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Former Employees of Foreign MNEs Boost Incumbent Workers' Wages in Domestic Firms?

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Do former employees of foreign MNEs boost incumbent workers' wages in domestic firms?

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Abstract

This paper examines evidence on wage spillovers from workers with experience in foreign multinational enterprises (MNEs) to incumbent workers in domestic firms. Using administrative panel data from Ireland, I examine possible heterogeneity for such spillovers across the wage distribution using quantile regressions. I begin by using existing methodology and find that, once industry-year and region-year dummies are added as control variables, the average wage spillover effect on incumbents from former foreign MNE workers moving to domestic firms disappears. The quantile results suggest that there are positive spillovers for incumbent workers in the top 40 percent of the wage distribution only. This indicates that foreign MNEs increase inequality through spillovers to domestic firms via labour mobility.

Keywords: foreign direct investment, spillovers, labor mobility, linked employer-employee data, wages
JEL Codes: F16, F23, J31, J60

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1 Introduction

Governments often offer incentives to attract foreign direct investment (FDI) with the intention of benefiting their economies including their domestic firms. MNEs have been shown to be more productive and pay higher wages than firms who are based in only one country [Alfaro-Ureña et al., 2021] [Balsvik, 2011] [Martins, 2011] [Driffield and Girma, 2003] [Aitken et al., 1996]. These premia may be reflective of MNEs' superior labour management, more efficient use of capital, more sophisticated sourcing of inputs and better sales and marketing of the products that they produce. It may also be that MNEs have invested considerable resources in training workers and retain them by paying higher wages [Alfaro-Ureña et al., 2021] Poole [2013] [Balsvik, 2011] [Görg et al., 2007]. Workers in foreign MNEs may come to embody the sources of these premia and bring this knowledge with them when they move to domestic firms, increasing the productivity and wages of incumbent workers there.

However, workers may also have heterogeneous effects on their peers. For example, Cornelissen et al. [2017] find wage spillovers from higher productivity workers to their co-workers occur in low paid occupations only. Similarly, economic surpluses within a firm may be shared heterogeneously. Kline et al. [2019] find that higher earnings from patent induced surpluses are captured by the top half of the earnings distribution. Former MNE workers may also affect different incumbent workers in different ways, with a corresponding effect on their wages. This in turn can affect wage inequality.

This paper examines whether the MNE wage premium spills over to incumbent workers in domestic firms through labour mobility and whether incumbent workers are affected heterogeneously. I add to the literature in two ways. My first contribution is to follow existing methodology to analyse wage spillovers to incumbent workers on average. Using a similar specification to Poole [2013], I identify positive wage spillovers from former MNE workers to incumbent workers in domestic firms. However, these results are not robust to controlling for industry-year and region-year dummies. Once this is included, I also do not find evidence for spillovers in sample splits of the data including by manufacturing and services, detailed

sector category, and men and women.

My second contribution to the literature is to examine possible heterogeneity of FDI spillovers across the wage distribution of incumbent workers using quantile regressions. The results suggest that there are positive spillovers for workers in the top 40 percent of the wage distribution. Former MNE workers appear be complementary to higher income incumbents only. Newly hired former MNE workers tend to be younger than incumbent workers while also earning income levels similar to higher paid incumbent workers. This suggests that they are higher up the firm's hierarchy and relatively better skilled than lower income incumbent workers. Incumbents with higher income, who are also likely to be better skilled, may be consequently better placed to learn from them.

I begin by following the methodology of Poole [2013], who uses administrative data from Brazil from 1996-2001 to analyse wage spillovers to incumbent workers. This approach assumes productivity to be in line with worker wages and has the potential to capture spillovers to incumbent workers at the worker level. This approach is intended to measure the peer effect of former MNE workers on productivity within the firm. [Poole, 2013] uses shares of workers to estimate peer effects; this is intended to capture the probability that an incumbent worker interacts with a former MNE worker.[1] She finds that a 10 percentage point increase in the share of workers with foreign MNE experience is consistent with a wage increase among their incumbent co-workers of 0.5 percent. Using the same methodology as Poole [2013] and matched employer-employee administrative data from Ireland, I find that a 10 percentage point increase in the share of workers with foreign MNE experience is consistent with a wage increase among their incumbent co-workers of 1.1 percent. However, this result is not robust to controlling for industry-year and region-year dummies.

Running unconditional quantile regressions, I find positive effects for workers in the top 40 percent of the wage distribution. This indicates that, taking account of potential wage

[1]This circumvents the reflection problem by focusing on the outcomes of incumbent workers only. The reflection problem occurs when an individual's outcome variable is both affected by and affects peer outcomes (measured as one or more of the explanatory variables) [Manski, 1993].

growth associated with greater shares of workers with experience from other domestic firms, higher shares of former MNE workers are associated with increased wages for higher paid workers. A 10 percentage point increase in the share of former MNE workers is associated with wage increases for these workers of between 1.2 and 3.4 percent. Former MNE workers appear be complementary to higher income incumbents. Both former MNE workers and higher paid incumbent workers are likely to be among the better skilled workers in the firm. Higher paid incumbent workers may be consequently better placed to learn from them. The results for workers at the 50^{th} and 60^{th} percentile are not statistically significantly different from zero, indicating that there are no FDI spillover effects for them. The consequence of this is to increase wage inequality among incumbent workers in domestic firms.

These findings contribute to research on the distributional consequences of FDI, an area that has not received much attention to date. Host countries typically attract FDI with the intention of benefiting their economies. However, FDI may also have negative effects on their hosts' countries, including increasing various dimensions of inequality. Hale and Xu [2016] find that foreign MNEs pay their workers higher wages than domestic firms and increase the premium on skilled workers, increasing income inequality within the economy. This also indicates that they can outcompete domestic firms for better workers. Their higher productivity rates, larger size and lower borrowing costs may also allow them to outcompete domestic firms for more scarce intermediate inputs by paying more for them, such as the most attractive locations for their premises, further increasing the productivity gap. If these productivity gains are shared by workers within the firm, this can further increase income inequality.

This paper demonstrates how MNE spillovers can be a source of income inequality through former MNE workers only benefiting higher paid incumbents. These findings complement the findings of Setzler and Tintelnot [2021] who show that increased employment in foreign firms in a commuting area increases the wages of high-paid workers and has no effect of low-income workers, increasing inequality. They also complement those of Alfaro-Ureña

et al. [2021] that the MNE wage premium for workers with a college education is higher than for workers without one (12 versus eight percent) and that higher training costs allow domestic workers to take some of the increase in employer rents resulting from higher sales to MNEs. The findings of Alfaro-Ureña et al. [2021] also have relevance for this paper. If higher wage incumbents have higher training costs than their lower paid peers, this may be partly responsible for their increased wages after former MNE workers join, since it would consequently be more costly for their employers to lose them. Using data on China from 2003-06, Girma et al. [2019] also provide broader evidence on why mixed results on FDI spillovers may occur. They find that a relatively low presence of foreign MNEs has a small positive effect on average workers' wages in domestic firms while a high presence negatively affects their wages.

The remainder of the paper proceeds as follows. Section 2 reviews the broader literature. Section 3 describes the administrative panel data used in this analysis. Section 4 describes the theoretical background. Section 5 describes the regression approach. Section 6 presents the results. Section 7 concludes.

2 Literature review

FDI is a component of globalisation. The effect of globalisation on inequality is an increasing source of concern. Globalisation shocks have played an important role in the rise in right wing populist movements [Rodrik, 2021]. Theory and empirical analysis find that the beneficiaries of globalisation are often the wealthiest while the losers are the poorest workers with less education and those in regions that are already negatively affected by deindustrialisation [Case and Deaton, 2020]. More broadly, policies that increase globalisation lead to long lasting declines in the labour share of income and corresponding increases in income inequality [Furceri et al., 2019]. Freeing capital to cross borders also increases the exposure of workers to idiosyncratic economic shocks [Buch and Pierdzioch, 2014]. However,

the distributional consequences of FDI, in particular its effect in host countries, has not received much attention to date.

This paper contributes to the wider literature on FDI spillovers. More generally, FDI spillovers refer to knowledge created by a foreign MNE that is used by a host country firm for which the host country firm does not, or does not fully, compensate the MNE [Smeets, 2008]. Spillovers are assumed to occur based on a domestic firm's proximity to an MNE; the literature distinguishes horizontal and vertical spillovers through labour mobility. Firms may be horizontally proximate, in the sense that they operate in the same industry. Horizontal spillovers may boost the domestic firm's productivity through increased competition, through a potential reduction in costs or due to learning about and adapting a new technology or through knowledge spillovers from worker mobility.

There are two types of vertical spillovers. They can occur through backward linkages, where a domestic firm improves their production processes through selling products to foreign MNEs. They can also take the form of forward linkages when a domestic firm boosts their productivity through purchasing a large share of their intermediate inputs from foreign MNEs [Smeets, 2008].[2]

The literature on both horizontal and vertical FDI spillovers is characterised by a mix of positive, negative and non-significant results. For surveys see Keller [2021], Smeets [2008] and Görg and Greenaway [2004]. One of the earliest papers in the horizontal spillovers literature is Aitken and Harrison [1999] who find evidence of negative horizontal spillovers for Venezuela using data from 1976-89. The seminal paper in the vertical spillover literature is Smarzynska Javorcik [2004] who finds positive evidence vertical spillovers through backward linkages using Lithuanian data from 1996-2000.

To the best of my knowledge, only four other papers have empirically analysed FDI spillovers through the channel of worker mobility. After Poole [2013], this paper is perhaps closest

[2]Industry linkages to estimate spillovers through backward or forward linkages are typically estimated using input-output tables. Earlier papers use the input-output table of the host country to estimate the likely input industries of foreign MNEs, while later ones, beginning with Barrios et al. [2011], use the input-output tables of the foreign MNE's home country to do so.

to Balsvik [2011]. Using comprehensive data on manufacturing firms in Norway from 1990-2000, she finds evidence that workers with MNE experience contribute 20% more to the total factor productivity (TFP) of their plant than workers without such experience. However, she points out that this spillover may be more a purchased factor of production rather than an externality. Unlike Poole [2013], this spillover combines both the direct and indirect (i.e., the peer) effect of former MNE workers on firm level productivity.

It is also possible that only some workers transfer spillovers. A third empirical paper on FDI spillovers through labour mobility is Görg and Strobl [2005]. Using World Bank survey data from Ghana from 1991-97, they find that domestic firms who have owners with prior experience in an MNE in the same industry are more productive than other domestic firms. A fourth is Fons-Rosen et al. [2018]. They find that inventor mobility between sectors is a channel to transfer technology between foreign and domestic firms, although this is not the primary focus of their paper. Similarly, Markusen and Trofimenko [2009] develop a model to understand how foreign experts visit a local plant and train its workers. Using fixed effects and nearest neighbour matching estimators on a panel of Colombian plant-level data from 1977-91, they find that these experts have positive effects on the wages of domestic workers.

Other literatures suggest that productivity spillovers can take place through labour mobility. This includes Serafinelli [2019] in the labour literature who examines labour-market based spillovers from 'good firms' (defined as high wage firms using a wage decomposition method outlined in Abowd et al. [1999]) to 'bad firms' (defined as low wage firms) using extensive data from the Veneto region in Italy for 1992-2001. His findings suggest that worker flows can explain about 10 percent of the TFP gains by incumbent firms when new highly productive firms are added to the local market. Using Danish manufacturing data from 1995-2007, Stoyanov and Zubanov [2012] find gains from hiring from more productive firms equal to 0.35 percent per year. Mas and Moretti [2009] suggest that having high productivity co-workers increases the marginal productivity of existing workers using data from six stores of a large supermarket chain in a metropolitan region in the United States between 2003 and

2006.

Greenstone et al. [2010] find TFP in incumbent plants in USA counties that attract a large manufacturing plant increases by 12 percent more than in similar counties that do not. This effect is particularly pronounced when incumbent firms in these same counties have a large share of labour market pooling with the manufacturing plants' industry. Their data is from 1973-98.

However, there is also evidence within the FDI literature to suggest why spillovers might not occur through labour mobility. Instead, the foreign MNE wage premium may be mostly related to foreign MNEs selecting better workers. Using administrative data from Portugal from 1991-2000, Martins [2011] finds that foreign firms can attract what he defines as the 'best' workers as they offer them large wage increases and that domestic firms tend to hire 'below-average' workers from foreign firms who tend to take pay cuts when coming to domestic firms. He suggests that FDI spillovers through labour mobility are unlikely to be large as a result.

Becker et al. [2020] is another paper within the FDI literature that suggests why spillovers might not occur through labour mobility. Using firm-level microdata on high tech sectors where skill shortages exist in 28 European countries from 2002-10, they find that FDI crowds out employment opportunities for the domestic sector, improves the position of skilled workers and increases inequality. Moreover, the benefits from FDI are lowest in regions where labour markets are least flexible and there is low absorptive capacity (ability to learn from foreign MNEs).

This paper also contributes to a strand of the FDI spillovers literature that uses Irish data. Foreign MNEs form a large share of the Irish economy. They are mostly US-owned firms and are concentrated in the manufacturing, information and communications, and the financial and insurance sectors [OECD, 2021]. Much like the broader literature, findings on horizontal and vertical FDI spillovers using Irish data are mixed. Di Ubaldo et al. [2018] examine the potential for both horizontal and vertical FDI spillovers to domestic firms in manufacturing

and services sectors in Ireland from 2008-2014 through backward and forward linkages. They find little evidence that MNEs affect domestic firm productivity. In contrast, Barrios et al. [2011] find robust evidence for positive backward FDI spillovers in Irish manufacturing sectors from 1990-98. Haller [2014] analyses horizontal spillovers from foreign MNEs in Irish services sectors from 2001-07. She finds negative FDI spillovers in two sectors (wholesale and retail trade; and transport, storage and communication) and non-significant results in a third (real estate, renting and business activities). Ruane and Uğur [2004] measure the effect of horizontal spillovers on domestic plants' labour productivity in manufacturing firms from 1991-98. They find only weak evidence of spillovers. None of the papers using Irish data have analysed FDI spillovers through the channel of worker mobility to date.

3 Data

3.1 Data sources

My main dataset is a worker-level administrative panel tracking the universe of formal workers in the Irish economy from 2005 to 2016. This dataset is based on tax records filed by employers through the P35 tax form on behalf of their workers to the Irish Revenue Commissioners. It is then combined with additional worker characteristics from the Irish Department of Social Protection's Client Record System using a unique worker identifier.

I further combine this with data at the firm level from the Irish Central Statistics Office (CSO) Business Register. The CSO Business Register covers all firms in the Irish economy and is based on data collected by the Irish Companies Registration Office. All firms in Ireland are required to register with the Companies Registration Office and file an annual return with them. Firms that are incorporated outside Ireland and establish a subsidiary within Ireland must also register an Irish firm with the Companies Registration Office. I obtain data on firms' country of ultimate ownership and their address within Ireland from the Business Register and match it at the firm level using a unique firm identifier. This data

is used to define whether a firm is a foreign MNE and the region where they are located within the country. A full variable description is available in the appendix.

3.2 Data preparation

I take several steps to prepare the data. The worker-level data contains a separate entry for every registered employment position in Ireland in each year from 2005 to 2016. I isolate workers based on their main social welfare category. Some workers are in one or all of the following categories; pensioner, director or employee. I assign workers to the category in which they have the most weeks of employment per year that are liable for social insurance contributions. Where they have 52 of each, I classify them as an employee. If they have 52 weeks as both a pensioner and a director, I classify them as a pensioner. I drop workers classified as pensioners. I also exclude workers over 60 and workers under 25.

Since I am interested in analysing market firms, I exclude workers currently employed in households and international/external government employers (NACE letters T and U) and workers in the public sector or similar (NACE letters O, P and Q). These steps leave me with 18.5 million worker-year observations in market firms over 10 years. This consists of three million unique workers in 272 thousand unique firms.[3]

While I have information on how many weeks a worker worked, I do not have information on the number of hours worked per year. Former MNE workers who work few hours are unlikely to have as much interaction with their peers, reducing the likelihood of spillovers. Incumbent workers may experience large annual wage increases due to going from part-time work with low hours to full-time work. I exclude many such part-time workers by dropping all workers with wages of less than 15,051 euros per year. The wage of 15,051 corresponds to the approximate wage one would earn from working full-time for one year at the national minimum wage in 2011. Excluding workers earning less than 15,051 per year reduces the number of worker-year observations to 13.9 million. I exclude such workers before defining

[3]2006 to 2016. The year 2006 is the first year in my regression sample as I do not have information on previous firm experience for workers in 2005.

former MNE workers and analysing their effect on incumbent workers. Once I have defined the shares of former MNE workers and workers with experience in other domestic firms, I only keep incumbent workers in domestic firms with no known experience outside their current firm. Isolating incumbent workers leaves me with 3.4 million worker-year observations.

I exclude firms with less than 10 workers to ensure the variables measuring shares of former MNE workers remain meaningful (i.e. to ensure that when one former MNE worker joins the firm their effect on the share variable is to increase it by 0.1 or less).[4] This reduces the number of worker-year observations by 30 percent to 2.4 million. This consists of 573 thousand unique workers in 22 thousand unique firms. Table A1 in the appendix displays more detail on the data preparation process. The sectors with the largest absolute declines in workers are wholesale and retail, construction, followed by professional and scientific activities. Real estate has the largest percentage decline in workers but does not cover many sectors (Figure A1, appendix). Dropping these workers has the effect of producing a similar wage distribution for the sample but at higher income levels (Figure A2, appendix).

3.3 Definitions and data description

My definition of an incumbent worker is someone who did not move firms since 2005 or since the year that they started to work if they started later than 2005.[5] I do not know workers' employment experience prior to 2005. For example, it could be that workers who I have only observed working for the same domestic firm may have had experience in a foreign MNE prior to the beginning of my sample.

The former foreign MNE and former domestic worker share variables refer to the shares of workers in a domestic firm in a particular year who previously worked for a foreign MNE or a domestic firm respectively. Former MNE workers are workers in a domestic market firm who have been in an MNE for at least one year since 2005. Workers previously in another

[4] As a robustness check, I also analyse the effect on incumbent workers in firms with less than 10 workers.

[5] I also analyse the effect on incumbent workers who were in the same firm in each year throughout the period as a robustness check.

domestic firm are workers in a domestic market firm who have been in another domestic market firm for at least one year since 2005. If a worker has been in an MNE and another domestic firm they are counted as a former MNE worker.

Table 1: Worker summary statistics

	N	Mean	Std Dev.	Median	P10	P90
	Workers in market firms, excluding low paid workers					
ln(wage)	13,890,695	10.488	0.519	10.445	9.844	11.144
Age	13,890,695	39.697	9.590	38.000	28.000	54.000
Weeks	13,890,695	50.093	5.865	52.000	46.000	52.000
Non-Irish worker	13,890,695	0.186	0.389	0.000	0.000	1.000
Share female workers in firm	13,890,695	0.454	0.282	0.448	0.071	0.832
	Incumbent workers in domestic firms with 10+ workers					
ln(wage)	2,396,452	10.517	0.555	10.459	9.852	11.234
Age	2,396,452	40.465	9.655	40.000	28.000	55.000
Weeks	2,396,452	50.253	5.590	52.000	47.000	52.000
Non-Irish worker	2,396,452	0.227	0.419	0.000	0.000	1.000
Share female workers in firm	23,96,452	0.343	0.232	0.292	0.067	0.667

Table 1 provides worker-level summary statistics for workers in market firms and incumbent workers in domestic firms with 10 or more workers. The median worker-year observation in the dataset from 2006-2016 earns $e^{10.445}$ (34,372) euros in wages, is aged 38 and works 52 weeks of employment per year that are liable for social insurance contributions. The median incumbent worker-year observation in domestic firms of 10 or more earns $e^{10.459}$ (34,857) euros in wages, is aged 40 and works 52 weeks of employment per year that are liable for social insurance contributions. The median incumbent worker is Irish and works in a firm where 29 percent of the workers are female.

Table 2 provides worker-level summary statistics for workers with experience in other domestic firms in their second year of working in a domestic firm with 10 or more workers. The median worker-year observation in the dataset from 2006-2016 earns $e^{10.42}$ (33,523) euros in wages, is aged 38 and works 52 weeks of employment per year that are liable for social insurance contributions. The median worker with experience in other domestic firms is Irish and works in a firm where 58 percent of the workers are female.

Table 2: Workers with other domestic firm experience based in domestic firms with 10+ workers

	N	Mean	Std Dev.	Median	P10	P90
ln(wage)	1,665,405	10.445	0.456	10.420	9.863	10.991
Age	1,665,405	39.701	9.493	38.000	28.000	54.000
Weeks	1,665,405	51.131	3.708	52.000	51.000	52.000
Non-Irish worker	1,665,405	0.155	0.362	0.000	0.000	1.000
Share female workers in firm	1,665,405	0.533	0.301	0.576	0.087	0.857

Table 3: Workers with experience in MNEs based in domestic firms with 10+ workers

	N	Mean	Std Dev.	Median	P10	P90
ln(wage)	258,349	10.484	0.502	10.425	9.889	11.132
Age	258,349	36.650	8.452	35.000	27.000	49.000
Weeks	258,349	51.215	3.522	52.000	51.000	52.000
Non-Irish worker	258,349	0.152	0.360	0.000	0.000	1.000
Share female workers in firm	258,349	0.473	0.271	0.480	0.098	0.852

Table 3 provides worker-level summary statistics for workers with experience in foreign MNEs in their second year of working in a domestic firm with 10 or more workers. The median worker-year observation in the dataset from 2006-2016 earns $e^{10.425}$ (33,691) euros in wages, is aged 35 and works 52 weeks of employment per year that are liable for social insurance contributions. The median worker with experience in foreign MNEs is Irish and works in a firm where 48 percent of the workers are female.

Table 4: Wages in foreign and domestic firms

Dependent variable: ln(wage)		
Foreign MNE	0.023	(0.005) ***
Domestic firm	(omitted category)	
Constant	8.228	(0.055) ***
N	9575585	
Adj. R^2	0.827	

Standard errors in parentheses
Standard errors are clustered at the firm level.
Control variables: ln(firm size), non-Irish worker, firm's share of female workers, age, age^2, weeks.
Includes year and worker fixed effects.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1: Wages in market firms by firm type

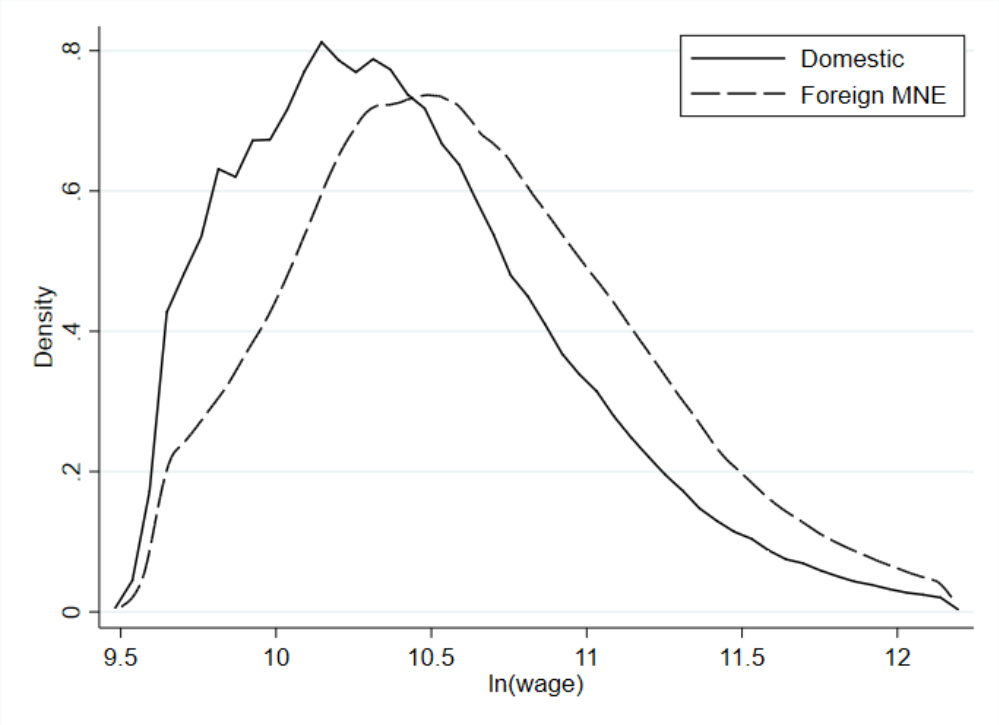


Chart excludes top one percent of wage distribution.
Sample covers all market firms excluding low paid workers (Stage 2 in Table A1).

Figure 1 and Table 4 demonstrate that foreign MNEs pay their workers more than domestic firms. This is consistent with previous literature [Balsvik, 2011] [Driffield and Girma, 2003] [Girma et al., 2001] [Aitken et al., 1996] and indicates a productivity gap between foreign MNEs and domestic firms. This is also in line with the evidence for Ireland using TFP at the firm level [Papa et al., 2021] [Haller, 2012].

Figure 2 illustrates how this wage gap also exists for workers with MNE experience within domestic firms. Here I compare the wages of all incumbent workers with wages of new workers from domestic firms and foreign MNEs in their second year of employment in the new firm. This avoids any issues around first year effects associated with wages of the previous job, redundancies and spells of unpaid absence between jobs. This figure shows that workers previously working in domestic firms are paid less than incumbent workers while former MNE workers are better paid than both, suggesting a productivity differential that they may be able to transfer. This evidence of a wage premium is further confirmed by

Figure 2: Wages for different groups of workers

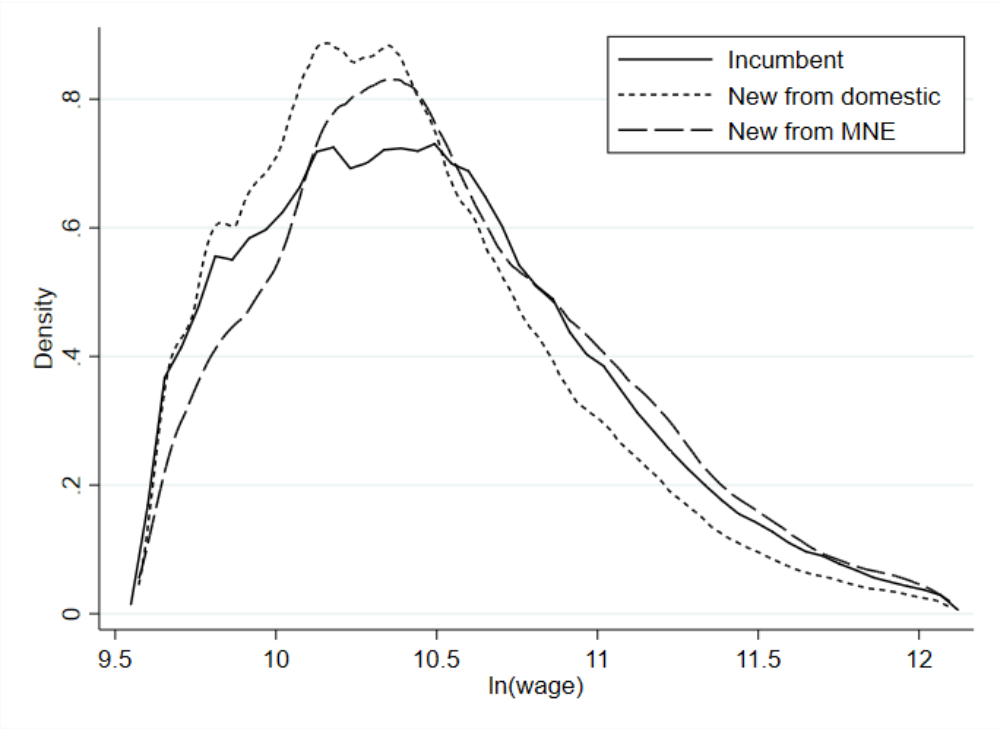


Chart excludes top one percent of wage distribution.
New from domestic and new from MNE are in second year of employment in new firm.
Sample covers all market firms excluding low paid workers (Stage 2 in Table A1).

a simple regression of wage on former worker status in domestic firms (Table 5). Workers with experience in another domestic firm earn three percent more than incumbent workers while workers with experience in a foreign MNE earn four percent more.

Taken together, we can say that former MNE workers in domestic firms earn a little more than workers previously in other domestic firms. However, they are younger and earn 3.5 percent more than incumbent workers and 0.8 percent more than workers previously in other domestic firms when controlling for other factors. Consequently, while they are younger, former MNE workers are coming in largely at the same point of the distribution as workers previously in other domestic firms.

Table 5: Returns to extra-firm experience

Dependent variable: ln(wage)		
Formerly in MNE	0.035	(0.002) ***
Formerly in domestic firm	0.028	(0.002) ***
Incumbent	(omitted category)	
Constant	8.132	(0.053) ***
MNE - dom wage	.008	
SE	.002	
N	5588964	
Adj. R^2	0.866	

Standard errors clustered at the firm level in parentheses.
Control variables: ln(firm size), non-Irish worker,
firm's share of female workers, age, age^2, weeks.
Includes year, firm and worker fixed effects.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4 Theory

This paper examines whether there is evidence consistent with peer effects of former MNE workers on incumbent workers in domestic firms. Cornelissen et al. [2017] provide a helpful theoretical model on peer effects in this context. The model states that workers increase productivity as a result of either peer pressure or knowledge spillover from more productive workers within the firm. More productive activity is more costly to workers. Firms

compensate this cost though workers' wages. The individual level production function is as follows:

$$f_i = y_i + \varepsilon_i = a_i + e_i(1 + \lambda^K \bar{a}_{\ i}) + \varepsilon_i \tag{1}$$

where f_i is output of individual i, y_i refers to worker i's productive capacity, which depends on individual ability a_i, individual effort e_i, knowledge spillovers λ^K and average peer ability $\bar{a}_i$. ε_i refers to random output variation that is beyond the worker's control and has an expected mean of zero. In this paper, where positive spillovers take place, λ^K is expected to be an increasing function of the share of former MNE workers.

For the worker, this is subject to a cost of effort and social pressure function:

$$c_i = C(e_i) + P(e_i, \bar{f}_{\sim i}) = ke_i^2 + \lambda^P(m - e_i)\bar{f}_{\ i} \tag{2}$$

where c_i, the cost of effort, depends on individual cost of effort $C(e_i)$ and a social peer pressure function $P(e_i, \bar{f}_{\sim i})$ that depends on one's effort e_i and everyone else's average output $\bar{f}_{\sim i}$. λ^P refers to the strength of peer pressure while m refers to the pain from peer pressure.

The worker's equilibrium effort is defined as follows:

$$e_i = \frac{\lambda^P}{2K}\bar{e}_{\ i} + \frac{b}{2k} + \frac{\lambda^P + b\lambda^k}{2k}\bar{a}_{\ i} \tag{3}$$

where b denotes the slope of the wage contract with respect to worker output. Equilibrium effort is increasing in peer ability or through peer pressure or knowledge spillover.

Firms reward workers effort with wages based on the following optimisation problem:

$$Ew_i = v(a_i) + C(e_i^*) + P(e_i^*, \bar{y}_{\ i}) \tag{4}$$

meaning that firms pay workers wages based on the value of ability, the cost of effort to the worker and the effort induced by others. In my empirical model, ability a_i is captured within workers' fixed effects. Effort e_i is affected by knowledge spillovers from workers from

foreign MNEs S_{jt}^{M} and domestic firms S_{jt}^{D}, captured within λ^{P}. I cannot empirically separate knowledge spillovers from peer pressure.

5 Regressions

An incumbent worker's wage depends on their characteristics and those of their firm:

$$lnY_{i(j)t} = \gamma_M S_{jt} + \beta_1 W_{i(j)t} + \beta_2 X_{jt} + FE + \varepsilon_{i(j)t} \tag{5}$$

where i refers to the individual, j refers to the firm, t indexes the time, $lnY_{i(j)t}$ denotes the individual's log wage, and S_{jt} refers to the share of the firm's workforce with previous experience in another firm. $W_{i(j)t}$, X_{jt} and FE refers to worker characteristics, other firm characteristics and relevant fixed effects respectively. This share of workers with previous experience S_{jt} can be split into experience in a foreign MNE S_{jt}^{M} or a domestic firm S_{jt}^{D}. This brings us to the following regression specification to examine the correlation between incumbent workers' wages and the extent of their potential exposure to workers from foreign MNEs:

$$lnY_{i(j)t} = \gamma_M S_{jt}^{M} + \gamma_D S_{jt}^{D} + \beta_1 W_{i(j)t} + \beta_2 X_{jt} + FE + \varepsilon_{i(j)t} \tag{6}$$

A domestic incumbent worker is a worker in a domestic firm who has no experience in any other firm during the time period. They may be in the sample throughout the period but may also join or leave the sample at any point during the period. The share of former MNE workers relates to the probability that the domestic incumbent worker interacts with new workers that have previous experience of working at a foreign MNE. The higher the share of workers from foreign MNEs in a domestic firm, the greater the probability that the incumbent worker interacts with such workers. However, workers from other domestic firms may also bring technology and new skills to the firm. Thus, I also control for the share of workers from other domestic firms. If positive spillovers through worker mobility

exist, we expect both $\gamma_M > 0$ and $\gamma_D > 0$. If these spillovers are greater from workers with multinational experience than from workers with experience in other domestic firms, we expect $\gamma_M > \gamma_D$. The base specification follows Poole [2013].[6] This approach circumvents the reflection problem by focusing on the outcomes of incumbent workers only. The reflection problem occurs when an individual's outcome variable is both affected by and affects peer outcomes (measured as one or more of the explanatory variables) [Manski, 1993].

In addition to this, I control for worker-level characteristics $W_{i(j)t}$. These are non-Irish worker, age, age^2 and number of weeks eligible for social insurance contributions. I also control for time-varying firm-specific characteristics X_{jt}. These are log firm size (i.e. number of workers in the firm), lagged growth in log firm size and the firm's share of female workers. Lagged firm size controls for the fact that firm growth may increase wages for all workers in a firm.

I control for three sets of fixed effects (FE): worker, industry-year and region-year fixed effects. Worker fixed effects control for time-invariant differences across workers and firms.[7] The industry-year and region-year fixed effects control for industry and region-specific business cycles. This implies that identification comes from variation in wages within workers and within firms over time. Regions refer to three digit NUTS (2016 version) regions. There are eight of these in Ireland. I use three digit NACE rev. 2 codes, covering 238 industry categories in Ireland. The appendix contains a full description of the variables used in this paper.

[6]Poole's main regression has different worker characteristics, no lag firm growth control and separate worker, firm and year fixed effects. I use a comparable set of fixed effects to Poole's main regression in my first regression. My second regression uses the same set of fixed effects as a more robust specification later in her paper. My preferred specification includes a lag firm growth control variable in addition to this.

[7]Worker fixed effects are identical to worker-firm fixed effects in this setting as incumbent workers are defined as workers who do not change firms.

6 Regression results

6.1 Baseline results

Table 6: Baseline results

	(1)		(2)		(3)	
Dependent variable: ln(wage)						
γ_M	0.114	(0.034) ***	0.020	(0.025)	0.037	(0.027)
γ_D	0.005	(0.019)	0.009	(0.013)	0.037	(0.015) **
Δ ln(firm size)$_{t-1}$					0.013	(0.004) ***
Constant	7.974	(0.082) ***	8.053	(0.074) ***	8.329	(0.077) ***
$\gamma_M - \gamma_D$	0.110		0.011		-0.001	
SE	0.031		0.026		0.027	
Worker FE	Yes		Yes		Yes	
Firm FE	Yes		Yes		Yes	
Year FE	Yes		No		No	
NACE3-year FE	No		Yes		Yes	
NUTS3-year FE	No		Yes		Yes	
N	2251181		2251167		1563619	
N firms	17527		17524		11916	
Adj. R^2	0.901		0.905		0.917	

Note: Standard errors clustered at the firm level in parentheses.
Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 contains my baseline results. In Column 1, I control for year, firm and worker fixed effects in addition to worker and firm characteristics. This specification follows Poole [2013]'s baseline regression's control variable assumptions. Year fixed effects control for features of the business cycle. Firm fixed effects control for any fixed factor that may affect an establishment's decision to hire workers from foreign MNEs, such as time-invariant management style or time-invariant productivity levels. Worker fixed effects control for time-invariant, unobservable worker characteristics. These include innate ability, motivation and, in the vast majority of cases, gender. The coefficient on the share of MNE workers γ_M is 0.11, while the coefficient for domestic workers γ_D is 0.005, resulting in $\gamma_M - \gamma_D$ equalling 0.11. This suggests that, under the same assumptions as Poole [2013], a 10 percentage point

increase in the share of former MNE workers in domestic firms is associated with a 1.2 percent increase in incumbent worker wages.[8] For comparison, Poole [2013] has a coefficient of 0.056 for MNE workers and 0.006 for former domestic workers and a combined $\gamma_M - \gamma_D$ coefficient of 0.051, suggesting a 10 percentage point increase in the share of former MNE workers in domestic firms is associated with a 0.5 percent increase.

In column 2 and in all further specifications I control for region-year, industry-year and worker-firm fixed effects. Worker-firm fixed effects allow for time invariant differences across workers and firms. The industry and region-year fixed effects control for industry and region-specific business cycles. This combination of fixed effects allows me to compare the same worker in the same firm, independent of region-time invariant characteristics and industry-time invariant characteristics. This causes the coefficient on the share of former MNE workers to fall to two percent and become non-significant, resulting in $\gamma_M - \gamma_D$ being equal to 0.11 and not statistically significant. Poole [2013] uses this specification as a robustness check. For comparison, she has a coefficient of 0.050 for MNE workers and 0.004 for former domestic workers and a combined $\gamma_M - \gamma_D$ coefficient of 0.046, significant only at the 10 percent level.

In column 3 and in all further specifications, I also control for lagged growth in log firm size (defined as number of workers). Lagged firm growth controls for the fact that firm growth may increase wages for all workers in a firm. This results in coefficient estimates for the share of workers from both foreign MNEs and other domestic firms of approximately four percent with only the γ_D coefficient being statistically significant. This suggests that there is no relationship between the share of former MNE workers and the average wages of an incumbent worker.

Using the same specifications with a balanced panel where only incumbent workers present throughout the entire sample are included, I also do not find $\gamma_M - \gamma_D$ to be statistically significant different from zero (see Table A2, appendix). As an alternative specification, I replace S_{jt}^M and S_{jt}^D with a variable for the share of new workers in the firm and a second

[8]The following formula should be use to precisely calculate the effects of coefficients when using a log linear model: $e^{(\gamma_M - \gamma_D)} - 1$.

variable for the share of these new workers who are from MNEs (see Table A3, appendix). Controlling for the share of new employees, the coefficient on the share of these new employees who are from foreign MNEs is not significant. New workers are defined as workers who have joined the firm in the last three years.

Table A4 (appendix) examines the impact of former MNE and workers from other domestic firms on incumbent wages by sector. Incumbent workers in both manufacturing and services firms do not appear to experience FDI spillovers. Splitting the analysis into further industry detail (Table A5) does not yield significant results either.[9]

Other sub-samples of the data also confirm these results. These included limiting workers previous employment experience counted in creating the share variables to three, five and six years (Tables A6 and A7); separate regressions for men and women (Table A8); focusing on new firms only (Table A9); restricting the sample to workers with only one job per year (also Table A9); and lagging the shares of former MNE workers (Table A10). These tables are available in the appendix.

6.2 Firm Size

Table 7 displays separate regressions for firms of different sizes (based on their number of workers). Here I also include a column on workers in firms with less than 10 workers for completeness. I do not find significant effects for firms with less than 250 workers. I find a negative and significant coefficient of -0.61 for workers in firms employing 250 or more people. This indicates that a 10 percentage point increase in the share of former MNE workers is associated with a decline in wages of 6 percent. It is worth noting that while the number of worker-years is high (660 thousand) the numbers of firm-years is relatively small (237).

Table 7: Firm size

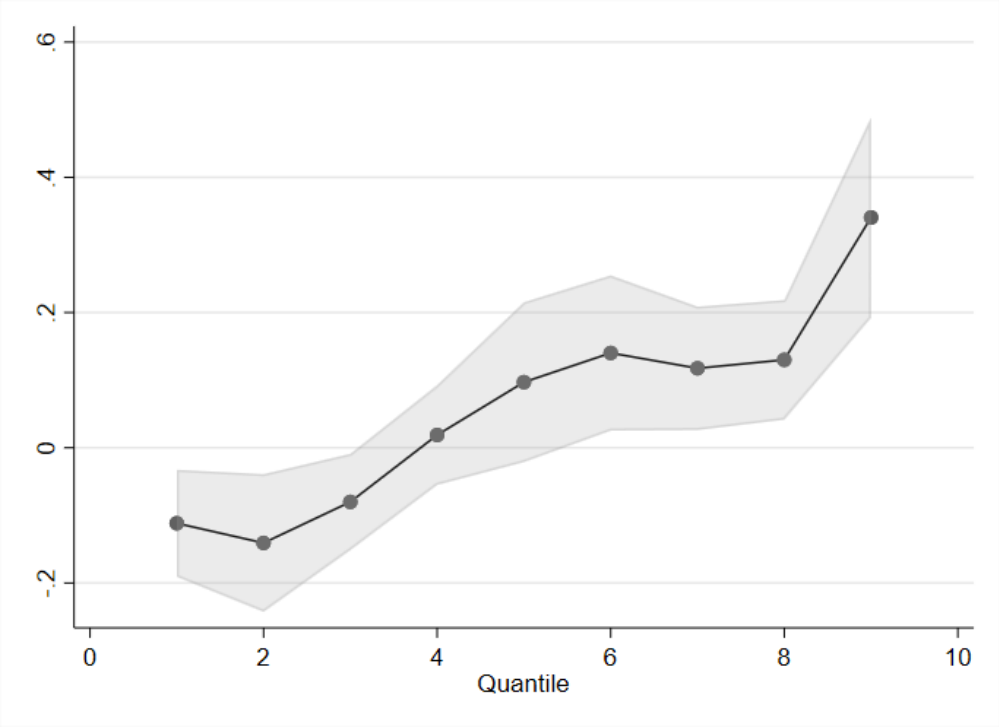
	(1)	(2)	(3)	(4)	(5)
	< 10	10-49	50-99	100-249	250+
γ_M	0.013	0.014	0.026	0.219**	-0.347**
	(0.009)	(0.019)	(0.083)	(0.093)	(0.148)
γ_D	0.001	0.004	-0.065	0.117*	0.262**
	(0.005)	(0.013)	(0.049)	(0.062)	(0.119)
lag Δ ln(firm size)	0.003**	0.012***	0.000	-0.063***	0.060**
	(0.001)	(0.004)	(0.013)	(0.016)	(0.030)
Constant	9.266***	8.515***	8.036***	8.176***	8.792***
	(0.112)	(0.110)	(0.181)	(0.164)	(0.365)
$\gamma_M - \gamma_D$	.012	.010	.091	.102	-.609
SE	.009	.018	.079	.091	.145
N	481299	544546	175181	153510	660362
N firms	47030	10582	1486	589	237
Adj. R^2	0.844	0.904	0.929	0.940	0.934

Note: Standard errors clustered at the firm level in parentheses.

Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 3: Quantile regression with $\gamma_M - \gamma_D$ displayed



Shaded area refers to 95% confidence interval.

6.3 Unconditional quantile regression

One aspect of FDI spillovers through labour mobility that has not been examined to date is its effect across the wage distribution. This can be analysed using within-year worker quantile regressions. These unconditional quantile regressions measure the effect of a covariate on the dependent variable for workers at different points in the wage distribution in a given year. Figure 3 displays the results of unconditional quantile regressions on incumbent worker wages, where quantiles are within-year wage deciles (see also Table A11, appendix).[10] The coefficients on the share of former MNE workers are significant from the fifth decile upwards as well as for the lowest decile. The MNE coefficients indicate positive effects for workers

[9] A set of more full length sector descriptions can be found in Figure A2.

[10] It is more useful to run an unconditional quantile regression using within-year worker quantiles than quantiles based on the distribution of workers across the whole period. Workers tend to earn higher wages in later periods and, by construction, higher shares of former MNE workers are found in later periods. This means that disproportionately more worker-year observations from later years are in higher quantiles and disproportionately more worker-year observations from earlier years are in lower quantiles, potentially biasing the results. An unconditional quantile regression on all worker years can be found in Table A15 in the appendix. The results display a similar pattern but have a wider gap between the top and the bottom.

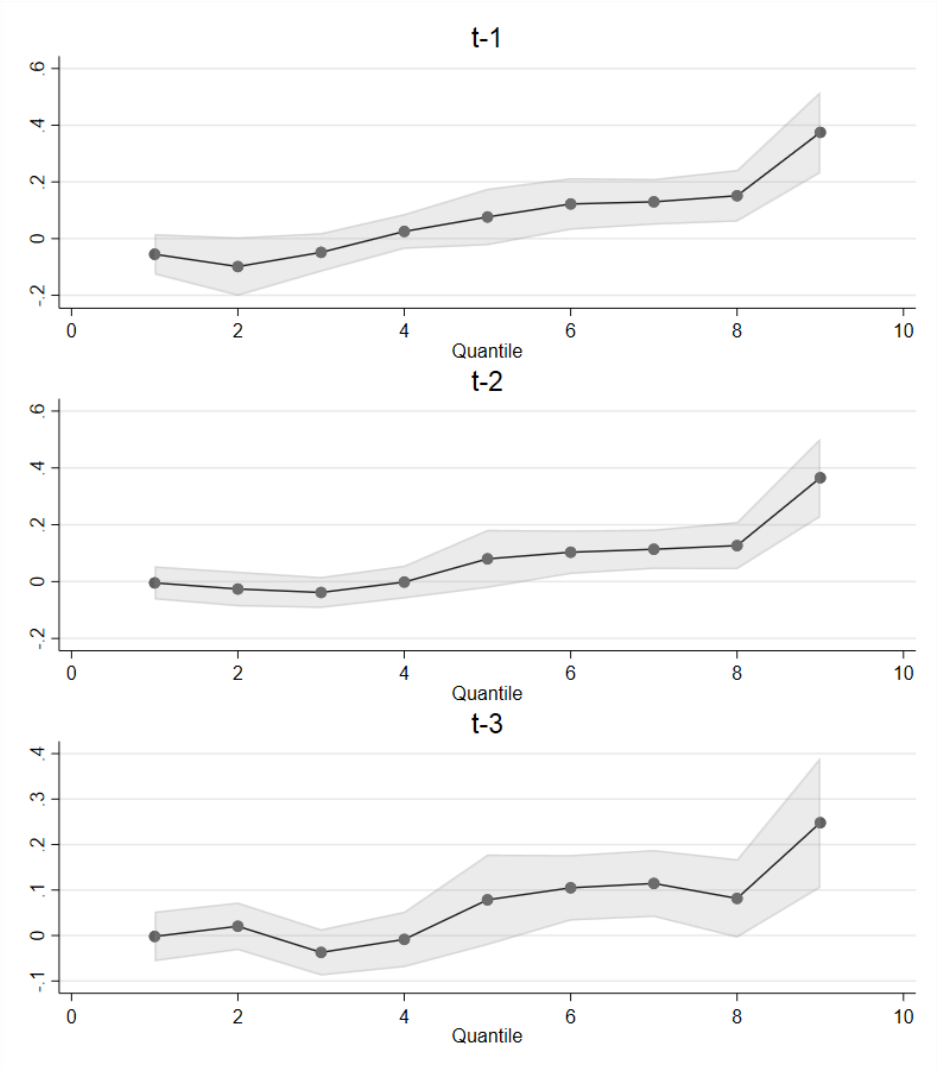
at higher quantiles and negative effects for workers at the lowest decile. The coefficients on the share of workers from other domestic firms indicate a positive effect at each decile but is only significant for the third one.

With the exception of the fourth to the sixth wage deciles, the joint coefficients are statistically significant. The incumbent worker at the highest decile has a $\gamma_M - \gamma_D$ coefficient of 3.41, indicating that a 10 percentage point increase in the share of former MNE workers is associated with a four percent increase in the wage of the incumbent worker at the 90th percentile. For the incumbent worker at the 80^{th}, 70^{th} and 60^{th} percentile, a 10 percentage point increase in the share of former MNE workers is associated with a 1.4, 1.5 and 1.2 percent increase in wages respectively. The coefficient for the 60^{th} percentile is only significant at the 5 percent level.

The incumbent worker at the lowest decile has a $\gamma_M - \gamma_D$ coefficient of minus -1.2 percent. This indicates that a 10 percentage point increase in the share of former MNE workers is associated with a 1.2 percent decline in the wages of the incumbent worker at the 10th percentile of the worker wage distribution. Workers at the 20^{th} and 30^{th} percentile also have negative $\gamma_M - \gamma_D$ coefficients. A 10 percentage point increase in the share of former MNE workers is associated with a 1.5 and 0.8 percent decline in wages. The results at the 40^{th} and 50^{th} percentile are not statistically significantly different from zero, indicating that there are no FDI spillover effects for them.

The quantile results above suggest that former MNE workers have different spillover effects on different incumbent workers in domestic firms. If former MNE workers are indeed affecting incumbent workers' wages, we should expect this to occur over more than the initial year. One can test this idea by running quantile regressions using lagged shares of former MNE workers and workers previously in other domestic firms. For lagged shares in t-1 (Figure 4), the coefficient on the share of former MNE workers in the previous period is significant at five percent or better in the top three deciles. The coefficients for the remaining deciles are either not significant or significant only at the 10 percent level. The coefficients on the share

Figure 4: Quantile regressions with lagged shares:
$\gamma_M - \gamma_D$ displayed



Shaded area refers to 95% confidence interval.

of former MNE workers progress from negative to positive values. The coefficients on the shares of workers previously in other domestic firms is not significant throughout. The joint coefficients are positive, significant and increasing from quantile 0.6 upwards. However, they are not significant below quantile 0.6.

For the lagged t-2 shares (Figure 4), most of the coefficients on the shares of former MNE workers are significant throughout, going from negative to positive. The coefficients on the shares of previously domestic workers are only significant for the lower quantiles where they are negative. Similarly, the joint coefficients are positive and significant for quantile 0.6 and above and are not significant below this.

For the lagged t-3 shares (Figure 4), the coefficients on former MNE workers tend to be less significant than those in t-2 but are more significant than in t-1 and continue to show a negative to positive trend. Again, for shares of workers from other domestic firms, the coefficients on the lowest shares are negative and mostly significant. As before, the joint coefficients are positive and significant for the higher quantiles and are not significant for the lower quantiles.

The pattern for the joint coefficients in these regressions with lagged shares have the same negative to positive values as the quantile regression with contemporaneous shares (Figure 3). Tables A12, A13 and A14 display these quantile regression results in tabular form. Unlike the contemporaneous results, the coefficients for the lower quantiles are not significant using lagged shares. However, the positive coefficients on higher wage deciles persist. This suggests that higher shares of former MNE workers result in higher income for higher paid incumbent workers within domestic firms while they do not have an effect on incumbents who are lower paid. The negative coefficients for lower quantile workers associated with increased shares of former MNE workers in the contemporaneous regressions are due to compositional effects. Former MNE workers may be be substitutable for lower income workers or associated with technological change that benefits higher income workers but makes the roles of lower income incumbents less important within the firm. Employers who hire former MNE workers may

be doing so as part of a wider strategy whereby lower paid workers are less likely to be rewarded with wage increases in the same year. Hiring of former MNE workers may also see the departure of incumbent workers in lower income quantiles and their replacement with incumbents who are paid less.

The evidence from these quantile regressions tells us several things. Former MNE workers are complementary to higher income incumbents (the 60^{th} percentile and above), particularly those at the top of the wage distribution (the 90^{th} percentile). The positive and significant coefficients for the lagged shares of former MNE workers joining the firm indicate that former MNE workers provide a positive spillover. Newly hired former MNE workers tend to be younger than incumbent workers (the median age is 35 rather than 40, see Table 3 and Table 1 respectively) and to earn income levels similar to higher paid incumbent workers. This suggests that they are higher up the firm's hierarchy and relatively better skilled than lower income incumbent workers. Incumbents with higher income, who are also likely to be better skilled, may be consequently better placed to learn from them. The corollary of this is to increase wage inequality among incumbent workers in domestic firms.

7 Conclusion

In this paper I investigate the possibility of FDI spillovers through labour mobility using administrative panel data from Ireland.

In the first part of the paper, I follow existing methodology to analyse wage spillovers to incumbent workers on average. Using a similar specification to Poole (2013), I identify positive wage spillovers from former MNE workers to incumbent workers in domestic firms. However, these results are not robust to controlling for industry-year and region-year dummies. Once this is included, I do not find evidence for spillovers even when checking for potentially heterogeneous effects through various sample splits.

In the second part of the paper, I examine possible heterogeneity of FDI spillovers across the

wage distribution of incumbent workers using quantile regressions. The results suggest that there are spillovers only for workers in the top 40 percent of the wage distribution. Former MNE workers appear be complementary to higher income incumbents. Newly hired former MNE workers tend to be younger than incumbent workers while also earning income levels similar to higher paid incumbent workers. This suggests that they are higher up the firm's hierarchy and relatively better skilled than lower income incumbent workers. Incumbents with higher income, who are also likely to be better skilled, may be consequently better placed to learn from them.

These findings have implications for policy. The existing evidence indicates that MNEs can have negative effects on domestic firms and that they increase wage inequality by paying their workers more. This analysis confirms the evidence of a wage gap for foreign MNEs relative to domestic firms. It also indicates that there are no overall spillover effects through worker mobility on average. Only higher income workers gain from such spillovers, increasing income inequality.

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8 Appendix

8.1 Additional tables

Table A1: Breakdown of market firms

Stage	Worker-years	Workers	Firm-years	Firms
1	18,456,652	2,959,595	1,416,497	272,450
2	13,890,695	2,260,593	1,078,825	214,212
3	11,101,867	2,020,926	1,049,346	211,526
4	10,203,154	1,801,935	1,012,742	202,309
5	3,418,027	800,733	611,161	116,825
6	2,396,452	573,213	110,900	22,425

Notes:
Stage 1: Population of workers in market firms.
Stage 2: Exclude workers with low pay (less than 15,051 euros per year).
Stage 3: Exclude foreign MNEs.
Stage 4: Exclude workers with foreign MNE experience.
Stage 5: Exclude workers with experience in other domestic firms.
Stage 6: Exclude firms with less than 10 workers.

Table A2: Balanced panel

	(1)		(2)		(3)	
Dependent variable: ln(wage)						
γ_M	0.319	(0.046) ***	0.233	(0.034) ***	0.034	(0.035)
γ_D	0.210	(0.029) ***	0.210	(0.023) ***	0.042	(0.022) *
Δ ln(firm size)$_{t-1}$	0.040	(0.009) ***	0.030	(0.007) ***	0.001	(0.006)
Constant	8.859	(0.120) ***	8.921	(0.106) ***	8.237	(0.112) ***
$\gamma_M - \gamma_D$	0.109		0.023		-0.008	
SE	0.049		0.041		0.040	
Separate FE	Yes		No		No	
NACE3-year FE	No		Yes		Yes	
NUTS3-year FE	No		Yes		Yes	
Worker-firm FE	No		No		Yes	
N	692164		692153		692153	
N firms	3865		3864		3864	
Adj. R^2	0.916		0.922		0.922	

Note: Standard errors clustered at the firm level in parentheses.
Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Alternative share specification

	(1)		(2)		(3)	
Dependent variable: ln(wage)						
Share new workers	0.147	(0.012) ***	0.115	(0.008) ***	0.033	(0.009) ***
Share new workers from MNEs	0.009	(0.010)	0.006	(0.007)	0.004	(0.007)
Constant	8.901	(0.079) ***	8.951	(0.074) ***	8.337	(0.077) ***
Separate FE	Yes		No		No	
NACE3-year FE	No		Yes		Yes	
NUTS3-year FE	No		Yes		Yes	
Worker-firm FE	No		Yes		Yes	
Lag firm growth	No		No		Yes	
N	1563627		1563619		1563619	
N firms	11916		11916		11916	
Adj. R^2	0.911		0.916		0.917	

Standard errors are clustered at the firm level.

Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.

Table A4: Manufacturing and services

	(1) Manufacturing		(2) Services	
γ_M	0.048	(0.030)	-0.008	(0.042)
γ_D	0.050	(0.018) ***	-0.001	(0.022)
$\gamma_{M*Sector}$	-0.056	(0.049)	0.056	(0.049)
$\gamma_{D*Sector}$	-0.051	(0.027) *	0.051	(0.027) *
Δ ln(firm size)$_{t-1}$	0.013	(0.004) ***	0.013	(0.004) ***
Constant	8.343	(0.077) ***	8.343	(0.077) ***
$\gamma_M - \gamma_D + \gamma_{M*Sector} - \gamma_{D*Sector}$	-0.007		-0.002	
SE	0.042		0.032	
N	1563619		1563619	
N firms	11916		11916	
Adj. R^2	0.917		0.917	

Standard errors are clustered at the firm level in parentheses.

Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.

* p <0.10, ** p <0.05, *** p <0.01

Table A5: Analysis by A10 sector

	(1) A Agri	(2) B-E Indust	(3) A Cons	(4) G-I Retail	(5) J IT	(6) K Fin	(7) L Real est	(8) MN Prof	(9) R-U Othr
γ_M	-0.023	0.063	0.062	-0.044	0.058	0.151	0.105	0.044	0.075
	(0.139)	(0.043)	(0.068)	(0.043)	(0.068)	(0.101)	(0.753)	(0.069)	(0.064)
γ_D	-0.007	0.040	0.118***	-0.021	-0.017	0.108	0.170	0.111**	0.025
	(0.063)	(0.025)	(0.036)	(0.023)	(0.069)	(0.082)	(0.213)	(0.056)	(0.045)
Δ ln(firm size)$_{t-1}$	0.019	-0.003	0.017**	0.005	0.034	0.102**	0.206***	0.020**	0.009
	(0.024)	(0.009)	(0.009)	(0.006)	(0.024)	(0.042)	(0.072)	(0.009)	(0.013)
Constant	8.833***	8.536***	7.692***	8.256***	8.552***	9.282***	11.224***	7.853***	8.548***
	(0.229)	(0.136)	(0.475)	(0.118)	(0.399)	(0.274)	(0.822)	(0.282)	(0.253)
$\gamma_M - \gamma_D$	-.016	.023	-.056	-.023	.075	.043	-.065	-.067	.05
SE	.14	.04	.065	.043	.075	.111	.665	.085	.06
N	18901	372412	101532	621800	57769	196207	6879	133413	50535
N firms	178	1965	1492	5097	543	389	109	1764	559
Adj. R^2	0.928	0.921	0.866	0.913	0.899	0.927	0.904	0.912	0.926

Standard errors are clustered at the firm level in parentheses.

Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.

* p <0.10, ** p <0.05, *** p <0.01

Table A6: Limiting experience counted

	(1) 6 year exp.		(2) 3 year exp.	
γ_M	0.025	(0.030)	0.005	(0.028)
γ_D	0.025	(0.011) **	0.023	(0.009) ***
Δ ln(firm size)$_{t-1}$	0.013	(0.004) ***	0.012	(0.004) ***
Constant	8.322	(0.077) ***	8.317	(0.077) ***
$\gamma_M - \gamma_D$	-0.000		-0.018	
SE	0.032		0.030	
N	1563619		1563619	
N firms	11916		11916	
Adj. R^2	0.917		0.917	

Note: Standard errors clustered at the firm level in parentheses.
Control variables: age, age^2, weeks, ln(firm size),
firm's share of non-Irish workers, firm's share of female workers.
Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

Table A7: Splitting MNE shares by years

	(1) All		(2) Manufacturing		(3) Services	
$\gamma_{M(<3years)}$	0.046	(0.043)	0.075	(0.072)	0.036	(0.048)
$\gamma_{M(3-5years)}$	-0.016	(0.039)	0.045	(0.074)	-0.022	(0.044)
γ_D	0.034	(0.014) **	0.037	(0.024)	0.034	(0.017) *
Constant	8.336	(0.077) ***	8.542	(0.135) ***	8.266	(0.095) ***
$\gamma_{M(<3years)}$ $+\gamma_{M(3-5years)} - \gamma_D$	-0.004		0.084		-0.019	
SE	0.074		0.108		0.084	
N	1563619		372412		1169463	
N firms	11916		1965		9864	
Adj. R^2	0.917		0.921		0.915	

Note: Standard errors clustered at the firm level in parentheses.
Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.
Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.
* p <0.10, ** p <0.05, *** p <0.01

Table A8: Separate analysis for men and women

	(1) Men		(2) Women	
γ_M	0.055	(0.029) *	0.006	(0.032)
γ_D	0.043	(0.016) ***	0.025	(0.019)
Δ ln(firm size)$_{t-1}$	0.014	(0.004) ***	0.011	(0.006) *
Constant	8.116	(0.101) ***	8.762	(0.121) ***
$\gamma_M - \gamma_D$	0.012		-0.019	
SE	0.030		0.030	
N	1037956		525558	
N firms	11331		9729	
Adj. R^2	0.920		0.897	

Note: Standard errors clustered at the firm level in parentheses.
Control variables: age, age^2, weeks, ln(firm size),
firm's share of non-Irish workers, firm's share of female workers.
Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A9: Further sample breakdowns

	(1) New firms		(2) One job	
γ_M	0.056	(0.054)	0.096	(0.025) ***
γ_D	0.004	(0.042)	0.052	(0.013) ***
Δ ln(firm size)$_{t-1}$	-0.003	(0.014)	0.008	(0.004) **
Constant	8.766	(0.263) ***	8.487	(0.075) ***
$\gamma_M - \gamma_D$	0.052		0.043	
SE	0.059		0.025	
N	103761		1337610	
N firms	1646		9581	
Adj. R^2	0.937		0.933	

Note: Standard errors are clustered at the firm level.
Control variables: age, age^2, weeks, ln(firm size),
firm's share of non-Irish workers, firm's share of female workers.
Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.
High growth defined as above or equal to median growth rate in $t-1$.
Column 1 only includes new firms. New firms are defined as firms that were established in 2005 or later.
Column 2 only includes the income from the most valuable job a worker has in a given year. Workers' wages in the other regressions refer to their total taxable pay for the full year in euros, regardless of whether it came from more than one job.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A10: Lag shares by 1, 2 and 3 years

	(1) t-1		(2) 1-2		(3) t-3	
γ_{Mt-1}	-0.020	(0.026)				
γ_{Dt-1}	-0.020	(0.014)				
γ_{Mt-2}			0.020	(0.022)		
γ_{Dt-2}			-0.010	(0.011)		
γ_{Mt-3}					0.016	(0.021)
γ_{Dt-3}					-0.021	(0.010) **
Δ ln(firm size)$_{t-1}$	0.016	(0.004) ***	0.008	(0.004) **	0.005	(0.003) *
Constant	8.301	(0.076) ***	8.505	(0.078) ***	8.548	(0.103) ***
$\gamma_M - \gamma_D$	0.000		0.030		0.037	
SE	0.027		0.024		0.022	
N	1563619		1331394		1044782	
N firms	11916		10719		8771	
Adj. R^2	0.917		0.935		0.942	

Note: Standard errors clustered at the firm level in parentheses.

Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.

Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A11: Quantile regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
γ_M	-0.103*	-0.103	-0.023	0.064	0.152*	0.170**	0.164***	0.159***	0.400***
	(0.056)	(0.078)	(0.041)	(0.051)	(0.084)	(0.086)	(0.062)	(0.048)	(0.074)
γ_D	0.009	0.038	0.057***	0.046	0.055	0.029	0.047	0.029	0.059
	(0.027)	(0.036)	(0.022)	(0.028)	(0.037)	(0.043)	(0.034)	(0.027)	(0.038)
Δ ln(firm size)$_{t-1}$	0.007	0.013*	0.020***	0.021***	0.022***	0.020**	0.020**	0.016**	0.032***
	(0.006)	(0.007)	(0.005)	(0.006)	(0.007)	(0.009)	(0.008)	(0.008)	(0.011)
Constant	7.786***	7.866***	8.093***	8.348***	8.422***	8.449***	8.599***	8.526***	8.410***
	(0.254)	(0.192)	(0.153)	(0.158)	(0.201)	(0.135)	(0.183)	(0.186)	(0.295)
$\gamma_M - \gamma_D$	-0.112	-0.141	-0.080	0.019	0.097	0.140	0.118	0.130	0.341
SE	0.040	0.052	0.036	0.038	0.060	0.059	0.047	0.045	0.076
N	1563627	1563627	1563627	1563627	1563627	1563627	1563627	1563627	1563627
N firms	11916	11916	11916	11916	11916	11916	11916	11916	11916
Adj. R^2	0.654	0.739	0.781	0.790	0.785	0.791	0.790	0.778	0.765

Note: Standard errors clustered at the firm level in parentheses.

Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.

Each column refers to a decile, e.g. 0.1 refers to workers at the point of the lowest wage decile and 0.5 refers to the median.

Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A12: Quantile regression with lagged t-1 shares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
γ_{Mt-1}	-0.067	-0.117*	-0.066*	0.021	0.091	0.106	0.113**	0.122**	0.403***
	(0.041)	(0.063)	(0.038)	(0.041)	(0.069)	(0.068)	(0.057)	(0.058)	(0.078)
γ_{Dt-1}	-0.012	-0.018	-0.018	-0.004	0.014	-0.016	-0.017	-0.029	0.028
	(0.020)	(0.023)	(0.021)	(0.026)	(0.035)	(0.039)	(0.035)	(0.031)	(0.037)
Δ ln(firm size)$_{t-1}$	0.012**	0.019***	0.024***	0.023***	0.023**	0.020*	0.021**	0.021***	0.027**
	(0.006)	(0.006)	(0.006)	(0.008)	(0.010)	(0.010)	(0.009)	(0.008)	(0.011)
Constant	8.000***	7.998***	8.155***	8.377***	8.492***	8.552***	8.731***	8.764***	8.489***
	(0.252)	(0.187)	(0.169)	(0.157)	(0.216)	(0.137)	(0.214)	(0.218)	(0.349)
$\gamma_{Mt-1} - \gamma_{Dt-1}$	-0.055	-0.099	-0.048	0.025	0.076	0.122	0.130	0.151	0.375
SE	0.036	0.053	0.035	0.031	0.051	0.047	0.041	0.047	0.073
N	1232708	1232708	1232708	1232708	1232708	1232708	1232708	1232708	1232708
N firms	9653	9653	9653	9653	9653	9653	9653	9653	9653
Adj. R^2	0.666	0.753	0.800	0.812	0.810	0.819	0.822	0.815	0.808

Note: Standard errors clustered at the firm level in parentheses.

Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.

Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

Each column refers to a decile, e.g. 0.1 refers to workers at the point of the lowest wage decile and 0.5 refers to the median.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A13: Quantile regression with lagged t-2 shares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
γ_{Mt-2}	-0.027	-0.083**	-0.076***	-0.013	0.105	0.121**	0.126***	0.144***	0.470***
	(0.031)	(0.035)	(0.029)	(0.034)	(0.069)	(0.050)	(0.045)	(0.052)	(0.081)
γ_{Dt-2}	-0.022	-0.057***	-0.038**	-0.011	0.025	0.017	0.012	0.018	0.104**
	(0.018)	(0.019)	(0.018)	(0.020)	(0.028)	(0.026)	(0.027)	(0.029)	(0.042)
Δ ln(firm size)$_{t-1}$	0.002	0.004	0.010*	0.011*	0.023**	0.014**	0.017***	0.016**	0.047***
	(0.006)	(0.005)	(0.005)	(0.006)	(0.010)	(0.007)	(0.006)	(0.007)	(0.011)
Constant	8.349***	8.166***	8.275***	8.365***	8.390***	8.485***	8.727***	8.790***	8.344***
	(0.288)	(0.187)	(0.197)	(0.173)	(0.226)	(0.147)	(0.287)	(0.309)	(0.494)
$\gamma_{Mt-2} - \gamma_{Dt-2}$	-0.005	-0.026	-0.038	-0.002	0.080	0.103	0.114	0.127	0.365
SE	0.030	0.031	0.028	0.030	0.052	0.039	0.036	0.043	0.071
N	974479	974479	974479	974479	974479	974479	974479	974479	974479
N firms	8067	8067	8067	8067	8067	8067	8067	8067	8067
Adj. R^2	0.678	0.768	0.813	0.827	0.825	0.836	0.840	0.832	0.825

Note: Standard errors clustered at the firm level in parentheses.

Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.

Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

Each column refers to a decile, e.g. 0.1 refers to workers at the point of the lowest wage decile and 0.5 refers to the median.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A14: Quantile regression with lagged t-3 shares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
γ_{Mt-3}	-0.029	-0.063**	-0.100***	-0.058*	0.062	0.082*	0.073	0.060	0.313***
	(0.026)	(0.027)	(0.025)	(0.033)	(0.064)	(0.048)	(0.049)	(0.053)	(0.076)
γ_{Dt-3}	-0.027*	-0.084***	-0.063***	-0.049***	-0.016	-0.023	-0.042	-0.021	0.065
	(0.016)	(0.017)	(0.016)	(0.018)	(0.026)	(0.027)	(0.029)	(0.030)	(0.042)
Δ ln(firm size)$_{t-1}$	0.001	-0.004	-0.002	-0.002	0.008	-0.003	-0.004	-0.007	0.020
	(0.005)	(0.005)	(0.006)	(0.007)	(0.012)	(0.008)	(0.008)	(0.008)	(0.012)
Constant	8.107***	8.067***	8.341***	8.200***	8.292***	8.245***	8.666***	8.880***	8.332***
	(0.246)	(0.216)	(0.224)	(0.207)	(0.240)	(0.199)	(0.401)	(0.287)	(0.538)
$\gamma_{Mt-3} - \gamma_{Dt-3}$	-0.002	0.020	-0.037	-0.009	0.079	0.105	0.114	0.082	0.248
SE	0.028	0.027	0.026	0.031	0.051	0.037	0.038	0.044	0.073
N	765142	765142	765142	765142	765142	765142	765142	765142	765142
N firms	6899	6899	6899	6899	6899	6899	6899	6899	6899
Adj. R^2	0.689	0.777	0.823	0.836	0.836	0.848	0.852	0.843	0.838

Note: Standard errors clustered at the firm level in parentheses.

Control variables: age, age^2, weeks, ln(firm size), firm's share of non-Irish workers, firm's share of female workers.

Fixed effects: worker, firm, year, NACE3-year, NUTS3-year.

Each column refers to a decile, e.g. 0.1 refers to workers at the point of the lowest wage decile and 0.5 refers to the median.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A15: Quantile regression: deciles defined across all worker-years

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
γ_M	-0.137**	-0.117	-0.037	0.042	0.120*	0.128	0.165**	0.262***	0.452***
	(0.061)	(0.078)	(0.042)	(0.052)	(0.069)	(0.081)	(0.079)	(0.058)	(0.077)
γ_D	-0.018	0.029	0.061***	0.052*	0.067*	0.044	0.055	0.044	0.052
	(0.027)	(0.033)	(0.023)	(0.028)	(0.035)	(0.043)	(0.040)	(0.028)	(0.037)
Δ ln(firm size)$_{t-1}$	0.004	0.013**	0.019***	0.021***	0.022***	0.022***	0.020**	0.020**	0.035***
	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.012)
Constant	7.612***	7.871***	8.009***	8.359***	8.412***	8.447***	8.630***	8.708***	8.516***
	(0.256)	(0.197)	(0.144)	(0.151)	(0.172)	(0.131)	(0.178)	(0.212)	(0.264)
$\gamma_M - \gamma_D$	-.119	-.145	-.098	-.01	.052	.084	.111	.218	.4
SE	.044	.054	.036	.039	.045	.053	.055	.052	.08
N	1563627	1563627	1563627	1563627	1563627	1563627	1563627	1563627	1563627
R^2	0.718	0.784	0.818	0.826	0.823	0.827	0.826	0.818	0.806

Note: Standard errors clustered at the firm level in parentheses.

Control variables: non-Irish worker, age, age^2, weeks, ln(firm size), firm's share of female workers.

Each column refers to a decile, e.g. 0.1 refers to the lowest wage decile.

* p <0.10, ** p <0.05, *** p <0.01

Figure A1: Impact of introducing threshold for firms with 10+ workers on wage distribution

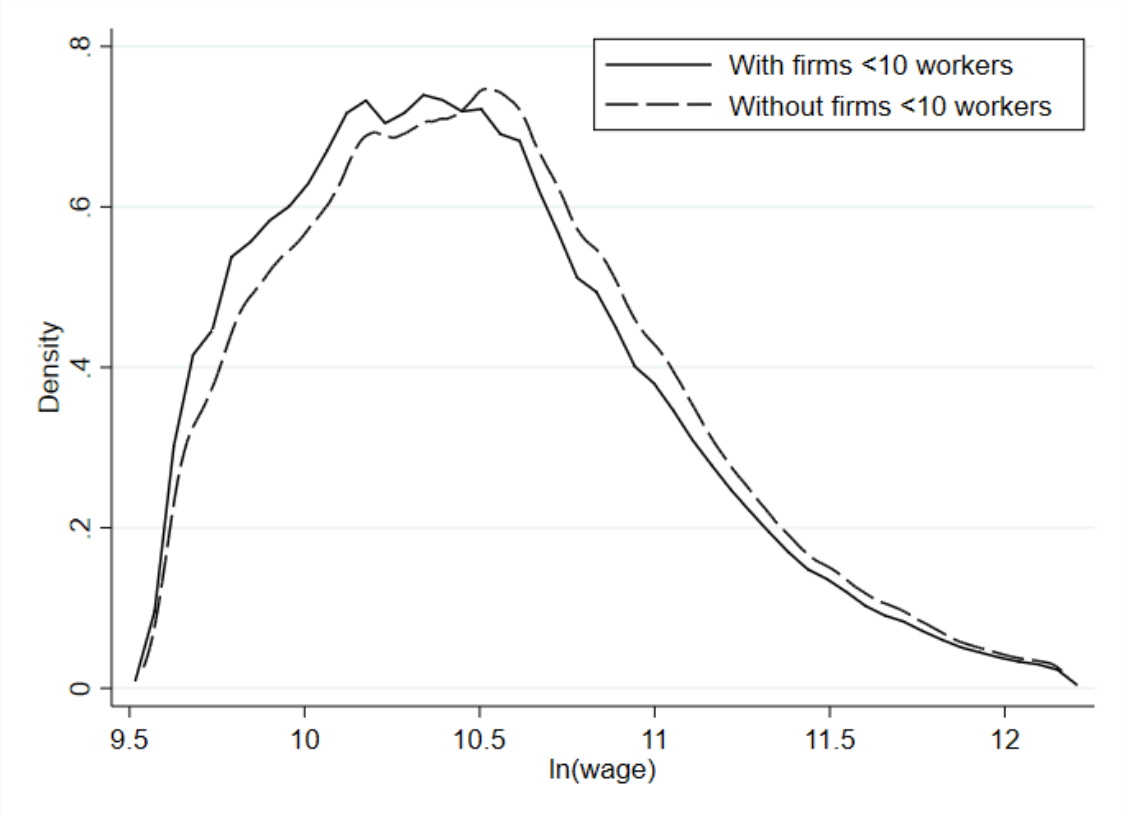
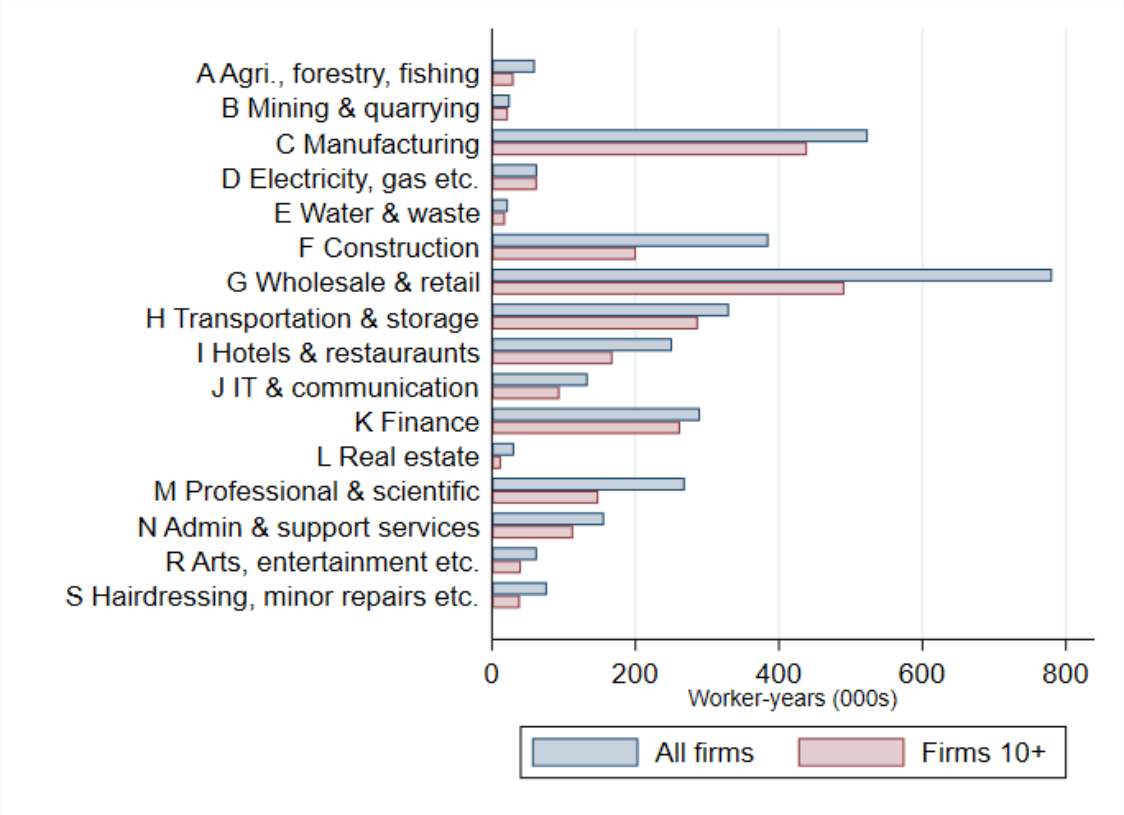


Chart excludes top one percent of wage distribution.

Chart compares wage distribution of workers in Stage 1 and 2 in Table A1.

Figure A2: Sectoral composition of incumbent workers in market firms with less than 10 workers included and excluded.



8.2 Variable descriptions

$Wage_{i(j)t}$ - Worker's total taxable pay for the full year in euros (regardless of whether it came from more than one job), deflated using the Consumer Price Index.

$lnY_{i(j)t}$ - Log of $Wage_{i(j)t}$

S_{jt}^{M} - Share of firm's workforce with previous experience in a foreign MNE.

S_{jt}^{D} - Share of firm's workforce hired from another domestic establishment (with no previous experience in a foreign MNE).

Age_i - Worker age

$Size_j$ - Log firm size, measured by number of workers.

$NonIrish_{i(j)t}$ - Anyone with non-Irish nationality, as recorded by the Irish Department of Social Protection when assigning someone with a Personal Public Service (PPS) number. The nationality recorded must be supported by documentation such as a birth certificate or passport from the person's country of origin.

$Weeks_{i(j)t}$ - Total number of weeks of employment per year that are liable for social insurance contributions.

MNE_{jt} - Foreign MNE is based on the country of ownership of a firm that is recorded in firms' filings to the Irish Companies Registration Office.

$Industry_{jt}$ - Three digit NACE rev. 2 industry code.

Regions - EU NUTS 3 digit 2016 regions for Ireland: Border Region IE041 (Cavan, Donegal, Leitrim, Monaghan, Sligo), West Region IE042 (Mayo, Roscommon, Galway and Galway City), Mid-West Region IE051 (Clare, Tipperary, Limerick City & County), South-East Region IE052 (Carlow, Kilkenny, Wexford, Waterford City & County), South-West Region IE053 (Kerry, Cork and Cork City), Dublin Region IE061 (Dublin City, Din Laoghaire–Rathdown, Fingal and South Dublin), Mid-East Region IE062 (Kildare, Meath, Wicklow, Louth), Midlands Region IE063 (Laois, Longford, Offaly, Westmeath).

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