sample), where the recorded earnings are considered too low for a regular full time earning. I set this threshold to be below 12 000 NOK per month in 2001 prices. Dropping these low-wage observations does not affect the results.

than plants of foreign MNEs.

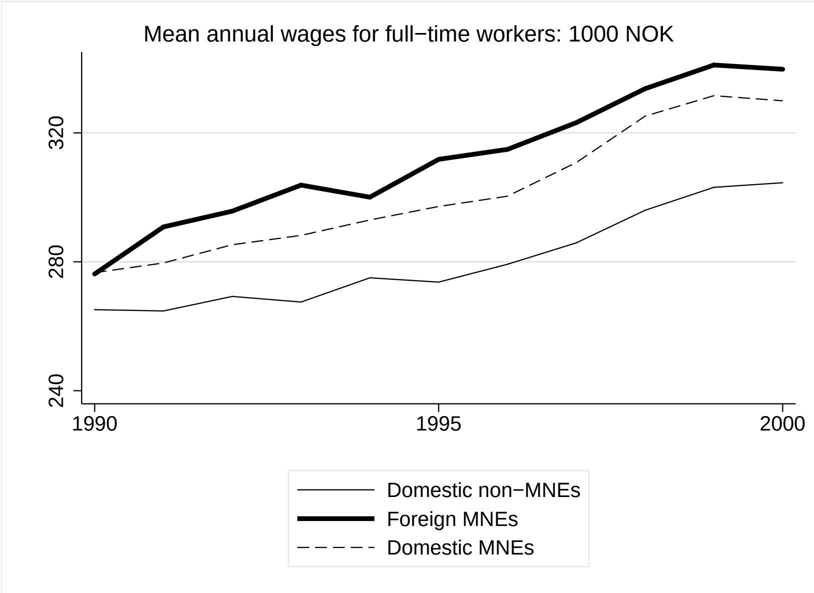
3 Is there a multinational wage premium?

A potential for spillovers from MNEs to non-MNEs requires that the local firms have something to learn from MNEs. One piece of evidence that would suggest such a potential is that MNEs pay higher wages than non-MNEs. Through on-the-job-experience (or training), workers in MNEs may get access to part of the MNE's superior technology, and bring valuable knowledge with them to a new employer. They may also set up a competing business. In order to prevent such spillovers, the MNE may pay a wage premium to reduce labour mobility, as discussed in the theoretical models of Fosfuri et al. (2001) and Glass and Saggi (2002). In these models the MNE shares rents with its workers. MNEs may also pay a wage premium because they are able to share rents across borders (Budd and Slaughter, 2004). Other explanations for the wage premium are that it is a compensation for a higher probability of plant closure (Bernard and Sjöholm, 2003), or higher labour demand volatility (Fabri et al., 2003). Both these hypotheses of compensating differentials are consistent with the existence of a foreign wage premium, but do not necessarily imply that the MNE has a firm-specific advantage that could be the basis for spillovers.[8]

For Norwegian manufacturing there are clear differences in unconditional mean wages between non-MNEs, domestic MNEs and foreign MNEs, see Figure 1. The difference between non-MNEs and foreign MNEs is around 10%. From Table 2 we see that domestic MNEs have on average more employees than foreign MNEs, and both types of MNEs are substantially larger than non-MNEs. In terms of labour productivity and wages, the domestic and foreign MNEs are relatively similar and both types of MNEs have higher productivity and wages than non-MNEs. In terms of mean age, experience and years of education of the workers, the three groups of plants seem very similar, though education levels are slightly higher in MNEs than in non-MNEs. The biggest difference is found in the length of tenure, where the Norwegian MNEs have considerably longer mean tenure

[8]Several papers investigate the extent of so-called wage-spillovers. Foreign direct investment by high productivity firms might lead to increased wages by affecting labour demand directly, but there could also be an indirect effect through knowledge diffusion. As noted by Aitken et al. (1996), labour turnover and knowledge diffusion should eventually increase wages also in domestic firms and thus reduce or eliminate the foreign wage premium (see also Barry et al., 2005). Indirect evidence of knowledge diffusion through wage-spillovers is found for the US (Aitken et al., 1996) and the UK (Girma et al., 2001; Driffield and Girma, 2003), while Aitken et al. (1996) find zero or even negative wage-spillovers for Venezuela and Mexico. As these studies do not follow workers between plants, they cannot say whether labour mobility played any role in facilitating the wage-spillovers.

Figure 1: Wages in MNEs and non-MNEs



(9.3 years) than both foreign MNEs (8 years) and domestic non-MNEs (7.3 years). The main reason for this difference is likely to be the age of the plants; the larger Norwegian MNEs are likely to be older than the other groups of plants. The mean tenure of foreign MNEs is to some extent affected by the recent entry of many of these plants.

When using plant level data for average wages it is a common finding that foreign firms pay higher average wages than domestically owned firms, and that the foreign wage premium is larger in developing countries than in developed countries.[9] In many plant level datasets it is not possible to control for the quality of the labour force when estimating the foreign wage premium, thus part of the wage premium may be due to foreign firms using more skilled labour than domestic firms. Studies of foreign wage premia using individual wage data typically find smaller wage premia than studies using only plant level average wages. This result suggests that part of the plant level premium can be explained by skill composition.

I estimate wage premia and control for both plant and individual observable characteristics in the following wage regression:

$$w_{ijt} = \beta_0 + \beta_1 D_{jt} + X'_{ijt}\beta_2 + F'_{jt}\beta_3 + e_{it}, \tag{1}$$

[9] Aitken et al. (1996) provide evidence for Mexico, Venezuela and the United States. Lipsey and Sjøholm (2004) provide evidence for Indonesia, and evidence of foreign wage premia in UK manufacturing are found by Conyon et al. (2002), Girma et al. (2001) and Griffith and Simpson (2003).

Table 2: Worker and plant characteristics: Means of annual values 1990-2000

	Non-MNEs		Foreign MNEs		Domestic MNEs	
	Mean	Sd	Mean	Sd	Mean	Sd
Real monthly wage	23,513	13,078	26,631	11,580	25,102	15,182
Tenure	7.33	6.10	7.95	6.48	9.28	6.56
Experience	22.23	12.72	22.36	12.34	22.55	12.59
Age	40.08	11.74	40.59	11.26	40.72	11.52
Years of schooling	10.54	2.37	10.92	2.74	10.87	2.56
Plant size	30.39	68.65	106.23	185.59	164.14	234.85
Labour Productivity	1224	1635	2068	8299	1817	1363
Skill share	0.36	0.22	0.44	0.21	0.39	0.19
Female share	0.27	0.23	0.24	0.20	0.27	0.22
Worker/Plant obs.	1,215,480/48,820		516,450/5,450		365,390/2,270	

Notes: Experience=age-years of education-7, labour productivity is real output per employee, skill share is share of workers with more than 11 years of education.

where w_{ijt} is the log real wage of worker i employed in firm j at time t, X_{ijt} is a vector of observable individual characteristics and F_{jt} is a vector of observable plant characteristics, while e_{it} is an idiosyncratic error term. The main variable of interest is D_{jt}, which is a dummy indicating the status of the plant.

Table 3 reports the results from estimating equation (1) with OLS for Norwegian manufacturing workers. In the upper part of the table, I analyse wage differences between foreign and domestic plants. D_{jt} is a dummy for foreign ownership. The lower part of the table shows results for wage differences between MNEs and non-MNEs. In this case, the foreign ownership dummy is replaced by 2 dummies, one indicating whether the plant is a domestic MNE and the other indicating whether the plant is a foreign MNE. Columns 1-5 show results using the full panel with additional sets of control variables in each column. By comparing results in Columns 2, 3 and 4 of Table 3, we can see that differences in observable plant characteristics are more important than the observable individual characteristics of workers. The foreign wage premium is reduced by almost 50% between Column 2 and Column 3, and only plant characteristics account for the difference between these columns. Adding individual characteristics in Column 4 has hardly any further effect on the wage premium.

Column 6 shows the result from the model in Column 5, when the estimating sample includes only individuals with less than 11 years of education. The result in Column 7 is for individuals with more than 15 years of education. The unconditional foreign wage

Table 3: Wage premia in foreign owned plants and in multinationals

	1	2	3	4	5	Low educ.	High educ.
Dependent variable is log individual wage							
Foreign dummy	.107***	.061***	.033***	.031***	.023***	.022***	.022***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.004)
Year dummies	yes	yes	yes	yes	yes	yes	yes
28 3-digit ISIC dummies	no	yes	yes	yes	yes	yes	yes
Plant characteristics	no	no	yes	yes	yes	yes	yes
Individual characteristics	no	no	no	yes	yes	yes	yes
Labour productivity	no	no	no	no	yes	yes	yes
N	2,092,,413	2,092,413	2,092,413	2,092,413	2,092,413	1,014,127	80,382
R-sq	.062	.156	.203	.398	.402	.329	.338
Dependent variable is log individual wage							
Foreign MNE dummy	.107***	.061***	.036***	.034***	.025***	.023***	.033***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.005)
Domestic MNE dummy	.073***	.050***	.012***	.008***	-.002	-.003*	.016*
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.006)
Year dummies	yes	yes	yes	yes	yes	yes	yes
28 3-digit ISIC dummies	no	yes	yes	yes	yes	yes	yes
Plant characteristics	no	no	yes	yes	yes	yes	yes
Individual characteristics	no	no	no	yes	yes	yes	yes
Labour productivity	no	no	no	no	yes	yes	yes
N	2,092,,413	2,092,413	2,092,413	2,092,413	2,092,413	1,014,127	80,382
R-sq	.059	.156	.203	.398	.403	.329	.338

Notes: Plant characteristics are log(number of employees) and its square, share of female workers, share of workers with more than 13 years of education, log(capital per unit of output). Individual characteristics are education in years, a quadratic in tenure, a quartic in experience (age minus education minus 7) and a gender dummy. Labour productivity is log(output per employee). The low education sample consists of workers with less than 11 years of education, high education corresponds to more than 15 years of education. ***, **, *= significant at 0.1, 1 and 5%, respectively. Standard errors clustered on individuals in parentheses premium is around 10% in Column 1, and falls to 2.3% in Column 5 after adding industry dummies, plant and individual characteristics. This is comparable to the 2% premium found by Heyman et al. (2004) for Sweden in a very similar regression, while for Portugal, Martins (2004) finds a foreign wage premium of around 10% when controlling for both individual and plant characteristics. An interesting feature in the lower part of Table 3 is that domestic MNEs have lower wage premia than foreign MNEs. When controlling for both plant and individual characteristics in Column 5, there is no wage premium in domestic MNEs while foreign MNEs have a premium of 2.5%.[10] This contrasts the findings of Heyman et al. (2004), who find no significant difference in wage premia between foreign and domestic MNEs, and find a wage premium of 5% for foreign MNEs relative to non-MNEs in Sweden. In Columns 6 and 7 of Table 3, we can see that foreign MNEs pay higher wages than non-MNEs to both educational groups, while domestic MNEs only have a significant premium for the high education group. This premium is about half the size of that in foreign MNEs.[11]

The wage regressions in Table 3 do not control for unobserved individual or firm-fixed effects. The results are therefore likely to be affected by omitted variable bias. On the one hand, if MNEs to a larger extent tend to select 'better' workers along unobserved dimensions, this may explain part of the wage premium. On the other hand, if MNEs systematically select better workers than non-MNEs, they may also be able to use their human resources more efficiently. And the demand for 'good' workers may be connected with their MNE status. In addition, foreign MNEs may perform better along unobserved plant dimensions that increase their ability to pay higher wages. The results in Table 3 indicates that to control for observable plant characteristics has more effect on the wage premium than to control for observable individual characteristics. Therefore it is likely that the remaining wage premium is partly due to unobservable plant effects connected with MNE status. This is consistent with the wage premium indicating a potential for spillovers from this group of plants.

[10] The results in Table 3 are not changed if we include interactions of year and 2-digit industry dummies.

[11] Comparable OLS regressions using plant level average wages as the dependent variable show a somewhat higher wage premium of 5% for foreign plants when controlling for plant characteristics, labour productivity, year and industry dummies. Similar to the individual wage regressions, if we replace the foreign dummy with separate dummies for foreign and domestic MNEs, there is no significant domestic MNE wage premium, while the foreign MNE premium is 4.5%.

4 The extent of labour mobility

In the matched panel from 1990 to 2000 we observe in total about 450 000 individuals working in manufacturing plants. Most of these individuals stay in the same plant all the years they are observed in a manufacturing industry, but around 20% of the workers change plants within manufacturing and generate around 110 000 incidents of plant change. Table 4 shows that almost 45% of these plant changes occur between non-MNEs. For the group of workers with low education this percentage is 48%, while only 27% of the job changes among the university educated workers occur between non-MNEs. For the university educated, the largest share of plant moves (39%) occurs between MNEs.[12] The flows of workers between MNEs and non-MNEs are roughly equal in both directions for all types of workers, thus the potential for spillovers through labour mobility seems equally large in both directions.

Table 4: Direction of mobility for incidents of plant change

		Education		
	All	1	2	3
Between non-MNEs	44.86	48.56	43.22	27.10
From non-MNE to MNEs	16.51	16.29	16.72	17.10
From MNE to non-MNEs	13.43	12.45	14.29	16.29
Between MNEs	25.20	22.70	25.77	39.51
Total moves (=100%)	110,377	61,736	39,431	9,210

Notes: 1=Non-technical education; 2=Vocational/technical education; 3=University education.

Table 5 shows for each of the three groups of plants (non-MNEs, foreign MNEs and domestic MNEs) where workers that were employed in t-1 are found the following year. This indicates the size of the mobility flows relative to the size of the plants. Concentrating on the columns for workers with low education, we see that on average 77.3% of the workers in non-MNEs with low education are employed in the same plant from one year to the next. A total of 80% of these workers are still found within manufacturing. The remaining 20% not accounted for in the table have left manufacturing for jobs in other sectors, are out of the labour force or unemployed. Mobility is slightly lower in foreign and domestic MNEs

[12] I have divided the workers into 3 groups based on detailed educational codes from Statistics Norway. Group 1, the low-education group, includes individuals with missing education code and workers that have completed up to 1 year of education after compulsory schooling. In addition, this group includes workers with completed high school without technical fields. Group 2 includes workers with technical/vocational education at the high school level, while group 3 includes workers with university education.

than in non-MNEs, 80.7% of low education workers in domestic MNEs continue in the same plant from one year to the next. The lower mobility in MNEs is likely to be connected to the size of the plants, as bigger plants have more of an internal labour market, and also a lower probability of exit. The lower mobility in domestic MNEs correspond to the longer tenure in these plants compared to non-MNEs, as revealed in Table 2. Workers with university education are substantially less mobile than workers with lower education. On average, around 85% of workers with university education stay in the same plant from one year to the next. This might indicate that workers with high education accumulate plant specific human capital to a larger extent than other workers.

Table 5: Within manufacturing mobility: Mean of annual values 1991-2000

	Low education		Vocational		University	
	N_t	% of N_{t-1}	N_t	% of N_{t-1}	N_t	% of N_{t-1}
Workers in non-MNEs in year t-1, are in year t found in:						
Same Plant	65,527	77.3	26,139	80.7	4,351	86.0
Non-MNE	1,681	2.0	983	3.0	141	2.8
Domestic MNE	192	0.2	110	0.3	28	0.6
Foreign MNE	358	0.4	282	0.9	57	1.1
% of N_{t-1} in manufacturing		80.0		84.9		90.5
Workers in foreign MNEs in year t-1, are in year t found in:						
Same Plant	23,106	78.7	12,241	81.8	3,699	85.4
Foreign MNE	317	1.1	223	1.5	90	2.3
Non-MNE	267	0.9	231	1.5	58	1.3
Domestic MNE	74	0.3	62	0.4	28	0.7
% of N_{t-1} in manufacturing		81.0		85.1		89.7
Workers in domestic MNEs in year t-1, are in year t found in:						
Same Plant	17,944	80.7	9,278	84.2	2,284	85.0
Domestic MNE	353	1.5	290	2.7	76	2.9
Non-MNE	115	0.6	100	0.9	31	1.1
Foreign MNE	112	0.5	92	0.8	33	1.2
% of N_{t-1} in manufacturing		83.3		88.6		90.2

Table 5 also indicates the presence of 'internal labour markets' within the group of multinational plants, in particular for domestic MNEs. On average 719 workers move from domestic MNEs to other domestic MNEs each year, while only 246 move from domestic MNEs to non-MNEs .[13] This gives a ratio of almost 3 movers from domestic MNEs to other

[13]From the lower part of Table 5 we find 719 by adding 353+290+76 from the row indicating movers to

domestic MNEs for each mover to a non-MNE. A rather different ratio from the average of less than 1 worker in domestic MNEs per 3 workers in non-MNEs, which can be calculated from Table 1. Movers from foreign MNEs spread evenly between other foreign MNEs and non-MNEs, with a ratio of approximately 1.1. Hence, workers in domestic MNEs tend to move within this group of plants to a much larger extent than their share of workers would suggest. This tendency is not so pronounced for movers from foreign MNEs.[14] One explanation for this feature is that domestic MNEs are more likely to be part of multi-plant firms, with workers moving between plants within the firm.

Table 6: Workers in non-MNEs with experience from MNEs

	All	Education		
		1	2	3
1995				
Experience from MNE	5.9	5.2	7.4	7.9
Experience from domestic MNE	2.8	2.3	3.7	4.0
Experience from foreign MNE	3.2	2.9	3.7	4.1
Total workers	113,862	77,422	32,144	4,296
2000				
Experience from MNE	15.1	12.4	19.2	22.1
Experience from domestic MNE	6.1	4.9	7.5	9.9
Experience from foreign MNE	10.4	8.4	13.4	15.3
Total workers	107,502	68,959	26,617	11,926

Notes: Numbers in percent. 1 = Non-technical education;
2 = Vocational/technical education; 3 = University degree

From Table 5 we find that on average, each year around 800 workers in MNEs move to non-MNEs.[15] This only accounts for about 1% of the workers in MNEs, cf. Table 1. This may suggest that the potential for knowledge diffusion is small. MNEs are far larger than non-MNEs, however. The mobility flows from MNEs may therefore look more important from the perspective of non-MNEs. Table 6 shows the percentage of workers in non-MNEs in 1995 and 2000 with recent experience from MNEs. Recent MNE experience is defined as having worked in an MNE for one or more of the last three years. Thus, a worker must have worked in a multinational for one or more of the years 1997-1999 to be counted

domestic MNEs, similarly we find 249 by summing along the row of movers to non-MNEs.

[14]Martins (2006), in his study of foreign to domestic labour mobility in Portugal, finds similar evidence of 'internal labour markets' within the group of foreign firms.

[15]We reach this number by summing along the row indicating movers from foreign MNEs to non-MNEs (267+231+58), and by summing along the row of movers from domestic MNEs to non-MNEs (115+100+31).

as having MNE experience in 2000. In 1995 only 5.9% of the workers in non-MNEs had experience from MNEs, and this was roughly equally divided between foreign and domestic MNE experience. In 2000 15.1% of workers in non-MNEs had experience from MNEs, the majority from foreign MNEs. The percentage of workers with experience from domestic and foreign MNEs respectively, do not sum to the percentage of workers with overall MNE experience (15.1%), because some of the workers may have experience from both types of MNEs. The largest increase in the incidence of MNE experience has come in the group of workers with university education. 22.1% of these workers had recent experience from MNEs in 2000, the majority with experience from foreign MNEs.

Table 7 shows the percentage of non-MNEs in 1995 and 2000 that employed workers with recent experience from MNEs. When comparing Tables 6 and 7 we see that although the percentage of workers with recent MNE experience is small, the percentage of plants employing such workers is much larger, 17.9% in 1995 (against 5.9% of workers) and 45.2% in 2000 (against 15.1% of workers). While at the individual level, the share of workers with MNE experience among the university educated in 2000 is larger than for the other groups, the picture is the opposite at the plant level. The percentage of plants that employ university educated workers with experience from MNEs is only 14.2% in 2000, while the share of university educated workers with MNE experience is 22.1%. Hence it is a rather small subset of non-MNEs that employ workers with university education.

Table 7: Non-MNEs employing workers with MNE experience

	All	Education		
		1	2	3
1995				
Experience from MNE	17.9	11.6	10.4	3.1
Experience from domestic MNE	8.0	4.6	4.6	1.5
Experience from foreign MNE	12.8	8.2	6.9	1.9
2000				
Experience from MNE	45.2	33.3	25.5	14.2
Experience from domestic MNE	24.7	15.6	12.2	6.7
Experience from foreign MNE	37.6	26.3	20.7	10.7

Notes: Numbers in percent. 1 = Non-technical education; 2 = Vocational/technical education; 3 = University degree

5 Productivity spillovers through labour mobility?

The evidence presented in Section 4 shows relatively small mobility flows. However, in terms of the potential for mobility to generate spillovers that affect plant productivity, the interesting issue is how the workers with MNE experience spread across the group of non-MNEs. The previous section also showed that during the 1990s there was a growing and fairly substantial percentage of plants that employed workers with previous experience from MNEs. I now proceed to investigate whether labour mobility gives rise to productivity effects at the plant level.

The empirical spillover literature surveyed by Görg and Greenaway (2004) has looked for evidence of productivity spillovers from foreign to domestic firms by regressing a measure of domestic plant productivity on a number of covariates, including a measure of foreign presence in the industry or region. As argued by Görg and Strobl (2005), this approach treats the channels through which spillovers may occur as a black box. A measure of foreign presence at the industry level is not able to capture the fact that firms within the same industry have different degrees of contact with foreign firms.[16] Domestic firms with explicit contacts with foreign firms may be the most likely to benefit from knowledge diffusion. Examples of contacts between foreign and domestic firms could, in addition to labour mobility, be technology licensing, R&D cooperation, or exchange of intermediate inputs. Unfortunately, information at the firm or plant level on such links between MNEs and non-MNEs is rarely available.[17] Görg and Strobl (2005) use information on whether the owners of domestic firms have previous experience from MNEs, and this firm-specific link between domestic firms and multinationals has a positive effect on the productivity of domestic firms in their sample of manufacturing firms from Ghana.

With the Norwegian data I am able to construct plant-specific measures for the shares of workers in non-MNEs with recent experience from MNEs, and I include this measure in a Cobb-Douglas production function. The interpretation of the coefficient on the share of workers with MNE experience is based on Griliches (1967). He argues that in a Cobb-Douglas production function one could ask whether different types of labour are equally

[16]If foreign presence is measured in the same industry as the domestic plants are located, this measure picks up intra-industry (also called horizontal-) spillovers (see e.g. Haddad and Harrison ,1993; Aitken and Harrison, 1999; Keller and Yeaple, 2002; Kinoshita, 2001). Regressions that include foreign presence in upstream or downstream industries from the domestic plants pick up inter-industry (also called vertical-) spillovers (Kugler, 2006; Smarzynska-Javorcik, 2004).

[17]Studies that find evidence consistent with spillovers through vertical linkages (e.g. Smarzynska-Javorcik, 2004) use aggregate input output tables to generate the variables representing the links between foreign and domestic firms, but these are not firm specific links.

'potent' in generating productivity growth.[18] I apply this idea to labour with recent experience from MNEs (L_M) and labour without such experience (L_N). Under the spillover hypothesis, we would expect that L_M should be weighted by a positive 'premium' δ in the production function. With two types of labour in the production function, effective labour L^* is

$$L^* = L_N + L_M(1+\delta) = L(1+\delta s),$$

where $s = L_M/L$ is the share of labour with MNE experience in the total use of labour, $L = L_N + L_M$. Given a Cobb-Douglas production function $Y = (K)^{\beta_K}(M)^{\beta_M}(L^*)^{\beta_L}$, the $\beta_L \ln L^*$ term in its log linearized version can be approximated by $\beta_L \ln L + \beta_L \delta s$, and we can estimate the following production function

$$\ln Y_{it} = \beta_K \ln K_{it} + \beta_M \ln M_{it} + \beta_L \ln L_{it} + \beta_L \delta s_{it} + \upsilon_i + \upsilon_t + \varepsilon_{it}. \quad (2)$$

In equation (2) $\ln Y$, $\ln K$, $\ln M$, and $\ln L$ are the natural logs of output, capital, material and hours in plant i, year t.[19] s_{it} is the share of workers that have experience from MNEs, υ_i and υ_t are plant and time fixed effects. When constructing the measures of s_{it}, I require the MNE experience of workers in non-MNEs to be relatively recent, i.e. for a worker to be counted as having MNE experience in year t, the worker had to work in a multinational for one or more of the years $t-3$ to $t-1$.[20] Since β_L is estimated separately, the combined $\beta_L \delta$ term can be used to compute the δ term.[21]

Table 8 presents results of estimating equation (2) with plant fixed effects on the sample of non-MNEs. 28 industry dummies corresponding to ISIC 3-digit level and year dummies are added in all regressions. In Column 1, s_{it} is the share of workers in the plant with recent experience from both foreign and domestic MNEs. The coefficient on the share of workers with MNE experience is positive and significant. We can calculate the implied δ

[18] Griliches (1986) applies this idea to different types of R&D expenditure.

[19] For variable construction, see the variable definitions in the Appendix.

[20] This corresponds to the definition of recent MNE experience used in Tables 6 and 7 in Section 4.

[21] L is measured as total man-hours in the plant. This variable is from the Manufacturing Statistics. The share of workers with MNE experience is constructed from the matches between fulltime workers from the employee data and plants in the Manufacturing Statistics. The use of L together with the share s means that I assume that the share of matched workers with MNE experience approximates the share of hours by workers with MNE experience. At the aggregate manufacturing level the match of individuals to plants generates total manufacturing employment that corresponds to what we would get by using the employment information from the Manufacturing Statistics. At the plant level, the employment correspondence is more variable, thus I prefer to use the hours variable from the Manufacturing Statistics in the production function rather than constructing labour input from the number of individuals that I match to the plant level data.

from the fixed effect results in Column 1 by combining the estimated coefficient on labour and the coefficient on the share of workers with MNE experience. The implied δ for workers with MNE-experience is found at the bottom of Column 1. $\delta = 0.27$, which means that workers with experience from MNEs contribute on average 27% more to the total factor productivity of the plant than workers without such experience. The effect is significant at the 5% level.[22] In Column 2, the measure of MNE experience is split into two parts; the shares of workers with experience from foreign and domestic MNEs, respectively. In this case both coefficients are positive, but not significant. More than 30% of plants that employ workers with domestic MNE experience also employ workers with foreign MNE experience, and this makes it difficult to identify the separate effects of foreign and domestic MNE experience. In Column 3, the workers with MNE experience are split by education, this time only the small group of university educated individuals is distinguished from the rest. In this case, only the coefficient on the largest group of workers with MNE experience, those without university education, is significant.

The way I have constructed the measure for the share of workers with MNE experience implies that this measure captures the newly hired employees with MNE experience in the plant, where newly hired means hired in year t, t-1 or t-2. If workers that change plants in general are better than stayers, the productivity premium found for newly hired workers with MNE experience may also apply to other newly hired workers. In Column 4 of Table 8 I check whether the productivity premium found for workers with MNE experience is an effect of newly hired workers in general being more productive than workers who have been longer in the plant. I do this by repeating Column 1 with the addition of a measure for the share of newly hired workers without MNE experience. The result clearly shows that there is a difference in the productivity premium connected with newly hired workers, depending on whether they do, or do not have, MNE-experience. The result for newly hired workers with MNE experience is more or less the same as in Column 1, with an implied productivity premium of 28%. In contrast, the implied productivity premium for newly hired workers without MNE experience is around 7%, and only significant at the 10% level.

I have estimated equation (2) by dropping 2-digit sectors one by one. The estimated coefficient on the share of workers with MNE experience is in all cases of the same order of magnitude as in Column 1 of Table 8. It is also significant at the 5% level in all cases except when I drop the machinery and equipment industry. In that case the coefficient on the

[22] Including the interaction of year dummies and 9 2-digit industry dummies does not change the direction of the result in Column 1. The implied δ falls to 23%, but is significant at the 5% level.

Table 8: Share of workers with MNE experience and plant productivity

Dependent variable: Log(Output)				
	1	2	3	4
Share of workers with MNE-exp.	.096*			.099**
	(.037)			(.037)
Share of workers with foregin MNE-exp.		.069		
		(.037)		
Share of workers with domestic MNE-exp.		.115		
		(.078)		
Share with MNE-exp. and low education			.100**	
			(.038)	
Share with MNE-exp. and high education			.038	
			(.175)	
Share of new workers without MNE-exp.				.027
				(.014)
Log(Capital)	.053***	.053***	.053***	.053***
	(.004)	(.004)	(.004)	(.004)
Log(Materials)	.507***	.507***	.507***	.507***
	(.007)	(.007)	(.007)	(.007)
Log(Hours)	.355***	.355***	.355***	.354***
	(.008)	(.008)	(.008)	(.008)
N	33,405	33,405	33,405	33,405
R-sq	.83	.83	.83	.83
δ (MNE-exp.)	.270*			.280**
	(.107)			(.107)
δ (without MNE-exp.)				.076
				(.040)

Notes: All regressions include year dummies and 28 industry dummies. ***, **, *= significant at 0.1, 1 and 5%, respectively. Standard errors clustered on plants in parentheses.

share of workers with MNE experience is significant at the 10% level. This suggests that the spillover effect from labour mobility is particularly strong in the Norwegian machinery and equipment sector. This is the largest manufacturing sector in Norway and employs around 35% of all manufacturing workers.

Table 9 includes the results for the estimated coefficient on the share of workers with MNE experience (cf. Column 1 of Table 8) from a number of different robustness checks. All regressions are estimated using the fixed effects (within effects) method. The first six rows of Table 9 repeat different variations of the regression presented in Column 1 of Table 8. The first two rows add control variables that are commonly used in the empirical literature on spillovers from FDI. These include foreign presence measured as the share of employment in foreign firms at the 5-digit industry level in Row 1, and variables to control for industry competition in Row 2.[23] In Row 3 I control for turnover and skill share at the plant level, since the hiring of workers with MNE experience could be systematically related to these variables. An alternative way to control for human capital is to replace the hours variable with a better measure of human capital at the plant level. I do this by multiplying hours with the average education level of the plant, and present the result in Row 4 of Table 9. As the result in Table 8 implies decreasing returns to scale, the regression in Row 5 of Table 9 imposes constant returns to scale in the production function. In this case the coefficient on the share of workers with MNE experience is reduced, but is still significant at the 10% level. The implied δ in the constant returns to scale estimation is 0.18; also significant at the 10% level. In Row 6 I use the lagged share of workers with MNE experience instead of the current share when estimating equation (2). This is to account for the likely possibility that the effect of the new workers on productivity may take time to materialise. When comparing Column 1 of Table 8 and the first six rows of Table 9, we see that the result is not affected by these alternative specifications. In all cases the coefficient on the share of workers with MNE experience is positive and significant and implies a productivity premium of 24 to 28%. The exception is the regression imposing constant returns to scale in the production function, but even here the result is significant at the 10% level and implies a productivity premium for workers with MNE experience of almost 20% compared to workers without such experience.

Rows 7-11 of Table 9 includes regressions that differ from the specification in equation (2), thus we cannot calculate the implied productivity premium for workers with MNE experience, but only estimate the effect of the share of workers with MNE experience in

[23]The competition variables were first proposed by Nickell (1996) and include market shares, profit margins, industry concentration and a measure of import competition.

Table 9: Robustness: Estimated coefficient on share of workers with MNE experience

	MNE-exp.		N	R-Sq	δ	
1. Industry level of foreign presence	.096*	(.037)	33,405	.83	.27*	[.011]
2. Competition variables	.1**	(.037)	33,405	.83	.28**	[.008]
3. Plant level skillshare and turnover	.093*	(.037)	33,405	.83	.26*	[.014]
4. Plant level human capital	.082*	(.038)	33,387	.83	.24*	[.033]
5. Impose constant returns to scale	.072	(.038)	33,405	.89	.18	[.062]
6. Lagged share of MNE-exp	.089*	(.035)	25,619	.81	.25*	[.011]
7. 3-digit industry input coefficients	.086**	(.031)	33,405	.85		
8. Dummy for MNE-exp	.015***	(.003)	33,405	.83		
9. TFP as dependent variable	.308***	(.059)	33,405	.07		
10. Levinsohn-Petrin residuals	.077*	(.033)	28,777	.05		
11. Labour productivity	.2*	(.085)	33,405	.04		

Notes: Rows 1-6 are different variations of the regression in Column 1 of Table 8 where the dependent variable is log(output). Log(output) is also dependent variable in Rows 7-8, but δ cannot be calculated. In Rows 9-11 the dependent variables are different productivity measures which are regressed on the share of workers with MNE experience, year and industry dummies. Standard errors in round brackets, P-values in square brackets. ***, **, *= significant at 0.1, 1 and 5%, respectively.

an augmented production function framework. Row 7 reports the result of a more general specification of the production function in equation (2) where the coefficients on capital, materials and hours are allowed to vary across 3-digit industries. In Row 8 of Table 9 the share of workers with MNE experience is replaced with a dummy equal to one if the plant employs one or more workers with MNE experience. This departs from the assumed linear relationship between the share of workers with MNE experience and plant level productivity that is implicit in equation (2). The estimated coefficient on the dummy is positive and significant at the 0.1% level.[24] In the last three rows of Table 9, I regress three different measures of plant level productivity on the share of workers with MNE experience while including year and industry dummies. The TFP-index used in Row 9 is described in the Appendix. In Row 10 I use the residuals from estimating a Cobb-Douglas production function at the 2-digit industry level according to the method proposed by Levinsohn and Petrin (2003). The method is developed in order to address the simultaneity problem in estimates of production functions.[25] The last row of Table 9 uses labour productivity

[24] The robustness checks in Rows 1-7 of Table 9 would all give a positive and significant coefficient at the 1 or 0.1% level if the share of workers with MNE experience is replaced by a dummy variable as in Row 8.

[25] An alternative method to control both for unobserved plant fixed effects and input simultaneity is to use the GMM-System estimator recently developed by Blundell and Bond (1998). For a recent application

measured as the log of output per hour as the dependent variable. In Rows 9-11, the results point in the same direction as before; the estimated coefficients on the share of workers with MNE experience are positive and significant. Thus the positive effect of MNE experience on plant level productivity is robust to several different measures of productivity.

To summarize, the estimation results suggest that workers with MNE experience contribute in the order of 20-25% more to the productivity of their plants than their colleagues without such experience. The mean share of workers with recent MNE experience is 7.7% for those non-MNEs that have workers with MNE experience, evaluated at the mean, these plants have 1.5-2% higher TFP than plants that have not recruited workers with MNE experience. The productivity premium attributed to workers with MNE experience is not associated with newly hired workers in general, as we do not find a similar productivity effect for newly hired workers without MNE experience.

6 Do workers benefit from mobility?

The results of the previous section indicated that workers with experience from MNEs are very important for the productivity of non-MNEs, and as such we would expect these workers to be rewarded in their new plants. The potential process of spillovers through labour mobility from MNEs to non-MNEs is similar to the process of R&D spillovers through labour mobility. The literature on R&D spillovers and labour mobility uses a human capital framework and focuses in particular on the relationship between mobility and wages. Since at least part of the knowledge acquired in a firm will move with the worker in the case of mobility, workers that get access to training/knowledge should be willing to pay for this by accepting a current pay cut in expectation of future private returns (Pakes and Nitzan, 1983).[26]

Table 10 shows mean wage growth in percent from the year before moving to the year after moving for different groups of movers. Their wage growth is also compared to the mean annual wage growth of workers who never change plant (stayers). The average wage growth of stayers is around 3% per year, while the movers experience wage growth of more than 5% upon moving from their old plant to a new one. Workers that change

to the question of whether foreign-owned firms are more productive than domestic firms, see Benfratello and Sembenelli (2006). I have tried variations of the GMM-System estimator using different lags of inputs and output as instruments. In all cases the validity of the instrument set was rejected.

[26] I find no evidence that workers in MNEs pay for the knowledge they accumulate on the job through lower wages early in their career. Møen (2005) finds the opposite result for technical staff in R&D-intensive firms in the Norwegian machinery and equipment industry.

from a MNE to a non-MNE experience on average a wage growth of 7.2%, while the wage growth for movers in the opposite direction is 8.1%. These growth rates are higher than for workers that change plants within the group of MNEs or non-MNEs (5.6 and 5.7%).[27] The difference between average wage growth in the year of moving compared to annual average wage growth in the sample indicates that most job changes are voluntary, and that the movers increase their wage as a result of moving. This is consistent with the view that workers are attracted to their new plants by a deliberate policy by the hiring plant to acquire new workers to get access to their knowledge. It is also consistent with the view that the moving workers are earning a private return on general training received by the previous employer, and that this return is larger with a new employer who has not paid any of the training costs (Loewenstein and Spletzer, 1999).

Table 10: Characteristics of movers and stayers

	Movers from MNEs		Movers from non-MNEs		Stayers	
	non-MNEs	MNEs	non-MNE	MNE	non-MNEs	MNEs
Wage before move	24,967	26,161	23,275	24,336	23,228	25,606
Wage after move	26,023	27,086	23,872	25,439	23,156	25,728
Wagechange %	7.2	5.5	5.8	8.1	3.0	3.3
Tenure	4.3	6.4	4.6	4.0	8.6	9.1
Age	35.0	37.9	36.4	35.2	41.1	40.8
Education	11.2	11.2	10.7	11.0	10.4	10.9
N	6,744	15,206	22,836	8,556	559,459	310,050

In Table 10 the wage growth for MNE to non-MNE movers and for non-MNE to MNE movers is very similar. In fact, the movers from non-MNEs to MNEs experience on average a larger wage jump than movers in the other direction.[28] As the wage growth numbers in Table 10 are unconditional means, they may be systematically affected by the characteristics of the movers or the plants they move between. For instance, when interpreting the wage growth of 8.1% for movers from non-MNEs to MNEs, we must bear in mind that most of these moves mean that the worker moves from a small plant to a larger plant (as the average size of MNEs is much larger than for non-MNEs). And since wages are positively correlated with plant size, the change in plant size may be an important factor in explaining the wage growth for non-MNE to MNE movers.

[27]Martins (2006) and Pesola (2006) investigate the private returns to mobility from foreign to domestic firms in Portugal and Finland, respectively. In Portugal foreign to domestic movers on average experience a pay cut upon moving, while the opposite is the case in Finland.

[28]One possible explanation is that the MNEs may be actively seeking to attract good workers from non-MNEs as a form of technology sourcing.

In order to investigate further the extent to which the movers may be selected out of their old plants and into their new plants, I follow the approach of Martins (2006). He compares the wages of foreign to domestic movers to the wages of their colleagues that do not move plants. He does this both before and after moving by estimating the following wage regression

$$w_{ijt} = \beta_0 + \beta_1 DM_{ij} + \beta_2 DN_{ij} + X'_{ijt}\beta_3 + F'_{jt}\beta_4 + d_j + e_{it}. \tag{3}$$

w_{ijt} is the log real wage of worker i employed in firm j at time t, X_{ijt} is a vector of observable individual characteristics, F_{jt} is a vector of observable plant characteristics, d_j is a plant fixed effect, while e_{it} is an idiosyncratic error term.

When comparing the wages of movers from MNEs before moving to wages of stayers in MNEs, DM_{ij} is a dummy equal to 1 if worker i of plant j moves to a MNE in the future, while DN_{ij} equals 1 if the worker moves to a non-MNE in the future.[29] The results, presented in the first two columns of Table 11, indicate that future movers to non-MNEs, are paid no differently than their fellow workers who will stay in the plant. By contrast, workers who move to other MNEs in the future earn a premium of about 1,5%. There is no difference in the results from OLS and fixed effects between Columns 1 and 2. The lack of difference between the OLS and fixed effect results indicates that the wage premium for movers from MNEs to other MNEs is not caused by these movers coming from high-wage MNEs.

Table 11: Before moving: Wages of movers vs stayers in old plant

	Movers from MNEs		Movers from non-MNEs	
Movers to non-MNEs	-.006	.000	.003	-.003
	(.004)	(.004)	(.002)	(.003)
Movers to MNEs	.015*	.015*	.029*	.012*
	(.003)	(.003)	(.004)	(.004)
N	335,017	335,017	581,784	581,784
R-sq.	.42	.48	.34	.48
	OLS	Plant-FE	OLS	Plant-FE

Notes: Regressions include year and 28 industry dummies. Variables for plant and individual characteristics are the same as indicated in the note to Table 3. *= significant at 1 percent level. Standard errors clustered on individuals in parentheses.

[29] Martins (2006) only considers movers from foreign to domestic firms and therefore uses only one dummy.

I next use equation (3) to compare the wages of movers from non-MNEs before moving to wages of stayers in non-MNEs, and the results are presented in the last two columns of Table 11. Movers from non-MNEs to other non-MNEs are not paid differently from their fellow workers before moving, while movers from non-MNEs to MNEs receive a wage premium compared to stayers in non-MNEs. This wage premium is 2.9% with OLS estimation, but falls to 1,2% when taking account of plant fixed effects, thus part of the wage premium found with OLS estimation is due to MNEs recruiting from high-wage local plants.[30] In terms of the potential for knowledge diffusion, the evidence of a wage premium for future movers from non-MNEs to MNEs points more in the direction of MNEs being better placed to benefit from mobility spillovers, since they seem to be able to select better workers.

So far we have only seen how the movers were doing before moving, but movers may be well paid relative to similar workers in their new plants, even though they may not seem particularly selected from (or well-paid in) their old plants. I investigate this using equation (3), but this time comparing wages of the movers after moving to wages of stayers in the plants they are moving to. In these regressions I account for the length of tenure in the plant prior to moving by replacing the dummy DM_{ij} in equation (3) with three dummies; the first equal to 1 if tenure in the MNE prior to moving is less than 1 year, the second capturing tenure of 1-3 years, and the third for workers with more than 3 years of tenure in the MNE before moving. Similarly, the dummy DN_{ij} is replaced by three dummies to capture the length of tenure in the non-MNE before moving.

The first two columns of Table 12 report the results for movers to non-MNEs.[31] In the OLS results in Column 1, movers from MNEs to non-MNEs earn a wage premium relative to the stayers in non-MNEs, and the wage premium increases with the length of tenure from the MNE. In the fixed effect results of Column 2 there is no significant wage premium for movers to non-MNEs with less than 1 year of tenure from the MNE prior to moving, while the wage premium is 4.7% for workers with more than 3 years of tenure from the

[30] All regressions in Table 11 require the movers to be observed in their old plant 3 years before moving, and the appropriate dummy applies for all these three years. (Similar results are obtained if the dummy only applies the last year before moving.) In addition, I only include movers that are observed moving in the indicated direction once during the period 1990-2000. For the stayers, I include only individuals that never change plant within manufacturing, and require that they are observed at least 5 years. Thus the wage regressions compare movers that were 'relatively stable' before moving to stayers that are 'relatively stable'.

[31] In a similar way as for the results in Table 11, the wage regressions presented in Table 12 are comparing movers that are 'relatively stable' after moving to stayers that are 'relatively stable'. See Footnote 30.

Table 12: After moving: Wages of movers vs stayers in new plant

	Movers to non-MNEs		Movers to MNEs	
Tenure from:				
MNE, <1 y.	.026*	.010	-.010	-.009
	(.007)	(.006)	(.006)	(.006)
MNE, ∈(1,3 y.)	.048*	.038*	.028*	.028*
	(.006)	(.006)	(.005)	(.006)
MNE, >3 y.	.059*	.048*	.051*	.036*
	(.005)	(.006)	(.004)	(.005)
Non-MNE, <1 y.	.009	-.007	-.019*	-.021*
	(.004)	(.004)	(.005)	(.005)
Non-MNE, ∈(1,3 y.)	.030*	.014*	-.001	.003
	(.004)	(.004)	(.006)	(.006)
Non-MNE, >3 y.	.026*	.020*	-.027*	-.01
	(.003)	(.003)	(.005)	(.006)
N	592,856	592,856	345,725	345,725
R-sq.	.34	.47	.42	.49
	OLS	Plant-FE	OLS	Plant-FE

Notes: Regressions include year and 28 industry dummies. Variables for plant and individual characteristics are the same as indicated in the note to Table 3. *= significant at 1 percent level. Standard errors clustered on individuals in parentheses.

MNE.[32] This wage premium is more than double that of movers from other non-MNEs. Thus, even though the results in Table 11 indicated no particular selection of workers from MNEs to non-MNEs, these movers are clearly doing better than their colleagues in their new plant.[33] Results for movers to MNEs are presented in the last two columns of Table 12. For movers from non-MNEs to MNEs, no length of tenure in a non-MNE gives an additional premium over and above tenure and experience in general. Thus, while the results in Table 11 indicated that these workers are selected out of the non-MNEs, they are not doing better than similar workers in their new plants. The evidence on the wages of movers from non-MNEs to MNEs is not consistent with a potential for spillovers from non-MNEs to MNEs, as there is no extra effect of prior experience in non-MNEs on the earnings of movers to MNEs.

[32]The results in both Tables 11 and 12 are unaffected by the inclusion of intreaction terms between year and 2-digit industry dummies.

[33]Similarly, Martins (2006) and Pesola (2006) find that previous tenure from foreign plants pays off after moving to domestic plants.

7 Conclusions

The evidence provided in this paper is consistent with labour mobility from MNEs to non-MNEs working as a channel for spillovers. First, as MNEs pay higher wages than non-MNEs, this suggests that MNEs have a firm-specific advantage, and hence that there is a potential for spillovers. Second, during the 1990s an increasing share of non-MNEs employ workers with previous experience from MNEs. Third, workers with MNE experience contribute substantially to the productivity of their new plants. According to the estimates in this paper, workers with MNE experience contribute 20-25% more to the productivity of non-MNEs than workers without such experience. Thus, mobility is clearly a channel for knowledge diffusion in Norwegian manufacturing. Fourth, it is in particular workers moving from MNEs to non-MNEs that are rewarded in terms of higher wages in their new plants. This private return to mobility is an indication that the hiring plants value the knowledge these workers bring with them, and it is consistent with the productivity effects found at the plant level.

It could be argued that the productivity premium found for workers with MNE experience is not a result of knowledge diffusion from MNEs to non-MNEs, but merely a result of better selection of workers. If MNEs are better in selecting workers to their plants than non-MNEs, the non-MNEs could use previous MNE experience as a screening device when hiring new workers. As a result, even if new workers in non-MNEs with recent MNE experience learnt nothing while employed in MNEs, the possible selection effect may be sufficient to generate a productivity premium associated with these workers. The pure selection argument implies that length of tenure in the MNE should not be important for the wage premium received by workers moving from MNEs to non-MNEs. The evidence provided in Table 12 indicates that length of tenure from MNEs does have an effect on the wage premium. This is not consistent with a pure selection effect, but is consistent with learning over time in MNEs and knowledge diffusion through labour mobility from MNEs to non-MNEs.

The wage premium for movers from MNEs to non-MNEs with more than 3 years of experience from MNEs is almost 5% compared to stayers in non-MNEs with similar characteristics. This 5% wage premium is far less than the 20-25% productivity premium these workers have relative to workers without MNE experience in non-MNEs. The difference between the wage premium and the productivity effect suggests that the hiring non-MNEs do not fully pay for the value of the workers to the firm, and thus labour mobility from MNEs to non-MNEs seems to be a source of knowledge externality in Norwegian manufacturing.

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8 Appendix

Definition of variables used in the production function: Equation (2) in Section 5.

L_{it} Number of person hours in the plant. Rented labour hours are calculated from the costs of rented labour using the calculated average wage for own employees. Since only blue-collar hours are reported prior to 1983, and only total hours from 1983, total hours before 1983 are estimated by using information on the blue-collar share of the total wage bill.

K_{it} The estimate of capital services uses the following aggregation:

$$K_{it} = R_{it} + (0.07 + \delta^m)V_{it}^m + (0.07 + \delta^b)V_{it}^b,$$

where R_{it} is the cost of rented capital in the plant, V_{it}^m and V_{it}^b are the estimated values of machinery and buildings at the beginning of the year, $\delta^m = 0.06$ and $\delta^b = 0.02$ are the depreciation rates. The rate of return to capital is taken to be 0.07. The values for depreciation rates and the rate of return to capital are also used by Salvanes and Førre (2003) using the same data. The estimated values of buildings and machinery are obtained from information on fire insurance values. To reduce noise and avoid discarding too many observations with missing fire insurance values, these values are smoothed using the perpetual inventory method. Fire insurance values are not recorded after 1995, thus from 1996 capital values are estimated by adding investments and taking account of depreciation. Where possible, I also use estimates of firm level capital values (distributed to the plant level according to employment shares) as starting values for plants with entry after 1995. These capital values are obtained from recent work to improve on capital estimates in Norwegian manufacturing, see Raknerud et al. (2003). Separate price deflators for inputs and output and for investment in buildings and machinery are obtained from Statistics Norway. The aggregation level for the price deflators is according to the sector classification used in the National Accounts, which is somewhere in between the 2- and 3-digit ISIC level.

M_{it} Total cost of materials used. Since this variable in the data includes rented labour and capital, I subtract these and allocate them to the labour and capital measures respectively.

Y_{it} Gross production value net of sales taxes and subsidies.

The total factor productivity (TFP) index used in Row 9 of Table 9 is calculated at the plant level as

$$\ln TFP_{it} = \ln Y_{it} - \alpha_t^K \ln K_{it} - \alpha_t^L \ln L_{it} - \alpha_t^M \ln M_{it}, \tag{4}$$

where the α_t^z's are the 5-digit means of cost shares of each factor z relative to output Y_{it}.