Chapter 3

Productivity Spillovers of Multinational Enterprises through Worker Mobility: New Evidence for the Netherlands

3.1 Introduction

Over the last few decades, many scholars have examined the theoretical knowledge spillover effects of foreign direct investment in the host country (see e.g, Fosfuri et al. (2001); Markusen (2001); Cooper (2001); Glass and Saggi (2002); Dasgupta (2012)). The literature has developed in several directions and has identified different channels along which knowledge may spill over from a multinational enterprise to a local firm (Saggi (2002)).

Labour mobility has been considered as one of the major sources of knowledge spillovers across firms (Görg and Strobl (2005)). Foreign firms generally heavily invest in education and training of their employees to improve their productivity (Fosfuri et al. (2001)).[1] Domestic firms which hire former employees of foreign firms can benefit from these employees' embodied knowledge and skills, which may have a positive effect on domestic firms' productivity (Zucker et al. (2002); Palomeras and Melero (2010); Stoyanov and Zubanov (2012)). Generally, employees do not leave the foreign firm unless offered better working conditions by other firms. Thus, productivity spillovers only take place if the foreign firm's employee is hired by a domestic firm, because he is offered a sufficiently attractive wage rate. There is some supportive evidence for this. Balsvik (2011) shows that Norwegian workers previously employed by multinationals received a wage premium of more than 3 percent compared to their new colleagues hired from non-multinationals. Poole (2013) confirms this finding for the Brazilian manufacturing sector. Likewise, Pesola (2011) reports that highly educated employees in Finland earn a return on prior experience in a foreign-owned firm, which is over and above the return on other previous work experience. Martins (2005) finds that Portuguese firms pay workers previously employed by multinationals higher salaries than similar employees without such a prior foreign experience. However, this study also reports that workers suffer sizable pay cuts when moving from foreign to domestic firms.

Javorcik (2004) argues that, foreign firms have strong incentives to prevent techno-

[1] In this chapter I use foreign firms and multinationals interchangeably.

logical leakage through demonstration effects and labour movement, as local competitors can gain strength and challenge foreign firms. For instance, foreign firms may try to prevent their former employees from being hired elsewhere. Many firms add non-compete covenants in their contracts, resulting in a number of court cases dealing with their violations (Stoyanov and Zubanov (2012)). This protective tendency led some researchers to conclude that the scope for positive productivity spillovers is limited in an intra-industry context. Using Danish data, Stoyanov and Zubanov (2012) examine how the productivity gains are distributed between the hiring firms, the incumbent employees and the new employees. Consistent with the findings of Balsvik (2011), who shows that the private returns to mobility are smaller than the productivity effect at the plant level, Stoyanov and Zubanov (2012) find that the hiring firm benefits most from labour mobility.

To study the spillover effects of the presence of multinational enterprises through labour mobility, I build on the recent work of Stoyanov and Zubanov (2012) and Poole (2013) using administrative data for the Netherlands. In particular, the study focuses on mobility of workers who were previously employed by foreign firms. I test the hypothesis that hiring workers from multinational firms increases domestic firms' productivity. I distinguish between skilled and unskilled workers, as notably skilled workers take their knowledge with them to share it with their new co-workers, thereby promoting new collaborative networks and ideas (Laudel (2003)). For instance, Almeida and Kogut (1999) show that inter-firm mobility of patent holders in the semiconductor industry of the US influences the local transfer of knowledge across firms. Breschi and Lissoni (2009) find similar results for US inventors in certain technological fields.

I test the hypothesis that hiring workers from multinational firms increases domestic firms' productivity using data of Dutch manufacturing provided by Statistics Netherlands(CBS). Multinational firms are very important for the Dutch economy. FDI to the Netherlands makes up a large share of GDP, increasing to nearly $US 154 billion in 2016 (equivalent to 19.8% of its GDP).[2] The core of the dataset is an employer-

[2] The information on FDI inflows of the Netherlands is obtained from the World Bank data base (data.worldbank.org).

employee dataset covering the entire Dutch labour force, matched with administrative records on firms in manufacturing sectors. This data set allows me to study the labour flows from multinational to domestic firms. I apply two different productivity proxies calculated as the natural logarithm of turnover per employee and value added per employee, both normalized by the applicable industry-year average. The panel feature of the data set allows me to track firms from 1999 to 2013, and hence look at cross-sectional variability and changes over time.

I find that domestic firms that hired workers form multinationals experience productivity gains one year after hiring. Estimation results suggest that a 10 percentage point increase in employees hired from multinationals coincides with an increase of about 2.7 percentage point of the turnover-labor ratio in the receiving firm. Similarly, receiving firms experience a 2.1 percentage point increase in value added per worker. My results suggest that positive spillovers from FDI occur mainly via skilled workers. Additionally, my analysis reveals a negative association between domestic firm labour productivity and mobility of unskilled workers among domestic firms. This underlines the importance of taking education and skills into account, when analyzing worker mobility and knowledge spillovers.

This chapter contributes to the literature in several ways. To the best of my knowledge, this study is one of the first to examine spillovers via worker mobility considering skill and education levels of mobile workers and it is the first of this kind for the Netherlands. Furthermore, the study employs a rich longitudinal data set of the Dutch workforce which covers a longer and more recent period compared to previous studies, notably Pesola (2011), Poole (2013) and Stoyanov and Zubanov (2012).[3]

The remainder of this chapter is structured as follows. Section 3.2 reviews the existing literature and highlights the contribution of this research. Section 3.3 describes the data and methodology and Section 3.4 shows the results. Finally, Section 3.5 interprets

[3] Pesola (2011) and Poole (2013) studied spillover through worker mobility in the Finish and Brazilian manufacturing sector during 1994-2002 and 1996-2001, respectively. They both attribute multinational spillovers to the increase in wages of incumbent domestic labors. Stoyanov and Zubanov (2012) studied spillovers from more productive firms during 1995-2007 in Denmark.

the results and concludes.

3.2 Literature review

A vast literature highlighted the effect of foreign firms' presence on local labour market conditions and productivity spillovers of foreign direct investment.[4] Regarding worker mobility as a knowledge spillover channel, the theoretical literature generally predicts a positive effect of FDI presence on domestic firms' productivity (Kaufmann (1997); Haacker (1999); Fosfuri et al. (2001); Glass and Saggi (2002)). Fosfuri et al. (2001) were among the first to formally model this channel of multinational enterprise knowledge spillovers. According to their model, a multinational invests in training of its employees to compete with domestic firms for the services of the trained workers. Therefore, the employee would not leave multinational enterprise unless he is offered better working conditions such as a higher wage. The model of Markusen and Trofimenko (2009) predicts similar results. Glass and Saggi (2002) reach comparable conclusions, and argue that the foreign firm can either pay a wage premium to prevent the movement of their trained employees or relocate its operations to keep up its technological superiority. Anecdotal evidence confirms that this might be the reason that multinationals choose to export instead of investing abroad. Görg and Strobl (2005) state that multinational firms invest in training and in the absence of slavery, it is impossible to forbid such resources to move to other firms. As a result, the movement of labour from multinational to domestic firms can generate productivity improvements. These improvements occur via two mechanisms: (1) a direct spillover to other workers of the domestic firm; and (2) workers who move may transfer knowledge of new technologies or new management methods to domestic firms (Görg and Strobl (2005)).

However, empirical studies attempting to identify the spillover effects via labour mobility and the mechanism behind it, generate inconclusive results. Using data from the Brazilian manufacturing sector Poole (2013) provides evidence of wage spillovers

[4] See, e.g., Aitken and Harrison (1999); Saggi (2002); Görg and Greenaway (2004); Driffield and Girma (2003); Lipsey (2004); Lipsey and SjÃűholm (2004); Sjöholm and Lipsey (2006), and Abolhassani and Danakol (2018). See Havranek and Irsova (2012) for a survey of the literature on productivity spillovers of FDI.

from the workforce of multinationals to workers of domestic firms. He attributes spillovers to the increase in wages of incumbent domestic labour. Markusen and Trofimenko (2009) studied variation in wages across Colombian manufacturing sectors and find evidence supporting the hypothesis that 'experts' hired from foreign firms can transfer skills to domestic workers. Görg and Strobl (2005), using a small survey from Ghana, report that firms whose owners once worked in a foreign firm in the same industry immediately prior to opening up their own firm are more productive than those working in similar domestic firms. However, they could not identify any positive productivity effects following experience in a foreign firm in a different industry.

Some studies focusing on developed countries show a positive effect of labour mobility on firms' productivity. Balsvik (2011) attributes spillovers from multinational to the increase in wages of incumbent domestic labour and shows that new workers hired from multinationals receive a wage premium compared to those hired from non-multinationals. Stoyanov and Zubanov (2012) set up a more general framework to trace the effects of labour mobility using employer-employee data. Tracking the flows in Danish manufacturing firms, they find that the productivity gains associated with hiring from more productive firms are equivalent to 0.35 percent per year for an average firm.

Most previous studies on knowledge spillovers of FDI do not examine in much detail how these spillovers occur. Therefore, in my study I attempt to explain the mechanism behind the spillovers by considering the education level of workers. There is a vast literature addressing the association between skilled worker mobility and knowledge transfer. Arrow (1962), Rosen (1972) and Stephan (1996) were among the first to formally model this association. Skilled workers might obtain new knowledge and learn new techniques and when they move to a new firm, they share these skills and knowledge in the new company and with their new co-workers. They also promote new collaborative networks and ideas and promote new combinations of knowledge (Laudel (2003)). Hence, the role of skills and education in the level of knowledge diffusion is key. In line with this reasoning, I formulate the following hypothesis:

Hypothesis: *Hiring from multinational firms increases domestic firms' productivity; this effect is driven by the mobility of high-skilled workers.*

I extend the literature by building on models proposed by Stoyanov and Zubanov (2012) and Poole (2013), using a unique dataset for the Netherlands. Furthermore, I try to explain the mechanism behind the knowledge spillover by considering the education level of workers.

3.3 Data and Methodology

3.3.1 Data Sources

The dataset used in this study is a matched employer-employee dataset from Statistics Netherlands (CBS) which covers the entire private sector. At the worker level, it contains information on employment status, in particular, the employer, the type of contract, the number of days worked, the starting date of employment, and the annual wage received. I define mobile workers as those employees with a new job in a new firm. All firms and individuals have unique identification numbers, which enables me to link the observations to administrative firm records and worker characteristics, such as age, gender and education.

The core of the firm data is the Business Registry data (ABR), which incorporates the whole population of firms and reports annual statistics on the number of employees, detailed industry codes of the establishment, and its location. I merge the Business Registry data with Production Statistics (PS-Industry and PS-Service), which consist of information about turnover, value added and the wage bill. An important variable in this study is foreign ownership, which is reported as the percentage of firms' equity owned by foreign investors in the Financial Statistics of Large Enterprises (SFGO) survey.[5] The SFGO incorporates firms with total assets of at least 22.69 million Euros. Our foreign ownership measure is therefore limited to large firms, which account for the

[5] Statistiek financiën van grote (niet-financiële) ondernemingen, in Dutch.

vast majority of foreign investment. I define firms with at least 10% foreign ownership as multinational.[6] From the SFGO, together with its equivalent for small firms SFKO[7] and the NFO survey[8], I obtain information on turnover, value added, wages, capital and the number of employees of enterprises.

In order to track the movement of workers across firms, I create a panel data set at the employee level including all workers in the manufacturing and service sectors. I dropped all part time workers (defined as people with a work contract for less than 75% of a full-time equivalent) and those with very low wages or for whom no wage was reported. I also excluded employees with flexible hour contracts.[9] Finally, I eliminated workers who changed jobs more than once in a year. Unlike Stoyanov and Zubanov (2012), our data covers all manufacturing and service firms, and therefore it covers not only workers moving within manufacturing but also those moving from service sectors to manufacturing sectors or vice versa. After calculating all necessary variables, I aggregated the data to the firm level. The final sample is an unbalanced panel data covering the years between 1999 and 2013 comprising 239,168 firm-year observations that span 43,590 firms, over a 15-year period. Appendix A describes the sample in more detail.

3.3.2 Methodological Approach

In this section, I develop a model to test whether and to what extent productivity growth is realized via mobility of workers previously employed by multinationals. I measure the spillover effect as the relationship between the labour productivity of domestic firms and the share of their workers with previous experience at multinational

[6] For some years, the SFGO survey contains a direct measure of the firm being either a multinational or a domestic firm. Most firms with foreign ownership higher than 10% are reported as a multinational (about 95%). We use the 10% threshold to measure foreign ownership consistently in all years.

[7] Statistiek financiën kleine ondernemingen, in Dutch.

[8] As of 2000, SFGO and SFKO have been merged into a single data set, the so-called statistics on finances of non-financial enterprises (NFO-statistiek financiën van niet-financiële ondernemingen in Dutch). However, SFGO is still available.

[9] Workers with flexible hours contract are reported as employees who have a contract without fixed working hours, and firms use them when needed. Therefore, their wages can fluctuate heavily depending on the number of times they are called in.

firms. The greater the share of employees who previously worked at a multinational firm, the greater is the probability of a transfer of technology and knowledge. Therefore, the main explanatory variables of interest are H_{it}^{Multi} and H_{it}^{Dom}, i.e. the total number of new employees hired from multinational and from domestic establishments respectively, as the percentage of all employees N_{it}:

$$H_{it}^{Multi} = \frac{\sum_s I_{st}^F H_{st}}{N_{it}}$$
$$H_{it}^{Dom} = \frac{\sum_s (1 - I_{st}^F) H_{st}}{N_{it}}$$

Here, I_{st}^F is a dummy variable equal to one if firm s (sending firm) is a multinational and zero otherwise, and H_{st} denotes the number of workers hired from firm s. To test whether the hiring of workers from foreign-owned firms affects productivity of the hiring firm, relative to hiring from domestic firms, I estimate the following model:

$$A_{it+1} = \gamma A_{it} + \alpha_1 H_{it}^{Multi} + \alpha_2 H_{it}^{Dom} + \beta_1 X_{it} + \beta_2 Y_{it} + \beta_3 Z_{it} + \tau_{kt} + \varepsilon_{it} \tag{3.1}$$

The dependent variable A_{it+1} is firm's productivity. I apply two different productivity measures: $A^{Turnover}$ and $A^{ValueAdded}$ defined as the natural logarithm of turnover per employee and value added per employee; both measures are normalized by the applicable industry-year average based on the NACE rev. 1.1 industry classification at the 5 digit level (SBI 5 digit level)[10]. I control for contemporaneous productivity to account for persistence in the dependent variable.

Furthermore, to account for other sources of productivity growth, I add a number of controls in the equations, including firm characteristics, labour characteristics and industry-year fixed effects (see also Stoyanov and Zubanov (2012)). The vector X_{it} includes firm characteristics, such as the number of employees, the number of newly

[10] SBI stands for 'standaard bedrijfsindeling' which corresponds to the Dutch version of the NACE industry classification. Note industry is defined at the 5-digit level of the NACE classification

hired workers relative to total employment and the natural logarithm of the capital labor ratio. Y_{it} is the vector of incumbent workers' characteristics and consists of average skill, average age, percentage of female and average number of years of work experience. Z_{it} is vector of characteristics of new workers and includes: averages of age, skill, year of work experience and percentage of new female employees as a ratio of total employees. Finally, to account for unobserved industry-specific time-varying effects I include a full set of industry-time fixed effects τ_{kt} of manufacturing sectors. ε is the disturbance terms.

The coefficients of interest are α_1 and α_2, which denote the productivity gain from hiring workers from multinational and domestic firms, respectively. Note that I control for the hiring share in the vector X already, and hence I test whether the composition of the hires affects productivity.

Further, in order to identify the workers which are most likely the main source of knowledge spillovers, I differentiate between hiring highly skilled ($D_j^{Skill} = 1$) and non-highly skilled ($D_j^{Skill} = 0$) workers from multinational and domestic firms, since high-skilled workers are most likely to transfer knowledge and skills. I define highly skilled workers as those who have tertiary education, resulting in a bachelor, master or Doctoral degree or equivalent (see Appendix A for more details):

$$
\begin{aligned}
&\text{Hired skilled workers from multinationals} && = HS_{it}^{Multi} && = \frac{\sum_s I_{st}^F \sum_j D_{jst}^{Skill}}{N_{it}} \\
&\text{Hired unskilled workers from multinationals} && = HUS_{it}^{Multi} && = \frac{\sum_s I_{st}^F \sum_j (1 - D_{jst}^{Skill})}{N_{it}} \\
&\text{Hired skilled workers from domestic firms} && = HS_{it}^{Dom} && = \frac{\sum_s (1 - I_{st}^F) \sum_j D_{jst}^{Skill}}{N_{it}} \\
&\text{Hired unskilled workers from domestic firms} && = HUS_{it}^{Dom} && = \frac{\sum_s (1 - I_{st}^F) \sum_j (1 - D_{jst}^{Skill})}{N_{it}}
\end{aligned}
$$

Next, using these definitions I explore the additional productivity impact of hiring highly skilled versus non-highly skilled workers, respectively, by amending the empirical model as follows:

$$A_{it+1} = \gamma A_{it} + \alpha_1 HS_{it}^{Multi} + \alpha_2 HS_{it}^{Dom} + \alpha_3 HUS_{it}^{Multi} + \alpha_4 HUS_{it}^{Dom} + \beta_1 X_{it} + \beta_2 Y_{it} + \beta_3 Z_{it} + \tau_{st} + \varepsilon_{it} \quad (3.2)$$

To isolate productivity shocks which can result in more hiring and in particular hiring workers from multinationals who are likely to be of better quality, I add productivity lags to all models presented above. Further, I estimate the equations for large and small firms. Additionally, I repeat the analysis with a subsample of start-ups and young firms.

3.3.3 Descriptive Analysis

Table 3.1 presents the descriptive statistics measured at the worker level. The figures reported cover the whole labour force of the Netherlands between 1999 and 2013.[11] As shown in Table 3.1, the average hiring rate is 13.8 %, while 4% of the newly hired workers come from multinationals. The average age of job stayers is 40.5 years and about 25% are female. The majority of stayers are in the middle-skilled group and the rest is almost equally spread between low- and high-skilled groups.[12] In comparison, new workers are on average 32 years old and about 8 years younger than stayers, and they are more likely to be in the middle-skilled group. The average annual wage of stayers is about 3% higher than that of newly hired employees, while employees who moved from multinationals are paid 2% more than stayers. This wage premium is consistent with numbers reported by Stoyanov and Zubanov (2012) for the Danish workforce. Hiring firms tend to be larger than non-hiring firms (non-hiring firms in our sample have on average about 6 employees). Firms which hired workers previously employed by multinationals have on average 63 employees and are relatively large firms.

[11] The total number of worker-year observations in the Netherlands in the final sample is about 84.1 million; about 7.4 million is for manufacturing sectors.

[12] I define skilled workers as workers who have tertiary education, bachelor, master, Doctoral or equivalent. However, in Table 3.1 I split workers in 3 groups to give a better overview of the Dutch workforce (see Appendix A for more details).

Table 3.1. Summary statistics for workers

Variable	Sample	Stayer	New Hire	H FDI
ln(value added)	3.90	3.64	3.96	3.96
ln(turnover)	4.92	4.85	4.97	4.97
ln(wage)	10.24	10.25	10.22	10.27
Age (workers)	38.8	40.5	31.97	38.2
Low-skilled	29.6	29.9	29.4	25.8
Middle-skilled	42.3	39.1	44.5	46.1
High-skilled	28.1	31	26.1	28.1
Female(manufacturing's labor)	26.4	25.6	25.5	10.25
Female(whole labor force)	40.5			
Average firm size	26.6		58.43	63.42
Labour hiring rate (%)			13.8	4

The number of worker-year observations for manufacturing is about 7.4 million. The average size of the firms with no hiring in our sample is 5.7.

The pairwise correlation of the main independent variables is presented in Table 3.2.[13] The table shows a positive correlation between hiring from foreign firms and both productivity measures of domestic firms. These correlations remain positive after differentiating between hiring highly skilled and unskilled workers from multinationals. Hiring employees from domestic firms is positively correlated with the productivity measure based on turnover. This is caused by the hiring of highly skilled workers as the the correlation between productivity ($A^{Turnover}$) and the hiring of non-skilled workers is negative. The correlation between hiring from domestic firms and A^{Value} is negative. However, this negative correlation is driven by the relationship between the hiring of unskilled workers and productivity growth; the hiring of skilled workers from domestic firms is positively correlated with value added per worker of the receiving firms. These correlations are consistent with the main hypothesis of this study. In the next section, I report the results of a regression analysis to further test this hypothesis.

Table 3.2. Pairwise correlation of main variables

	$A^{Turnover}$	A^{Value}	HS^{Multi}	HS^{Multi}	HS^{Dom}	HS^{Dom}	H^{Multi}	H^{Dom}
$A^{Turnover}$	1							
A^{Value}	0.7467	1						
HS^{Multi}	0.0285	0.0353	1					
$HUIS^{Multi}$	0.0113	0.0089	0.0159	1				
HS^{Dom}	0.0213	0.0321	0.0321	0.0047	1			
$HUIS^{Dom}$	-0.0103	-0.027	0.0047	0.0310	0.0119	1		
H^{Multi}	0.0495	0.0498	0.2676	0.5492	0.0336	0.0632	1	
H^{Dom}	0.0227	-0.037	0.0234	0.0517	0.2565	0.5595	0.1637	1

[13] The correlation matrix of all variables is shown in Table 3.A.3 in Appendix A.

3.4 Empirical Results

I start by estimating the model introduced in section 3.3.2 for all Dutch manufacturing firms during 1999-2013. Columns 1 and 2 of Table 3.3 show the results for equation 3.1 for 2 different productivity proxies. I find a positive and significant association between hiring new employees who were previously employed by multinational enterprises and the productivity of the receiving domestic firm. In contrast, hiring new employees from domestic firms does not seem to have a significant effect on the productivity of the receiving domestic firm.

As shown in Columns 3 and 4 of Table 3.3, notably the hiring of highly skilled workers has a significantly positive effect on labour productivity of the receiving domestic firm after one year. A ten percentage point increase in the ratio of hiring high-skilled workers from multinational firms corresponds to a 1.83 and 4.12 percentage point increase in the turnover-labor ratio and the value-added-labor ratio, respectively. By contrast, hiring low-skilled workers from multinational firms seems not to have a significant effect on productivity of the receiving domestic firm. Hiring highly skilled workers from domestic firms has a significantly positive effect on productivity in the receiving domestic firm as well, no matter whether productivity is measured based on value added or turnover. But hiring low-skilled employees from domestic firms appears to have a significant negative effect on the receiving domestic firm's performance after one year. A 10 percentage point increase in unskilled employees newly hired from domestic firms reduces turnover per employee by about 1 and value added per employee by 1.1 percentage point.

Next, I split the sample into large (number of employees $\geq$ 50) and small firms (number of employees $<$ 50). One reason why large domestic firms might benefit more from knowledge spillovers could be that hiring firms in this study are relatively larger (58 employees) than non-hiring firms (about 6 employees) and firms which hired ex-employees of multinationals have on average 63 employees. Beside this, most of multinationals are also large firms or share relevant characteristics with large firms

Table 3.3. Hiring skilled workers from multinationals

	Base Model		Skilled vs. Unskilled	
	(1)	(2)	(3)	(4)
VARIABLES	Turnover	Value added	Turnover	Value added
Turnover	.661***		0.688***	
	(.012)		(0.002)	
Value		.560***		0.625***
		(.013)		(0.003)
H^{FDI}	.270**	.206**		
	(.014)	(.015)		
H^{Dom}	.079	-.031		
	(.108)	(.116)		
HS^{FDI}			0.183**	0.412***
			(0.077)	(0.150)
HUS^{FDI}			0.072	-0.059
			(0.048)	(0.099)
HS^{Dom}			0.301***	0.376***
			(0.060)	(0.112)
HUS^{Dom}			-0.097**	-.112*
			(0.034)	(0.068)
Ln(labour)	0.10**	0.017***	0.032***	0.027***
	(0.005)	(0.006)	(0.001)	(0.002)
New labour ratio	0.126***	0.120***	0.112***	0.109***
	(0.045)	(0.050)	(0.047)	(0.053)
Ln(capital)	0.012***	0.005**	0.015***	0.007***
	(0.003)	(0.004)	(0.001)	(0.001)
Female	-0.043**	-0.039**	-0.042***	-0.052***
	(0.017)	(0.014)	(0.009)	(0.013)
Highly skilled	0.139***	0.280***	0.126***	0.171***
	(0.036)	(0.042)	(0.049)	(0.058)
Experience	0.002	0.002	0.005**	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.004	-0.007	-0.0001	0.0002
	(0.002)	(0.002)	(0.0003)	(0.001)
Age of new worker	-0.001	-0.001	-0.0003	-0.001
	(0.001)	(0.001)	(0.0004)	(0.0004)
New worker skill ratio	0.102***	0.036**	0.047***	0.043***
	(0.024)	(0.025)	(0.008)	(0.011)
Experience of new worker	0.008***	0.003**	0.003***	0.002**
	(0.001)	(0.003)	(0.001)	(0.001)
Constant	.095	0.065	0.106***	0.117***
	(0.025)	(0.047)	(0.005)	(0.008)
Observations	133,229	56,163	133,229	56,163
R-squared	0.508	0.418	0.509	0.419

Columns 1 and 2 show the results for equation 3.1 and Columns 3 and 4 show the results for equation 3.2 for 2 different productivity proxies. All specifications include industry-year effects and characteristics of incumbent firms' workers and new workers ($X_{it}$and Z_{it}).
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 .

(Malchow-MÃÿller et al. (2013)). Additionally, larger firms are more likely to be better run by managers (Lucas (1978)). Better management can help facilitate the application of knowledge of newly hired employees resulting in higher levels of productivity. Columns 1-4 of Table 3.4 present the estimation results for these sub samples for both productivity proxies. Hiring highly skilled employees from multinationals has a positive and significant effect on domestic firm productivity, but this effect is larger for large firms than for small firms. Similarly, hiring highly skilled workers from domestic firms is positively associated with domestic firm productivity and the coefficients are larger for enterprises with at least 50 employees. The effect of hiring low-skilled workers on productivity seems to be insignificant except for turnover per employee. This means that for large firms hiring from multinationals is positively associated with their turnover-labor ratio, regardless of the level of education and skill of new employees. Moreover, I find a significantly negative effect of hiring low-skilled employees from domestic firms for large firms. For small firms, hiring low-skilled workers who were not previously employed by a multinational lowers turnover per employee, although these results have weak significance.

Start-ups have a powerful impact on productivity and job creation. In particular, firms younger than 5 years have been found to be job creators, while older firms might be job destroyers (Haltiwanger et al. (2013)). Additionally, young firms are less likely to have been hit by productivity shocks which could affect their hiring choices. I therefore repeat the analysis with a subsample of start-ups and young firms. This sub sample includes only enterprises that have existed for less than 5 years since their establishment (firm $age \leq 5$). Columns 5 and 6 in Table 3.4 report the estimation results for these young firms. I find a significantly positive association between domestic firm productivity and recruiting skilled workers from multinationals. A 10 percentage point increase in hiring skilled workers from foreign firms seems to increase turnover and value added per employee in young domestic firms by 2.5 and 5 percentage points, respectively. The effect of hiring low-skilled labour from domestic firms remains significantly negative for small firms.

Table 3.4. Large vs. small firms and young firms

VARIABLES	(1) Turnover	(2) Value added	(3) Turnover	(4) Value added	(5) Turnover	(6) Value added
$A_{it-1}^{Turnover}$	0.775***		0.663***		.652***	
	(0.003)		(0.002)		(.003)	
$A_{it-1}^{Valueadded}$		0.598***		0.644***		.589***
		(0.004)		(0.004)		(.005)
HS_{it}^{FDI}	0.868**	.958***	0.174**	0.219*	0.248**	.501**
	(0.340)	(0.391)	(0.084)	(0.170)	(.099)	(.221)
HUS_{it}^{FDI}	0.616***	0.076	0.053	-0.033	-.004	-.338**
	(0.189)	(0.221)	(0.053)	(0.117)	(.063)	(.16)
HS_{it}^{Dom}	0.833***	0.881***	0.285***	0.371***	0.192**	.199
	(0.248)	(0.292)	(0.066)	(0.128)	(.079)	(.189)
HUS_{it}^{Dom}	-0.367***	-0.456***	-0.066*	-0.009	-.122***	-.175*
	(0.122)	(0.148)	(0.037)	(0.080)	(.047)	(.119)
	$N \geq 50$		$N < 50$		Age< 6	
Observations	36,073	26,321	97,531	26,330	66,937	24,404
R squared	0.607	0.393	0.438	0.415	.448	.369

Columns 1 and 2 show estimation results for large firms and Columns 3 and 4 represent results for small firms. The last two Column shows result for start-up.
All specifications include industry-year effects and characteristics of firms, incumbent workers and new workers (X_{it} and Z_{it}).
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 .

3.5 Conclusions

The goal of this chapter is to investigate the role of labour mobility in knowledge spillovers from multinationals to domestic firms for the Netherlands. Theoretical literature suggests that information externalities may be created by the movement of trained workers of foreign firms to domestic firms. However, empirical studies on these effects are rare. This research offers evidence based on a comprehensive linked employee-employment data set for transmission of technology and knowledge through worker turnover for a developed country. Moreover, my study emphasizes the potential importance of skills and education in knowledge spillovers from multinationals via worker mobility.

I find that the hiring by domestic firms of new workers previously employed by a multinational is positively associated with labour productivity of the receiving domestic firm. My results also suggest that the movement of labour from one domestic firm to another has no significant effect on productivity. Additionally, I find hiring highly skilled workers from domestic firms has a significantly positive effect on productivity in the receiving domestic firm. Finally, I provide evidence that hiring low-skilled employees from domestic firms is negatively associated with the receiving firm's per-

formance after one year.

Moreover, I show that the positive effect of hiring from foreign firms is related to the education level and skills of the workers. This finding confirms the argument that skilled workers might better obtain new knowledge and learn new technologies. Additionally, they can better transfer this knowledge to their new working environment and promote new collaborative networks and ideas (see, e.g. Laudel (2003)). I also find a negative link between unskilled workers moving across domestic firms and labour productivity of the receiving firm.

The main results of this study are consistent with the spillover through labour mobility theory according to which new employees bring knowledge and skills from their previous position. In particular, the comparison of results for hiring from multinationals affirm the theory introduced by Fosfuri et al. (2001) and Markusen and Trofimenko (2009). Moreover, when I do not control for the level of skills of workers, my findings confirm the finding of previous empirical studies of Poole (2013) and Balsvik (2011). However, when I take the skills of former employees of multinationals into account, my results suggest that the level of education of workers plays a key role in knowledge diffusion. Furthermore, I demonstrate that the results obtained are not driven by productivity shocks since my results for newly established firms are consistent with those based on the full sample. Since my estimates are stable across various measures of productivity they reveal a genuine relationship.

Although an individual country study of the Netherlands does not lend itself easily to generalizations, the consistency of my results with other studies for EU nations, suggests that my findings are relevant for other developed countries as well. Consequently, I believe that even though my research focuses on a single country, my empirical evidence provides valuable insights into the role of FDI in transferring knowledge and technology into the host countries' enterprises, and may be applied to other European country settings. It has been argued that knowledge diffusion via worker mobility and the ability of workers to apply new knowledge can be dependent on workers' occupation (Song et al. (2003)). Therefore, an interesting avenue for future work may

be to examine whether workers' previous occupation and position in multinationals plays a role in the knowledge spillovers of multinational firms to domestic firms.

3.A Data Description

Table 3.A.1 reports the main variables used in this study including their sources. In Section 3.3.3 I refer to 3 educational groups, namely low-skilled, middle-skilled and high-skilled workers. This classification is based on the International Standard Classification of Education (ISCED). The low-skilled group refers to education codes 0,1 and 2, namely people with lower secondary education or lower certificate. The mid-skilled group include workers with upper secondary or post secondary education (education codes 3 and 4). Finally, the high-skilled group consists of workers with eduction code 5: short-cycle tertiary education, bachelor or master and education code 6: people with doctoral or equivalent certificate. In the analysis, I refer to skilled workers if they are highly skilled (workers with education code of 5 or 6).

Table 3.A.1. Variables: Description and data sources

VARIABLE	DESCRIPTION	DATA SOURCE
$A^{Turnover}$	Total turnover divided by total employment at time t normalized by the applicable industry-year average	Production Statistics, SFGO, NFO, SFKO
$A^{ValueAdded}$	Valued Added divided by total employment at time t normalized by the applicable industry-year average	Production Statistics, SFGO, SFKO,
FDI	Firm's foreign equity at time t	SFGO
ln(Labor)	Logarithm of total number of employees in firm i at time t	Business Register
Capital	Capital of firm i divided by total number of employees of i at time t	SFGO, SFKO, NFO
Firm Age	The number of the years since a firm has been established	Business Register
Age	Average age of workforce in firm i at time t	GBA
Female	Proportion of female employees in firm i at time t	GBA
Skill	The proportion of high-skilled employees who have a college education	Educational Level

International Standard Classification of Education (ISCED) forms the basis for the variable SKILLit.Namely, employees with the educational level 5 or 6 based on ISCED codes are considered as highly-skilled workers. Programmes classified at ISCED level 5 include, for example: (higher) technical education, community college education, technician or advanced/higher vocational training, associate degree. Likewise, programs classified at ISCED level 6 cover, for example: bachelor's programs, license, or first university cycle.

The descriptive statistics (including the definition of the variables) and the pairwise correlation matrix are reported in Table 3.A.2 and Table 3.A.3, respectively. One can see from Table 3.A.2 that Dutch manufacturing firms employ on average about 29 employees with an average age of 38, of which 33% are highly skilled workers and 26 percent are female. The employees on average have 5.03 years of work experience in

the same company while newly hired people on average worked 2.03 years in a previous company. Moreover, sending firms have about 45 employees on average while the multinational sending firms are much larger with an average number of employees of 296. This not unexpected since the information for FDI is obtained from SFGO and incorporates firms with total assets of at least 22.69 million euros and firms with such a large balance sheet generally are big and have a high number of employees. Hiring firms on average hired 5 new workers during the sample period, with an average age of 32, of which 28 % are female.

Table 3.A.2. Summary statistics

Variable	Description	Mean	Std.	Min	Max
$A^{Turnover}$	Normalized turnover per employee	-.0045	.89	-.5.87	5.08
$A^{ValueAdded}$	Normalized value added per employee	-.0044	.76	-.5.29	4.93
Size of sending firm	Average size of sending firm	45.47	245.59	1	35018
Size of FDI sending firm	Average size of sending firm if it is foreign	296.58	562.58	25	9489
Labour	Total number of employees of firm i at time t	29.5	191.62	0	35018
Age firm	Years since a firm is established at time t	9.51	10.64	0	37
Capital	Firm capital stock divided by total number of employees at time t	13933.13	130354.7	0	9558426
Hiring ratio	Total number of new workers divided by total number of employees at time t	0.233	0.276	0	1
Experience	Total number of years that an employee has work experience	5.034	4.121	0	49
Female	The proportion of female employees of firm i at time t	0.264	0.288	0	1
Skilled	The proportion of highly skilled employees of firm i at time t	0.329	0.213	0	1
Age	Average age of the workforce of firm i at time t	38.8	8.82	16	80
Age new	Average age of new workers hired in firm i at time t	31.97	9.93	16	80
Experience new	Total number of years that new workers hired worked in previous firm at time t	2.03	2.93	0	49
Female new	The proportion of female in new workers hired in firm i at time t	0.28	0.35	0	1
Hiring	Total number of new workers hired in firm i at time t	5.38	33	0	7895

Note: All statistics reported in this table are based on the sample of 239,168 firm-year observations.

Table 3.A.3. Pairwise Correlation

	A^{T}	A^{V}	Gap^{T}	Gap^{V}	Age Firm	ln(labour)	Hiring	Exp	Female	Skill	Age	Age new	Skill new	Exp new
$A^{Turnover}$	1													
A^{Value}	0.746	1												
$Gap^{turnover}$	-0.527	-0.358	1											
Gap^{Value}	-0.359	-0.480	0.687	1										
Age firm	0.003	-0.010	0.005	-0.075	1									
ln(labour)	0.021	-0.054	-0.038	-0.021	0.194	1								
Hiring	0.004	0.022	0.039	0.01	-0.145	-0.189	1							
Experience	-0.002	0.020	-0.022	-0.004	0.126	0.36	-0.425	1						
Female	-0.010	-0.039	0.005	0.019	0.036	-0.09	0.057	-0.12	1					
Skill	0.097	0.086	-0.064	-0.052	0.051	0.101	-0.027	0.015	0.045	1				
Age	-0.066	0.030	-0.010	0.023	-0.034	0.006	-0.288	0.401	-0.068	0.079	1			
Age new	-0.013	0.013	0.010	0.033	-0.119	-0.035	0.059	0.034	-0.039	0.064	0.652	1		
Skill new	-0.053	0.010	-0.026	0.001	-0.039	-0.336	-0.499	0.21	0.005	0.212	0.275	0.069	1	
Experience new	0.020	0.036	0.031	0.043	-0.06	0.001	-0.003	0.045	-0.068	0.012	0.226	0.347	-0.027	1
ln(Capital)	0.083	0.068	0.073	0.062	0.104	0.312	0.119	0.013	0.007	0.045	0.11	0.094	0.041	0.006