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

Eóin T. Flaherty*

15 September 2020

**Abstract**

This paper examines wage spillovers from workers with experience in foreign multinational enterprises (MNEs) to incumbent workers in domestic firms. For firms with 10 workers or more, I analyse incumbent wage changes associated with shares of workers who previously worked in foreign MNEs. The evidence supports the idea of positive FDI spillovers through labour mobility and larger spillovers for higher paid workers and workers in larger firms. However, I find evidence suggesting that increasing the panel length results in larger spillover coefficients. Correcting for this suggests that a 10 percent increase in former MNE workers is associated with a wage increase of one to six percent. Secondly, I perform a dynamic difference in difference analysis for firms with less than 10 workers. For such micro firms, it is more appropriate to focus on individuals than shares of workers. I find the first former MNE worker to join a domestic micro firm is associated with a subsequent increase in incumbent wages of between zero and six percent.

*University College Dublin and the Central Statistics Office, Ireland. I thank Stefanie Haller, Ron Davies, Kevin O'Rourke, Benjamin Elsner and participants at the UCD Economics PhD Seminar for very helpful comments. The views expressed here are not necessarily held by the CSO and are my personal responsibility.

# 1 Introduction

This paper examines wage spillovers from workers with experience in foreign multinational enterprises (MNEs) to incumbent workers in domestic firms. MNEs are demonstrated to be more productive, or at least pay workers more, than firms who are based in only one country [Helpman et al., 2004] [Balsvik, 2011] [Driffield and Girma, 2003] [Girma et al., 2001] [Aitken et al., 1996]. This paper examines whether such a premium spills over to incumbents in domestic firms through labour mobility.

I analyse whether greater shares of former foreign MNE workers are associated with an increase in the wages of incumbent workers in domestic firms, consistent with an increase in their productivity. Using existing methodology and matched worker-firm administrative panel data from Ireland, I provide evidence consistent with the idea that, not only are workers with previous experience in an MNE more productive than other workers in domestic firms without MNE experience, they also positively affect the productivity of incumbent workers. The intuition of this methodology is that the higher the share of employees with previous experience in foreign MNEs, the greater the probability that incumbents in domestic firms will be exposed to these workers and become more productive. This correlation increases with incumbent workers' wage quantiles and with firm size. It is also stronger in services firms than manufacturing ones.

I find that hiring both former MNE workers and workers who previously worked in another domestic firm is associated with incumbent promotion. This can partly explain incumbent wage increases. However, this promotion phenomenon appears to be slightly more associated with hiring workers from other domestic firms, while wage increases are more associated with hiring former MNE workers. I also find evidence suggesting that increasing the panel length results in larger spillover coefficients. Correcting for this suggests that a 10 percent increase in former MNE workers is associated with a wage increase of one to six percent.

While using shares of workers as an independent variable may be appropriate for spillover analysis for firms with larger numbers of staff, this is not the case with micro firms (firms

of less than 10 workers) where most or all workers in the firm are likely to be exposed to each other. I use a dynamic differences in differences (also called an event study) model to examine the possibility of a causal effect of spillovers through labour mobility for these micro firms. I find the first former MNE worker to join the firm is associated with a subsequent increase in incumbent wages of zero to six percent.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the administrative panel data used in this analysis. Section 4 describes some motivating theory. Section 5 describes my regression approaches. Section 6 describes my regression results. Section 7 concludes.

# 2 Literature review

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. Firms may be horizontally proximate, in the sense that they share the same industry. Analysis of horizontal spillovers is based on a domestic firm sharing the same industry as one or more foreign MNEs, potentially boosting the domestic firm's productivity through increased competition, through a potential reduction in the cost of learning about and adapting a new technology or through knowledge spillovers from worker mobility.

Another type of spillover is the vertical spillover. This can occur through backward linkages, where a domestic firm improves their production processes through selling products to foreign MNEs. Vertical spillovers through forward linkages ocurr when a domestic firm boosts their productivity through purchasing a large share of their intermediate inputs from foreign MNEs [Smeets, 2008].[1]

[1]Industry linkages to estimate spillovers through backward or forward linkages are typically estimated using input-output tables. Earlier papers, beginning with Smarzynska Javorcik [2004], 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, often

Much like the broader FDI spillovers literature [Smeets, 2008] [Görg and Greenaway, 2004], findings on horizontal and vertical FDI spillovers in Ireland 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 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. Haller [2014] analyses horizontal spillovers from foreign MNEs in Irish services sectors. She finds negative FDI spillovers in two sectors (wholesale and retail trade; and transport, storage and communication) and insignificant results in a third (real estate, renting and business activities). Ruane and Uğur [2005] measure the effect of horizontal spillovers on domestic plants' labour productivity in manufacturing firms. They find only weak evidence of spillovers.

Another type FDI spillover is through the channel of worker mobility from a foreign MNE to a domestic firm. This is a spillover since the foreign MNE is not being compensated for this potential knowledge transfer [Smeets, 2008]. Fosfuri et al. [2001] analyse FDI spillovers via worker mobility in a theoretical framework. An MNE can transfer superior technology to its foreign affiliate having trained local managers. Once trained, these managers can be hired later by a local firm in the host country and technological spillovers may occur. This is more likely to occur when the local firm and and the MNE are not close competitors.

To the best of my knowledge, only three papers have empirically analysed FDI spillovers through the channel of worker mobility. The first is Görg and Strobl [2005]. Using World Bank survey data from Ghana, 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. Using comprehensive data on manufacturing firms in Norway Balsvik [2011] 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

using data from the World Input-Output Database (WIOD) to estimate MNEs' supplier or buyer industries.

this spillover may be more a purchased factor of production rather than an externality. This spillover combines both the direct and indirect (i.e the peer) effect of former MNE workers on firm level productivity.

Poole [2013] uses administrative data from Brazil to analyse wage spillovers on incumbent workers. She finds that a 10 percent increase in workers with foreign MNE experience is consistent with a wage increase among their incumbent co-workers of six percent. Rather than using TFP, this approach assumes productivity to be in line with worker wages but has the advantage of having the potential to capture spillovers to incumbent workers at the worker level. This apporach measures the indirect (i.e the peer) effect of former MNE workers on productivity within the firm. Her approach of using shares of workers to estimate peer effects is designed to capture the probability that an incumbent worker interacts with a former MNE worker. This circumvents the reflection problem by focusing on the outcomes of incumbents 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].

There are several other papers in the FDI literature closely related to this work. Abebe et al. [2018] examine the effects of greenfield foreign MNE plant openings on incumbent firms in the same districts in Ethiopia. They find positive effects on firms' TFP, production processes, managerial and organisational practices, logistics and knowledge about exporting.

Using matched firm-worker data from Brazil, Martins et al. [2015] find changes in ownership do not tend to affect wages significantly. Movers from foreign firms to domestic firms take larger wage cuts than movers to foreign firms. Martins [2011] looks at worker mobility from domestic to foreign firms using matched firm-worker data from Portugal. He 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 to come to domestic firms. He suggests that FDI spillovers through labour mobility are unlikely to be large as a result.

Another closely related paper is Markusen and Trofimenko [2009]. They 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 plant-level data they find that these experts have positive effects on the wages of domestic workers.

There are other papers in other literatures related to spillovers and 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. 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.

Similarly, using Danish manufacturing data, Stoyanov and Zubanov [2012] find that the gains from hiring from more productive firms equal 0.35 percent per year. Greenstone et al. [2010] find that TFP in incumbent plants in USA counties that attract a large manufacturing plant increases by 12 percent more than equivalent counties that do not. This effect is particularly pronouced when incumbent firms in these same counties have large share of labour market pooling with the manufacturing plants' industry. Mas and Moretti [2009] suggest that having high productivity coworkers 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.

In the trade literature, Choquette and Meinen [2015] examine export spillovers (where non-exporters may learn to export from exporters) through labour mobility (number of employees previously in an exporter) using the population of manufacturing firms in Denmark. They find that firms with more workers from exporters are more likely to become exporters than their peers.

# 3 Data

## 3.1 Data sources

My main dataset is a worker-level panel of Irish administrative data from 2005 to 2016. This dataset is based on tax records filed by firms on behalf of their workers to the Irish Revenue Commissioners, combined with additional worker characteristics from the Irish Department of Employment Affairs and Social Protection using a unique worker identifier. This dataset allows me to track workers over time, estimate fixed effects (worker, firm, NACE rev.2 industry, NUTS3 region and year) and control for the following worker-level characteristics: non-Irish worker, age, $age^2$ and weeks eligible for social insurance contributions. It also allows me to control for log firm size (i.e. number of workers in the firm) and the firm's share of female workers.

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 establishes a subsidiary within Ireland must also register an Irish firm with the Companies Registration Office. I obtain information on firms' country of ultimate ownership and their address within Ireland. This data is matched at the firm level using a unique firm identifier. This data allows me to define a firm as a foreign MNE or a domestic firm and to establish a firm's NUTS 3 (EU Nomenclature of Territorial Units for Statistics) region within Ireland. A full variable description is available in the appendix.

Since this is a panel, I can say where workers are in employment throughout the time period. I can also define incumbent workers. My definition of an incumbent worker is someone who did not move firms throughout the sample. New workers with no previously

observed experience are also classified as incumbents.[2] Since my research question is about the effect of former MNE workers on domestic incumbent workers' wages, I keep observations that relate to incumbents in domestic firms in market-sectors (i.e. I exclude industries in NACE rev. 2 letters O, P, Q, T and U).

I create former foreign MNE and former domestic worker share variables at the firm level. These 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. Unless otherwise stated, the share of former MNE workers in my regressions refers to the share of workers who have ever had MNE experience in my sample. The share of former domestic workers refers to workers who have joined the firm from another domestic firm but who have not had any foreign MNE experience. I do not include workers with public sector experience (i.e. NACE letters O, P, and Q) in either share specification.

It could be that workers who I have only observed working for a domestic firm may also have had experience in a foreign MNE prior to the beginning of my sample. My expectation is that the value of such experience eventually depreciates over time and that this does not matter so much. Another limitation of the dataset is that I do not observe changes in the country of ownership of firms. Instead, I have information on the country of ownership of a firm as of 22 November 2019. This is an issue that also arises in other datasets, including Amadeus and Orbis.

## 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

[2] I also analyse incumbents who were in the same firm in each year throughout the period as a robustness check.

contributions. Where they have 52 of each, I classify them as employeers. If they have 52 weeks as both a pensioner and a director, I classify them as a pensioner. I drop all people who are mainly pensioners. I also exclude people over 60 and people under 25. I keep male and female workers. Since I am interested in analysing market firms, I exclude workers currently in household employers 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 13 million worker-year observations in market firms over 10 years. This consists of 2.3 million unique workers in 247 thousand unique firms.[3]

While I can estimate 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 9.5 million. I exclude such workers before defining 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 with no known experience outside their current firm. This leaves me with 3.5 million worker-year observations.

For worker share regressions, I finally exclude firms with less than 10 workers. This ensures more meaningful analysis of within-firm wage distributions. This reduces the number of worker-year observations by 25 percent to 2.6 million. This consists of of 627 thousand unique workers in 31 thousand firms. Table 16 in the appendix displays the data preparation process in more detail. See Figure 3 and Figure 4 in the appendix for the impact of this on

[3]2006 to 2011. 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.

the distribution of workers accross the economy.

For the dynamic differences in differences approach, I exclude firms with 10 workers or more. This reduces the number of worker-year observations by 75 percent to 867 thousand. This consists of of 237 thousand unique workers in 101 thousand firms. Table 17 in the appendix displays the data preparation process in more detail.

## 3.3 Summary statistics

Table 1: Employee summary statistics

| | N | Mean | Std Dev. | Median | P10 | P90 |
|---|---|---|---|---|---|---|
| | Market firms | | | | | |
| ln(wage) | 9532790 | 10.46 | 0.54 | 10.38 | 9.82 | 11.17 |
| Age | 9532790 | 38.66 | 9.31 | 37.00 | 27.00 | 53.00 |
| Weeks | 9532790 | 51.03 | 12.49 | 52.00 | 44.00 | 52.00 |
| | Incumbent workers in domestic firms with $> 9$ workers | | | | | |
| ln(wage) | 2640938 | 10.51 | 0.55 | 10.45 | 9.84 | 11.23 |
| Age | 2640938 | 40.30 | 9.58 | 39.00 | 28.00 | 54.00 |
| Weeks | 2640938 | 50.96 | 8.81 | 52.00 | 47.00 | 52.00 |
| | Incumbent workers in domestic firms with $< 10$ workers | | | | | |
| | N | Mean | Std Dev. | Median | P10 | P90 |
| ln(wage) | 862666 | 10.32 | 0.50 | 10.25 | 9.76 | 10.96 |
| Age | 862666 | 41.59 | 9.61 | 41.00 | 29.00 | 55.00 |
| Weeks | 862666 | 51.05 | 11.49 | 52.00 | 46.00 | 52.00 |

Table 1 provides worker-level summary statistics for workers in market firms, incumbents in domestic firms with 10 or more workers and incumbents in domestic firms withless than 10 workers. The median worker earns $e^{10.38}$ (32,208) euros in wages, is aged 37 and works 52 weeks of employment per year that are liable for social insurance contributions. The median incumbent worker in domestic firms of 10 or more earns $e^{10.45}$ (34,544) euros in wages, is aged 39 and works 52 weeks of employment per year that are liable for social insurance contributions. The median incumbent worker in domestic firms of less than 10 workers or more earns $e^{10.25}$ (28,283) euros in wages, is aged 41 and works 51 weeks of employment per year that are liable for social insurance contributions.

Figure 1: Wages in market firms by firm type

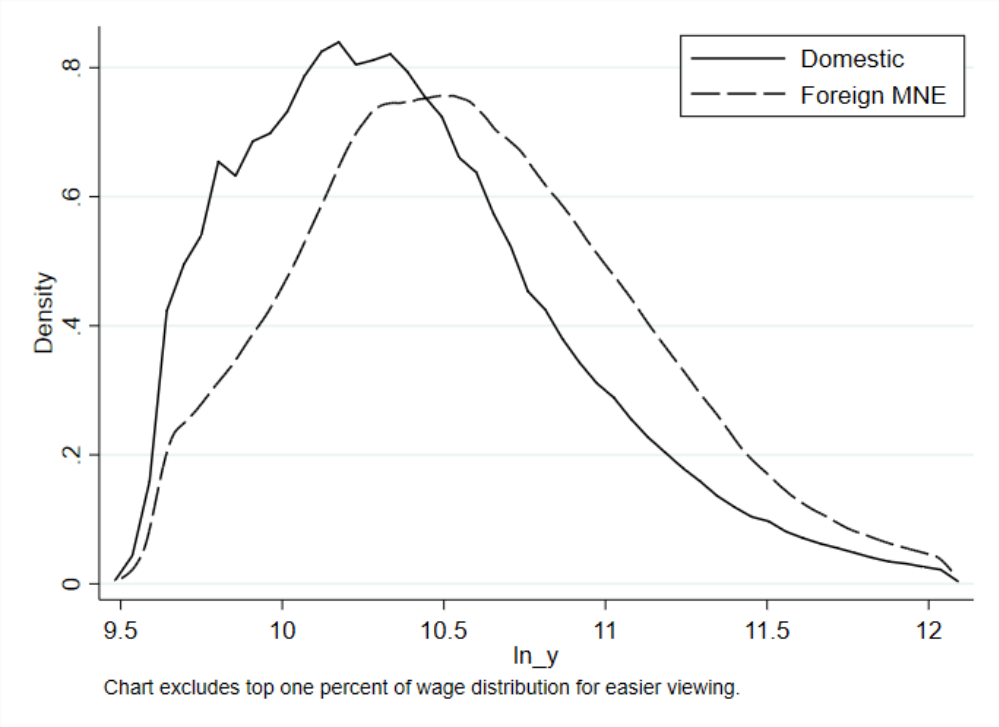



Table 2: Wages in foreign and domestic firms

| | | (1) ln(wage) |
|---|---|---|
| Foreign MNE | 0.025*** | (0.0054) |
| Constant | 8.61*** | (0.057) |
| N | 9298354 | |
| R2 | 0.86 | |

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 2: Wages for different groups of workers

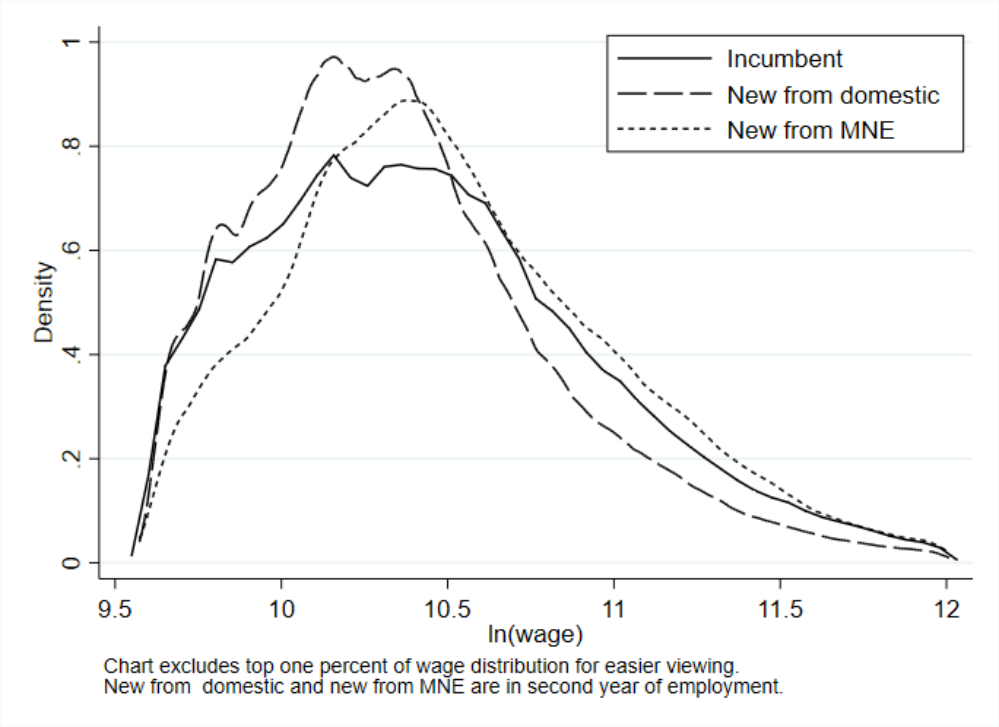



Figure 1 and Table 2 demonstrate that foreign MNEs pay their workers more than domestic firms. This is consistent with previous literature [Balsvik, 2011] [Driffield and Girma, 2003] [Girma et al., 2001] [Aitken et al., 1996] and indicates a productivity gap between foreign MNEs and domestic firms. This is also in line with the evidence for Ireland using TFP at the firm level [Papa et al., 2018].

Figure 2 illustrates how this wage gap also exists for workers with MNE experience within domestic firms. Here I compare the wages of all incumbents with wages of new workers from domestic firms and foreign MNEs in their second year of employment. 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 incumbents while former MNE workers are better paid than both, suggesting a productvity difference that they may be able to transfer. This evidence of a wage premium is further confirmed by a simple wage determinant regression for workers in domestic firms (Table 3). Workers with experience in another domestic firm earn four

percent more than incumbents while workers with experience in a foreign MNE earn seven percent more.

Table 3: Returns to extra-firm experience

| | (1) ln(wage) | |
|---|---|---|
| Formerly in MNE | 0.068*** | (0.0024) |
| Formerly in domestic firm | 0.040*** | (0.0015) |
| Constant | 8.52*** | (0.060) |
| MNE - dom wage | .028 | |
| SE | .002 | |
| N | 5011413 | |
| R2 | 0.90 | |

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, 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 incumbents in domestic firms. Cornelissen et al. [2017] provide a helpful theoretical model on peer effects. 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:

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

where $f_i$ is output of individual $i$, $y_i$ refers to worker $i$'s productive capacity, which depends on individual abitlity $a_i$, individual effort $e_i$, knowledge spillovers $\lambda^K$ and average peer ability $\bar{a}_i$. $\varepsilon_i$ refers to random output variation that is beyond the worker's control and has an

expected mean of zero. In this paper, $\lambda^K$ is expected to be an increasing function of the share of foreign switchers.

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

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

where $c_i$, the cost of effort, depends an individual cost of effort $C(e_i)$ and a social peer pressure function $P(e_i, \bar{f}_{\sim i})$ that that depends on one's effort $e_i$ and everyone else's average output $\bar{f}_{\sim i}$. $\lambda^P$ 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:

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

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:

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

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 $\lambda^P$ from workers from foreign MNEs $S_{jt}^M$ and domestic firms $S_{jt}^D$. I cannot empirically separate knowledge spillovers from peer pressure.

# 5 Regressions

## 5.1 Specification: worker shares

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

$$lnY_{ijt} = \gamma_M S_{jt} + \beta_1 W_{ijt} + \beta_2 X_{jt} + FE_{ijt} + \varepsilon_{ijt}$$

where $i$ refers to the individual, $j$ refers to the firm, $t$ indexes the time, $lnY_{ijt}$ are the individual's log wages, and $S_{jt}$ refers to the share of the firm's workforce with previous experience in another firm. $W_{ijt}$, $X_{jt}$ and $FE_{ijt}$ 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 incumbents' wages and the extent of their potential exposure to workers from foreign MNEs:

$$lnY_{ijt} = \gamma_M S_{jt}^M + \gamma_D S_{jt}^D + \beta_1 W_{ijt} + \beta_2 X_{jt} + FE_{ijt} + \varepsilon_{ijt}$$

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 probablility 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 probablility that the incumbent workers interact 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 for the share of workers from other domestic firms. If postive 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 $\gamma_M > \gamma_D$. This specification follows Poole [2013].[4] This approach circumvents the reflection problem by focusing on the outcomes of incumbents 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 $W_{ijt}$. 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 factors $X_{jt}$. 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 different sets of fixed effects; $FE_{ijt}$. These are worker-firm, industry-year and region-year fixed effects. Worker-firm fixed effects control 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 and industry time-invariant characteristics.[5] Regions refer to three digit NUTS (2016 version) regions. There are eight of these in Ireland. I use three digit NACE (revision 2) codes, referring to 272 potential industry categories that a firm can be classified in. The appendix contains a full description of the variables used in this paper.

## 5.2 Specification: dynamic differences in differences

While using shares of workers as an independent variable may be appropriate for spillover analysis for firms with larger numbers of staff, this is not the case with micro firms (firms of less than 10 workers) where most or all workers in the firm are likely to be exposed to each

[4]The only differences with Poole's approach are that Poole 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 in my baseline regression.

[5]While Kropko and Kubinec [2018] and Plümper and Troeger [2019] argue that two-way fixed effects are poor substitutes for control variables, I do not have a comprehensive set of control variables available instead.

other. I use a dynamic differences in differences framework to examine the possibility of a causal effect of spillovers through labour mobility for these micro firms.[6]

The basic differences in differences approach attempts to estimate causal effects using an untreated control group and a treated group that is treated at a particular time in the sample. The treatment effect refers to changes in trends over time associated with treatment relative to non-treatment. The differences in differences approach requires us to assume that the treatment and control outcomes would move in parallel in the absence of treatment (the common trends assumption).[7] A differences in differences approach only requires controlling for unit (e.g. worker) and time (e.g. year) effects [Angrist and Pischke, 2014]. This model can be stated as follows:

$$Y_{ijt} = \alpha + \beta_{ij} + \gamma_t + 1\{t > t^*_{ij}\}\delta_{ijt} + \varepsilon_{it}$$

Where $Y_{it}$ refers to the wage of an incubment worker in the firm, $\alpha$ is the intercept, $\beta_i$ is a worker-firm fixed effect, $\gamma_t$ is a time fixed effect, $t^*_s$ is the year of the event, $\gamma_t + 1\{t > t^*_{ij}\}$ is the post treatment variable and

$\delta_{it}$ is the differences in differences treatment effect.

The dynamic differences in differences is is applied to cases where treatment occurs for different units in different years. It centres the year variable for each firm at the point of treatment, where the year variable equals zero at the year of treatment (in this case when the first former MNE worker joined the firm). Unlike the basic differences in differences approach, this approach is dynamic in the sense that workers in treated firms are compared against workers in not-yet treated firms. Workers in treated firms are also compared against workers in firms that were never treated. Like the basic approach, the dynamic differences in differences approach requires us to make the common trends assumption; that in the absence

[6]The term event study is also used for the dynamic differences in differences model but it means something quite different in the finance literature.

[7]One can also include unit-specific time trends variables (i.e. a worker-year fixed effect) but there is not enough data to do this in practice.

of treatment, the trends would be the same among firms, controlling for a firm-specific linear trend. This model can be stated using the same equation as before, although the meaning of some of the symols change:

$$Y_{ijt} = \alpha + \beta_{ij} + \gamma_t + 1\{t > t^*_{ij}\}\delta_{ijt} + \varepsilon_{it}$$

Specifically, $t^*_s$ is the time of the event, normalised at zero. $t$ continues to refer to year, but is recentered around the year of the event. The time for non-treated units remains the same.

Further variables can be added:

$$Y_{ijt} = \alpha + \beta_{ij} + \gamma_t + 1\{t > t^*_{ij}\}\delta_{ijt} + 1\{t > t^*_{ij}\}year\zeta_{ijt} + year\eta_{ijt} + \varepsilon_{ijt}$$

Where $1\{t > t^*_{ij}\}year$ is a phase-in variable and $year$ is a year variable.

A further development is the non-parametric dynamic differences in differences model:

$$Y_{ijt} = \beta_{ij} + \gamma_t + \sum_{r=k_{min}, r\neq 0}^{kmax} 1\{t = t^*_{ij} + r\}\delta_r + \varepsilon_{ijt}$$

Where $Y_{it}$ refers to the incumbent's wage, $\beta_{ij}$ is a worker-firm fixed effect, $\gamma_t$ is year fixed effect, $t$ is the year, $t^*_{ij}$ is the year of the event, $r$ is the relevant leads and lags on the treatment year and $\delta_r$ is the set of coefficients on the relevant leads and lags.

This follows Lafortune et al. [2018].[8] Rather than including a post-treatment effect, this model includes leads and lags of the treatment year. In this model, the lead and coefficients $\delta_r$ should be interpreted relative to the worker or firm in the treatment year.

[8] I have made some changes to the notation of Lafortune et al. [2018], such as substituting $\theta$ with $Y$.

# 6 Regression results: worker shares approach

## 6.1 Baseline results

Table 4: Baseline results

| | (1) ln(wage) | | (2) ln(wage) | | (3) ln(wage) | |
|---|---|---|---|---|---|---|
| $\gamma\_M$ | 0.24*** | (0.030) | 0.14*** | (0.018) | 0.13*** | (0.023) |
| $\gamma\_D$ | -0.037 | (0.021) | 0.023* | (0.0100) | 0.054*** | (0.012) |
| lag $\Delta$ ln(firm size) | | | | | 0.0081** | (0.0028) |
| Constant | 8.52*** | (0.080) | 8.58*** | (0.073) | 8.85*** | (0.080) |
| $\gamma\_M - \gamma\_D$ | .279 | | .118 | | .076 | |
| SE | .028 | | .018 | | .022 | |
| Worker FE | Yes | | No | | No | |
| Firm FE | Yes | | No | | No | |
| Year 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 | 2298284 | | 2298276 | | 1257624 | |
| R2 | 0.93 | | 0.93 | | 0.94 | |
| N firms | 803261 | | 803261 | | 803261 | |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 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]. 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 $\gamma_M$ is 0.40, while the coefficient for domestic workers $\gamma_D$ is 0.15, resulting in $\gamma_M - \gamma_D$ equalling 0.25. This suggests that, under Poole [2013]'s control variable assumptions,

a 10 percent increase in the share of former MNE workers in domestic firms is associated with a 25 percent increase in incumbent worker wages. In 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. My coefficients are much larger for both variables, particularly for workers with experience in other domestic firms. This appears to be due to the fact that I use a longer time panel. I discuss this later in more detail.

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 allow 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 results in an increase in the coefficient on the share of former MNE workers and a slight fall in the coefficent on the share of workers previously in domestic firms, resulting in $\gamma_M - \gamma_D$ being equal to 13 percent.

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 my coefficient falling by two percentage points. At this more appropriate specification in column 3, I find that $\gamma_M - \gamma_D$ is 9.6 percent. The intuition of this is that a 10 percent increase in the share of former MNE workers is associated with a 10 percent increase in the average wages of an incumbent.

Using the same specifications with a balanced panel (where only incumbents present throughout the period are included), I find that $\gamma_M - \gamma_D$ are the same to two decimal places and continues to be significant (see Table 18, appendix). I also perform the same analysis with part time workers workers. The joint coefficient $\gamma_M - \gamma_D$ is 12.3 percent (see Table 19, appendix). As an alternative approach, I replace $S_{jt}^M$ and $S_{jt}^D$ with a variable for the share of new workers in the firm and a second variable for the share of these new workers who

are from MNEs (see Table 20, appendix). Controling for the share of new employees, the coefficient on the share of these new employees who are from foreign MNEs continue to be positive, and, except for column 1, significant.[9]

## 6.2 Manufacturing versus services

Table 5: Analysis by sector

| | (1) Manufacturing | | (2) Services | |
|---|---|---|---|---|
| $\gamma\_M$ | 0.14*** | (0.025) | 0.074* | (0.037) |
| $\gamma\_D$ | 0.052*** | (0.014) | 0.056** | (0.020) |
| interaction_mne | -0.063 | (0.042) | 0.068 | (0.041) |
| interaction_dom | 0.0079 | (0.024) | -0.0026 | (0.024) |
| lag $\Delta$ ln(firm size) | 0.0081** | (0.0028) | 0.0081** | (0.0028) |
| Constant | 8.85*** | (0.080) | 8.85*** | (0.080) |
| $\gamma\_M - \gamma\_D$ | .087 | | .017 | |
| SE | .025 | | .037 | |
| N | 1257624 | | 1257624 | |
| R2 | 0.94 | | 0.94 | |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 examines the impact of former MNE and workers from other domestic firms on incumbent wages. Workers in services firms appear to experience larger FDI spillovers, with a combined coefficient of 12 percent. Workers in manufacturing firms have a combined coefficient of five percent. Workers in services firms appear to enjoy higher returns to shares of former foreign MNE workers than their counterparts in manufacturing firms but approximately the same returns to shares of workers from domestic firms.

Table 6: Firm size

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | 10-19 | 20-49 | 50-99 | 100-199 | 200+ |
| $\gamma\_M$ | 0.051* | 0.083** | 0.15** | 0.30** | -0.080 |
| | (0.021) | (0.025) | (0.055) | (0.12) | (0.16) |
| $\gamma\_D$ | 0.029* | 0.017 | 0.024 | 0.12* | 0.079 |
| | (0.014) | (0.017) | (0.033) | (0.054) | (0.072) |
| lag $\Delta$ ln(firm size) | 0.014*** | 0.012*** | 0.013 | -0.0040 | -0.0020 |
| | (0.0039) | (0.0037) | (0.0065) | (0.015) | (0.017) |
| Constant | 9.35*** | 8.65*** | 8.90*** | 8.98*** | 9.10*** |
| | (0.15) | (0.18) | (0.14) | (0.16) | (0.27) |
| $\gamma\_M - \gamma\_D$ | .022 | .066 | .128 | .183 | -.159 |
| SE | .02 | .025 | .058 | .112 | .185 |
| Firm size | 138351 | 204245 | 113788 | 82187 | 585220 |
| N | 0.94 | 0.95 | 0.96 | 0.96 | 0.94 |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

## 6.3 Firm Size

Table 6 suggests that workers in larger firms experience greater spillovers than workers in smaller firms. For firms between 10 and 19 workers, a ten percent increase in the share of former MNE workers is associated with an increase in incumbents' wages three percent. Workers in firms of 10 to 49 workers experience an increase of nine percent while workers in firms of 50 to 99 experience an incrase of 17 percent. Workers in firms of 100-199 experience the greatest increase of 20 percent. My results are insignificant for firms of 200 or more employees.

## 6.4 Managers and non-managers

Table 7 displays results for managers and non-managers. Managers are defined as workers in the top wage quartile of their firm (excluding the low paid workers removed during data processing). Column 1 splits the share variables by management experience. $\gamma_M$ (managers) refers to the share of workers who were managers in a foreign MNE, $\gamma_D$ (managers) refers to the share of workers who were managers in a domestic firm and so on. Here I find that having former MNE managers in a firm is associated with a considerably larger increase in incumbent wages compared to non managers. However, this does not apply for having workers who were previously managers in a domestic firm.

Column 2 refers to the wage growth for incumbents who are managers that is associated with increased shares of former MNE workers. Here I find that incumbent managers have much greater wage growth associated with increased shares of workers with both former MNE and other domestic firm experience than their non-manager incumbent counterparts.

Column 3 refers to the wage growth associated with having former MNE managers in a firm on incumbents who are managers. Here I find that having former managers in a firm is associated much greater wage increases for incumbent managers than incumbent non-managers.

[9]New workers are defined as workers who have joined the firm in the last three years.

Table 7: Managers and non-managers

| | (1) Effect of managers on all | | (2) Effect on incumbent managers | | (3) Effect of managers on managers | |
|---|---|---|---|---|---|---|
| $\gamma\_M$ (managers) | 0.21*** | (0.062) | | | -0.55*** | (0.073) |
| $\gamma\_D$ (managers) | -0.016 | (0.033) | | | -0.58*** | (0.033) |
| $\gamma\_D$ (non-managers) | 0.12*** | (0.021) | | | 0.10*** | (0.021) |
| $\gamma\_M$ (non-managers) | 0.064*** | (0.012) | | | 0.061*** | (0.012) |
| lag $\Delta$ ln(firm size) | 0.0082** | (0.0028) | 0.0098*** | (0.0027) | 0.0094*** | (0.0027) |
| $\gamma\_M$ | | | -0.061* | (0.026) | | |
| $\gamma\_D$ | | | -0.080*** | (0.012) | | |
| $\gamma\_M$ x manager | | | 0.47*** | (0.033) | | |
| $\gamma\_M$ x manager | | | 0.36*** | (0.011) | | |
| $\gamma\_M$ (managers) x manager | | | | | 2.24*** | (0.14) |
| $\gamma\_D$ (managers) x manager | | | | | 1.74*** | (0.077) |
| Constant | 8.85*** | (0.081) | 9.08*** | (0.083) | 8.97*** | (0.083) |
| $\gamma\_M - \gamma\_D$ | . | | . | | . | |
| SE | . | | . | | . | |
| N | 1257624 | | 1257624 | | 1257624 | |
| R2 | 0.94 | | 0.95 | | 0.94 | |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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

All refers to effect of workers with management experience on all incumbents.

Managers refers to effect of workers with management experience on incumbent managers.

Managers are defined as workers in the top 25 percent of income in their firm.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

## 6.5 Unconditional quantile regression

Table 8: Quantile regression

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| $\gamma\_M$ | -0.053 | 0.051* | 0.033 | 0.069** | 0.091* | 0.0045 | 0.025 | 0.087 | 0.21*** | 0.80*** |
| | (0.030) | (0.024) | (0.023) | (0.025) | (0.045) | (0.023) | (0.026) | (0.056) | (0.056) | (0.22) |
| $\gamma\_D$ | 0.030 | 0.048** | 0.011 | 0.0036 | 0.019 | -0.030* | -0.038* | -0.056 | -0.078* | -0.39** |
| | (0.020) | (0.015) | (0.014) | (0.014) | (0.017) | (0.014) | (0.015) | (0.030) | (0.031) | (0.13) |
| lag $\Delta$ ln(firm size) | 0.011* | 0.012** | -0.0016 | -0.00036 | -0.0017 | 0.0036 | -0.0022 | 0.00071 | 0.012 | 0.044 |
| | (0.0052) | (0.0041) | (0.0032) | (0.0031) | (0.0035) | (0.0030) | (0.0038) | (0.0049) | (0.0068) | (0.033) |
| Constant | -2.31*** | 0.32 | 0.12 | -0.021 | 0.16 | -0.030 | 0.10 | 0.28* | -0.26 | 0.12 |
| | (0.23) | (0.23) | (0.13) | (0.14) | (0.12) | (0.11) | (0.20) | (0.14) | (0.26) | (0.84) |
| $\gamma\_M - \gamma\_D$ | -.083 | .003 | .023 | .065 | .072 | .035 | .062 | .143 | .286 | 1.183 |
| SE | .03 | .025 | .024 | .021 | .034 | .02 | .022 | .038 | .056 | .239 |
| N | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 | 1257635 |
| R2 | 0.73 | 0.53 | 0.50 | 0.48 | 0.48 | 0.50 | 0.51 | 0.54 | 0.62 | 0.65 |

Standard errors in parentheses

Bootstrapped standard errors.

Standard errors are clustered at the firm level.

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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8 displays an unconditional quantile regression on incumbent workers wages. These wages are a residual from running a regression on industry-year characteristics to take account of industry-specific cyclical factors accross the period. Standard errors are clustered, and should also be bootstrapped but I was unable to do them both in practice. Each column refers to a specific decile. The lowest 10 percent of workers experience negative coefficients on average of five percent. This corresponds to an increase in the share of former MNE workers is associated with a five percent increase in incumbent wages. The top 10 percent of workers experience very large positive coefficients, suggesting that a ten percent increase in the share of former MNE workers in their firm is associated with an increase in their wages of 120 percent. With the exception of the 50-60 percent decile, each increased decile has an increased wages associated former MNE workers compared to the previous decile. Workers wage growth associated with increased shares of former MNE workers increase based on increased income.

## 6.6 Within-firm deciles

Table 9: Within-firm deciles

| | (1) 0.1 | (2) 0.2 | (3) 0.3 | (4) 0.4 | (5) 0.5 | (6) 0.6 | (7) 0.7 | (8) 0.8 | (9) 0.9 | (10) 1.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma\_M$ | 0.16*** | 0.15*** | 0.14*** | 0.13*** | 0.13*** | 0.13*** | 0.12*** | 0.11*** | 0.12*** | 0.059* |
| | (0.022) | (0.023) | (0.022) | (0.022) | (0.023) | (0.022) | (0.023) | (0.023) | (0.023) | (0.023) |
| $\gamma\_D$ | 0.073*** | 0.072*** | 0.064*** | 0.057*** | 0.055*** | 0.053*** | 0.049*** | 0.041*** | 0.044*** | 0.011 |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) |
| Share prev. MNE*decile | -0.77*** | -0.16*** | -0.069*** | -0.025 | -0.0023 | 0.041** | 0.046*** | 0.094*** | 0.13*** | 0.47*** |
| | (0.071) | (0.018) | (0.014) | (0.014) | (0.014) | (0.015) | (0.012) | (0.015) | (0.019) | (0.036) |
| Share prev. domestic*decile | -0.55*** | -0.21*** | -0.090*** | -0.034*** | -0.0063 | 0.018*** | 0.036*** | 0.065*** | 0.10*** | 0.33*** |
| | (0.031) | (0.0068) | (0.0042) | (0.0042) | (0.0035) | (0.0043) | (0.0037) | (0.0042) | (0.0059) | (0.012) |
| lag $\Delta$ ln(firm size) | 0.0080** | 0.0078** | 0.0082** | 0.0081** | 0.0081** | 0.0081** | 0.0081** | 0.0079** | 0.0081** | 0.0091*** |
| | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) | (0.0028) |
| Constant | 8.91*** | 8.88*** | 8.85*** | 8.85*** | 8.85*** | 8.85*** | 8.85*** | 8.86*** | 8.87*** | 8.86*** |
| | (0.077) | (0.082) | (0.080) | (0.080) | (0.080) | (0.080) | (0.080) | (0.080) | (0.080) | (0.082) |
| $\gamma\_M - \gamma\_D$ | .085 | .074 | .074 | .075 | .075 | .074 | .075 | .07 | .073 | .048 |
| SE | .022 | .022 | .022 | .022 | .022 | .022 | .022 | .022 | .022 | .023 |
| N | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 | 1257624 |
| R2 | 0.95 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

While Table 8 focuses on the wage distribution accross the economy, Table 9 focuses on wage growth associated with different deciles of workers within firms. This approach follows the basline specification but also includes both share variables being interacted with each relevant decile. Column 1 suggests that an increase in the share of former MNE workers is associated with a two percent fall in their wages for incumbent workers at the bottom wage decile. Only workers in the upper five deciles experienced positive wage growth associated with increased shares of former MNE workers.

## 6.7 Worker rank

Table 10: Regressing shares on worker rank

| | (1) | |
|---|---|---|
| | Worker percentile | |
| $\gamma\_M$ | 0.072*** | (0.014) |
| $\gamma\_D$ | 0.078*** | (0.0093) |
| lag $\Delta$ ln(firm size) | 0.00011 | (0.0015) |
| Constant | -0.62*** | (0.059) |
| $\gamma\_M - \gamma\_D$ | -.007 | |
| SE | .015 | |
| N | 1257624 | |
| R2 | 0.88 | |

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

One potential concern is that, rather than new former MNE workers boosting incumbent workers wages, it may be that we are observing an ordering effect, where incumbents are being promoted, with former MNE workers taking their place. The analysis in Table 10 examines the correlation between shares of former MNE workers and incumbent worker rank. Worker rank is defined as the worker's percentile within the firm (e.g. the highest paid worker in a 100-worker firm would have a rank value of 1, while the lowest paid worker in a 100-worker firm would have a rank value of 0.1). The coefficient on the share of former

MNE workers is 16 percent, while the coefficient on the share of workers with experience in other domestic firms is close to 14 percent. This suggests that 10 percent increase in the share of former MNE workers in domestic firms is associated with a one percent increase in an incumbent worker's percentile within the firm.

## 6.8 Addressing missing experience: considering younger workers only

Table 11: Analysis by age

| | (1) | |
|---|---|---|
| | Under 30 in 2006 | |
| $\gamma\_M$ | 0.19*** | (0.028) |
| $\gamma\_D$ | 0.078*** | (0.017) |
| l_l_firm_growth | -0.0010 | (0.0044) |
| Constant | 8.59*** | (0.33) |
| $\gamma\_M - \gamma\_D$ | .116 | |
| SE | .027 | |
| N | 182425 | |
| R2 | 0.94 | |

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

One limitation previously mentioned is that I do not know about workers' experience prior to 2005. This affects both my definition of incumbent workers (and thus the dependent variable) and my defintion of former MNE and domestic workers (both included in the independent variables). In Table 11 I limit my analysis of incumbents to workers under the age of 30 in 2006. With this approach, it is less likely that I am missing much extensive work experience for these workers. I find a $\gamma_M - \gamma_D$ coefficient of 12 percent, four percent more than in the baseline regression.

### 6.9 Avoiding upward trend in worker shares

Table 12: Limiting amount of experience counted

| | (1) 6 year exp. | | (2) 3 year exp. | |
|---|---|---|---|---|
| firm_share_MNE_l6 | 0.091*** | (0.023) | | |
| firm_share_dom_l6 | 0.034*** | (0.0097) | | |
| lag $\Delta$ ln(firm size) | 0.0077** | (0.0028) | 0.0068* | (0.0028) |
| firm_share_MNE_l3 | | | 0.040 | (0.022) |
| firm_share_dom_l3 | | | 0.029*** | (0.0078) |
| Constant | 8.83*** | (0.080) | 8.82*** | (0.081) |
| $\gamma\_M - \gamma\_D$ | .057 | | .011 | |
| SE | .024 | | .023 | |
| N | 1257624 | | 1257624 | |
| R2 | 0.94 | | 0.94 | |

Standard errors in parentheses

Standard errors are clustered at the firm level.

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

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Given that I only have information on workers' experience since 2005, firms' average shares of former MNE and domestic workers go up accross the period. One concern related to this is that the coefficents on shares of former MNE and domest workers increases with data on more of years. This appears to be the case. In Table 12, limiting the experience counted in creating shares of workers with experience in other firms to six years reduces the MNE spillover coefficient ($\gamma_M - \gamma_D$) from eight percent in the baseline estimate to six percent. Limiting the experience counted to three years reduces the spillover coefficient further to one percent.

## 7 Regression results: dynamic differences in differences

I perform a difference in difference analysis for firms with less than 10 workers. For such micro firms, it is more appropriate to focus on individuals rather than shares of workers. While using shares of workers as an independent variable may be appropriate for spillover

analysis for firms with larger numbers of staff, this is not the case with micro firms (firms of less than 10 workers) where most or all workers in the firm are likely to be exposed to each other.

I first apply a simple parametric dynamic differences in differences analysis. The results are available in Table 13. I find that workers wages increase by five percent upon the entry of the first former MNE worker into the firm. Checking for robustness by adjusting the years covered accross the period, my results vary from three to four percent.

Table 13: Simple differences in differences

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All years | 2007+ | 2009+ | Up to 2014 | Up to 2012 |
| post_treatment | 0.046*** | 0.043*** | 0.032*** | 0.043*** | 0.038*** |
| | (0.0023) | (0.0023) | (0.0021) | (0.0025) | (0.0027) |
| Constant | 10.3*** | 10.3*** | 10.3*** | 10.3*** | 10.3*** |
| | (0.0019) | (0.0019) | (0.0018) | (0.0021) | (0.0023) |
| Post treatment | | | | | |
| N | 1091005 | 911842 | 539713 | 981146 | 857779 |
| R2 | 0.84 | 0.84 | 0.88 | 0.84 | 0.85 |

Standard errors in parentheses
Standard errors clustered at firm level.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14 displays my results from a parametric dynamic differences in differences analysis. Column 1 suggests workers wages increase by three percent upon the entry of the first former MNE worker into the firm with a one percent decline afterwards. As with the dataset of firms over 10 workers, this result is considerably more sensitive to the sample chosen than the simple parametric differences in differences analysis. The post-treatment coefficient varies between two percent and insignificance and the phase-in coefficient varies between minus three percent and zero.

Table 14: Parametric differences in differences

| | (1) All | (2) 2007+ | (3) 2009+ | (4) Up to 2014 | (5) Up to 2012 |
|---|---|---|---|---|---|
| post_treatment | 0.025*** | 0.014*** | 0.015*** | 0.014*** | -0.0018 |
| | (0.0023) | (0.0023) | (0.0022) | (0.0025) | (0.0027) |
| phase_in | -0.013*** | -0.013*** | -0.0058*** | -0.021*** | -0.032*** |
| | (0.00063) | (0.00062) | (0.00085) | (0.00079) | (0.00096) |
| time_var | 0.011*** | 0.011*** | 0.0065*** | 0.016*** | 0.027*** |
| | (0.00058) | (0.00057) | (0.00080) | (0.00074) | (0.00091) |
| Constant | 12.8*** | 13.6*** | 9.33*** | 17.9*** | 17.5*** |
| | (0.34) | (0.33) | (0.41) | (0.41) | (0.49) |
| Post treatment | | | | | |
| N | 1091005 | 911842 | 539713 | 981146 | 857779 |
| R2 | 0.83 | 0.83 | 0.87 | 0.84 | 0.84 |

Standard errors in parentheses

Standard errors clustered at firm level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15 displays my results from a non-parametric analysis. These results suggest that incumbent wages increase more after treatment than before treatment. However, varying the sample length mostly renders these results insignificant.

Table 15: Non-parametric differences in differences

| | (1) All | (2) 2007+ | (3) 2009+ | (4) Up to 2014 | (5) Up to 2012 |
|---|---|---|---|---|---|
| f3_yr_1_treatment | -0.0011 | 0.0010 | 0.0050 | -0.0025 | -0.0039 |
| | (0.0039) | (0.0044) | (0.0061) | (0.0051) | (0.0087) |
| f2_yr_1_treatment | 0.010* | 0.0048 | 0.0099 | 0.0085 | 0.014 |
| | (0.0043) | (0.0050) | (0.0076) | (0.0056) | (0.0099) |
| f_yr_1_treatment | 0.018*** | 0.011* | 0.012 | 0.013* | 0.0067 |
| | (0.0042) | (0.0052) | (0.0067) | (0.0050) | (0.0071) |
| l_yr_1_treatment | 0.022*** | 0.011* | -0.0010 | 0.012* | -0.017 |
| | (0.0041) | (0.0052) | (0.0077) | (0.0047) | (0.0086) |
| l2_yr_1_treatment | 0.031*** | 0.023*** | -0.0039 | 0.021** | -0.026* |
| | (0.0053) | (0.0067) | (0.012) | (0.0064) | (0.013) |
| l3_post_treatment | 0.041*** | 0.030*** | 0.0025 | 0.030*** | 0 |
| | (0.0064) | (0.0074) | (0.013) | (0.0082) | (.) |
| Constant | 10.4*** | 10.4*** | 10.4*** | 10.5*** | 10.5*** |
| | (0.0050) | (0.0060) | (0.011) | (0.0065) | (0.00070) |
| Post treatment | | | | | |
| N | 183502 | 117205 | 54274 | 123377 | 59194 |
| R2 | 0.90 | 0.93 | 0.97 | 0.91 | 0.95 |

Standard errors in parentheses

Standard errors clustered at firm level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

# 8 Conclusion

This paper examines wage spillovers from workers with experience in foreign multinational enterprises (MNEs) to incumbent workers in domestic firms. For domestic firms with 10 workers or more, I analyse incumbent wage changes associated with shares of workers who previously worked in foreign MNEs. Using existing methodology and matched worker-firm administrative panel data from Ireland, I provide evidence consistent with the idea that, not only are workers with previous experience in an MNE more productive than other workers in domestic firms without MNE experience, they also positively affect the productivity of incumbent workers. I provide evidence consistent with the idea that wage spillovers increase with incumbent workers' wage quantiles (both within the firm and accross the economy) and with firm size. The correlation is also stronger for workers in services firms than manufacturing ones.

I find that hiring both former MNE workers and workers who previously worked in another domestic firm is associated with incumbent promotion. This can partly explain incumbent wage increases. However, this promotion phenomenon appears to be slightly more associated with hiring workers from other domestic firms, while wage increases are more associated with hiring former MNE workers. I also find evidence suggesting that increasing the panel length results in larger spillover coefficients. Correcting for this suggests that a 10 percent increase in former MNE workers is associated with a wage increase of one to six percent.

While using shares of workers as an independent variable may be appropriate for spillover analysis for firms with larger numbers of staff, this is not the case with micro firms (firms of less than 10 workers) where most or all workers in the firm are likely to be exposed to each other. I use a dynamic differences in differences (also called an event study) model to examine the possibility of a causal effect of spillovers through labour mobility for these micro firms. I find the first former MNE worker to join the firm is associated with a subsequent increase in incumbent wages of zero to six percent.

# Bibliography

Girum Abebe, Margaret S McMillan, and Michel Serafinelli. Foreign direct investment and knowledge diffusion in poor locations: Evidence from Ethiopia. Technical report, National Bureau of Economic Research, 2018.

John M Abowd, Francis Kramarz, and David N Margolis. High wage workers and high wage firms. *Econometrica*, 67(2):251–333, 1999.

B Aitken, AE Harrison, and R Lipsey. Wages and foreign ownership: a comparative study of Mexico, Venezuela, and the United States. *Joumal of International Economics*, 1996.

Joshua D Angrist and Jörn-Steffen Pischke. *Mastering 'Metrics: The Path from Cause to Effect*. Princeton University Press, 2014.

Ragnhild Balsvik. Is labor mobility a channel for spillovers from multinationals? Evidence from Norwegian manufacturing. *The Review of Economics and Statistics*, 93(1):285–297, 2011.

Salvador Barrios, Holger Görg, and Eric Strobl. Spillovers through backward linkages from multinationals: Measurement matters! *European Economic Review*, 55(6):862–875, 2011.

Eliane Choquette and Philipp Meinen. Export spillovers: Opening the black box. *The World Economy*, 38(12):1912–1946, 2015.

Thomas Cornelissen, Christian Dustmann, and Uta Schönberg. Peer effects in the workplace. *American Economic Review*, 107(2):425–56, 2017.

Mattia Di Ubaldo, Martina Lawless, and Iulia Siedschlag. Productivity spillovers from multinational activity to local firms in Ireland. *OECD Productivity Working Papers*, (2018-16), 2018.

Nigel Driffield and Sourafel Girma. Regional foreign direct investment and wage spillovers: Plant level evidence from the UK electronics industry. *Oxford Bulletin of Economics and Statistics*, 65(4):453–474, 2003.

Andrea Fosfuri, Massimo Motta, and Thomas Rønde. Foreign Direct Investment and Spillovers through Workers' Mobility. *Journal of International Economics*, 53(1):205–222, 2001.

Sourafel Girma, David Greenaway, and Katharine Wakelin. Who benefits from foreign direct investment in the UK? *Scottish Journal of Political Economy*, 48(2):119–133, 2001.

Holger Görg and David Greenaway. Much Ado About Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment? *The World Bank Research Observer*, 19(2): 171–197, 2004.

Holger Görg and Eric Strobl. Spillovers from foreign firms through worker mobility: An empirical investigation. *Scandinavian Journal of Economics*, 107(4):693–709, 2005.

Michael Greenstone, Richard Hornbeck, and Enrico Moretti. Identifying agglomeration spillovers: Evidence from winners and losers of large plant openings. *Journal of Political Economy*, 118(3):536–598, 2010.

Stefanie A Haller. Do Domestic Firms Benefit from Foreign Presence and Import Competition in Irish Services Sectors? *The World Economy*, 37(2):219–243, 2014.

Elhanan Helpman, Marc J Melitz, and Stephen R Yeaple. Export versus FDI with heterogeneous firms. *American Economic Review*, 94(1):300–316, 2004.

Jonathan Kropko and Robert Kubinec. Why the two-way fixed effects model is difficult to interpret, and what to do about it. *Available at SSRN 3062619*, 2018.

Julien Lafortune, Jesse Rothstein, and Diane Whitmore Schanzenbach. School finance reform and the distribution of student achievement. *American Economic Journal: Applied Economics*, 10(2):1–26, 2018.

Charles F Manski. Identification of endogenous social effects: The reflection problem. *The Review of Economic Studies*, 60(3):531–542, 1993.

James R Markusen and Natalia Trofimenko. Teaching locals new tricks: Foreign experts as a channel of knowledge transfers. *Journal of Development Economics*, 88(1):120–131, 2009.

Pedro S Martins. Paying More to Hire the Best? Foreign Firms, Wages, and Worker Mobility. *Economic Inquiry*, 49(2):349–363, 2011.

Pedro S Martins, Luiz A Esteves, et al. Foreign Ownership, Employment and Wages in Brazil: Evidence from Acquisitions, Divestments and Job Movers. *Technology and Investment*, 6(01):22, 2015.

Alexandre Mas and Enrico Moretti. Peers at work. *American Economic Review*, 99(1): 112–45, 2009.

Javier Papa, Luke Rehill, and Brendan O'Connor. Patterns of firm level productivity in Ireland. *OECD Productivity Working Papers*, (2018-15), 2018.

Thomas Plümper and Vera E Troeger. Not so harmless after all: The fixed-effects model. *Political Analysis*, 27(1):21–45, 2019.

Jennifer P Poole. Knowledge transfers from multinational to domestic firms: Evidence from worker mobility. *Review of Economics and Statistics*, 95(2):393–406, 2013.

Frances Ruane and Ali Uğur. Foreign direct investment and productivity spillovers in Irish manufacturing industry: Evidence from plant level panel data. *International Journal of the Economics of Business*, 12(1):53–66, 2005.

Michel Serafinelli. "Good" Firms, Worker Flows, and Local Productivity. *Journal of Labor Economics*, 37(3):747–792, 2019.

Beata Smarzynska Javorcik. Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review*, 94(3):605–627, 2004.

Roger Smeets. Collecting the pieces of the FDI knowledge spillovers puzzle. *The World Bank Research Observer*, 23(2):107–138, 2008.

Andrey Stoyanov and Nikolay Zubanov. Productivity spillovers across firms through worker mobility. *American Economic Journal: Applied Economics*, 4(2):168–98, 2012.

# 9 Appendix

## 9.1 Additional tables

Table 16: Breakdown of market firms

| | Market firms | Exclude low pay | Exclude MNEs | Exclude MNE experience | Exclude other experience | Exclude firms $< 10$ workers |
|---|---|---|---|---|---|---|
| Worker-years | 12,966,223 | 9,532,790 | 7,096,665 | 6,353,434 | 3,503,604 | 2,640,938 |
| Workers | 2,339,903 | 1,711,680 | 1,465,659 | 1,284,580 | 816,729 | 627,877 |
| Firm-years | 1,245,354 | 954,993 | 931,356 | 900,247 | 615,345 | 157,920 |
| Firms | 247,144 | 194,222 | 190,991 | 183,066 | 117,463 | 31,193 |

Table 17: Breakdown of market firms, excluding firms with less than 10 workers

| | Market firms | Exclude low pay | Exclude MNEs | Exclude MNE experience | Exclude other experience | Exclude firms > 9 workers |
|---|---|---|---|---|---|---|
| Worker-years | 12,966,223 | 9,532,790 | 7,096,665 | 6,353,434 | 3,503,604 | 862,666 |
| Workers | 2,339,903 | 1,711,454 | 1,465,659 | 1,284,580 | 816,729 | 237,078 |
| Firm-years | 1,245,354 | 955,117 | 931,356 | 900,247 | 615,345 | 457,425 |
| Firms | 247,144 | 194,233 | 190,997 | 183,072 | 117,466 | 101,137 |

Table 18: Balanced panel

| | (1) ln(wage) | (2) ln(wage) | (3) ln(wage) |
|---|---|---|---|
| $\gamma\_M$ | 0.42*** | 0.33*** | 0.29*** |
| | (0.036) | (0.024) | (0.024) |
| $\gamma\_D$ | 0.14*** | 0.19*** | 0.17*** |
| | (0.026) | (0.017) | (0.017) |
| Constant | 9.45*** | 9.50*** | 9.47*** |
| | (0.098) | (0.095) | (0.090) |
| $\gamma\_M - \gamma\_D$ | .273 | .137 | .119 |
| SE | .035 | .028 | .027 |
| 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 size | No | No | Yes |
| N | 746531 | 746530 | 671163 |
| R2 | 0.93 | 0.93 | 0.94 |

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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 19: Panel including low paid workers

| | (1) ln(wage) | (2) ln(wage) | (3) ln(wage) |
|---|---|---|---|
| $\gamma\_M$ | 0.43*** | 0.32*** | 0.28*** |
| | (0.032) | (0.021) | (0.021) |
| $\gamma\_D$ | 0.12*** | 0.16*** | 0.15*** |
| | (0.024) | (0.012) | (0.013) |
| Constant | 8.38*** | 8.36*** | 8.40*** |
| | (0.11) | (0.11) | (0.11) |
| $\gamma\_M - \gamma\_D$ | .307 | .155 | .123 |
| SE | .029 | .023 | .023 |
| Worker FE | Yes | No | No |
| Firm FE | Yes | No | No |
| Year 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 | 2048749 | 2048734 | 1602214 |
| R2 | 0.91 | 0.91 | 0.91 |
| N firms | 803261 | 803261 | 803261 |

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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 20: Alternative share specification

| | (1) ln(wage) | (2) ln(wage) | (3) ln(wage) |
|---|---|---|---|
| share_new_emplys | 0.14*** | 0.11*** | 0.093*** |
| | (0.010) | (0.0064) | (0.0070) |
| share_new_emplys_mne | 0.0042 | 0.0078*** | 0.0081*** |
| | (0.0040) | (0.0023) | (0.0023) |
| Constant | 9.30*** | 9.33*** | 9.32*** |
| | (0.077) | (0.074) | (0.079) |
| 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 size | No | No | Yes |
| N | 1602929 | 1602921 | 1257599 |
| R2 | 0.93 | 0.94 | 0.94 |

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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 3: Impact of introducing threshold for firms with 10+ workers on wage distribution

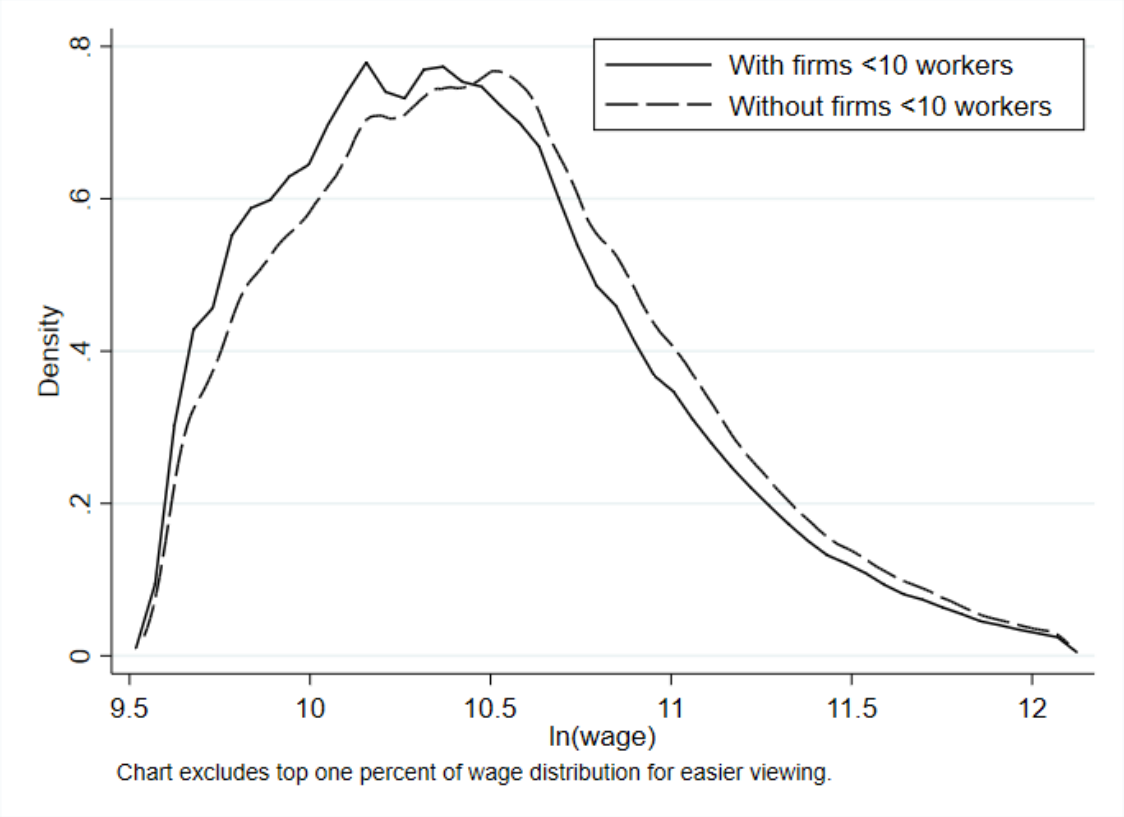


Figure 4: Impact of introducing threshold for firms with 10+ workers

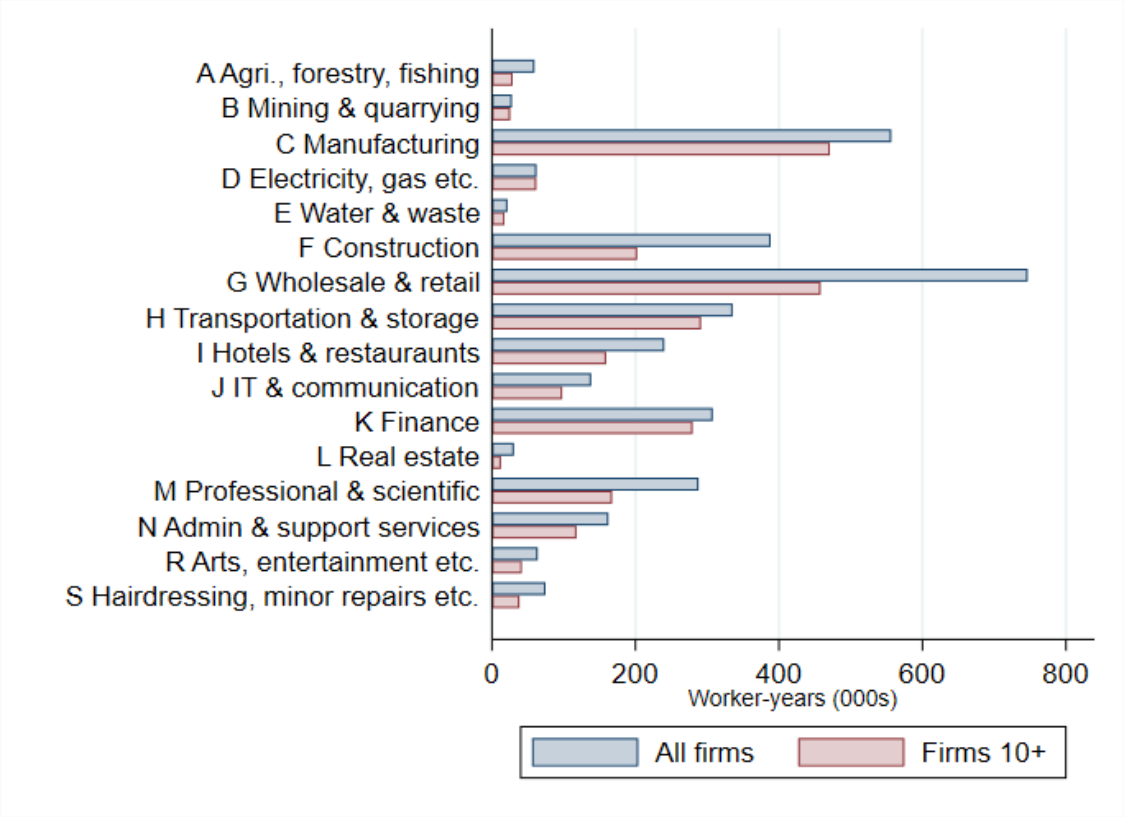


Figure 5: Distribution of firms' first former MNE worker by year, firms over 10 workers

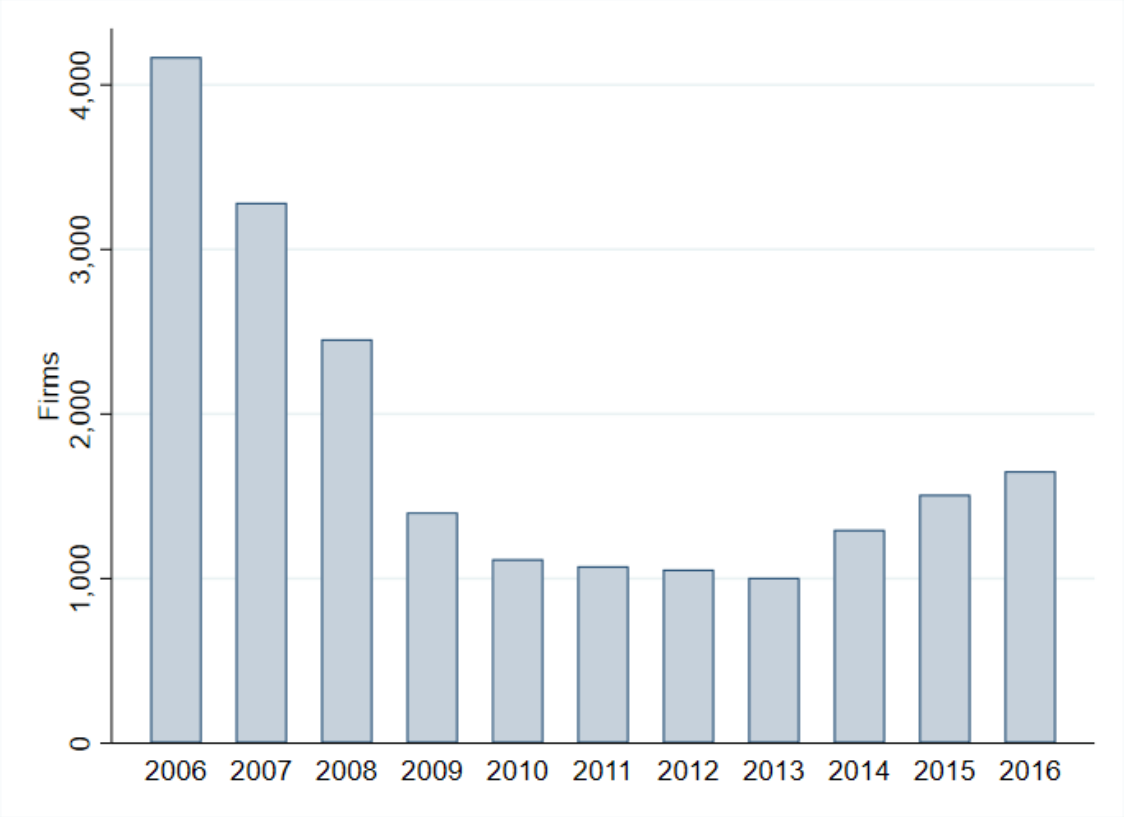
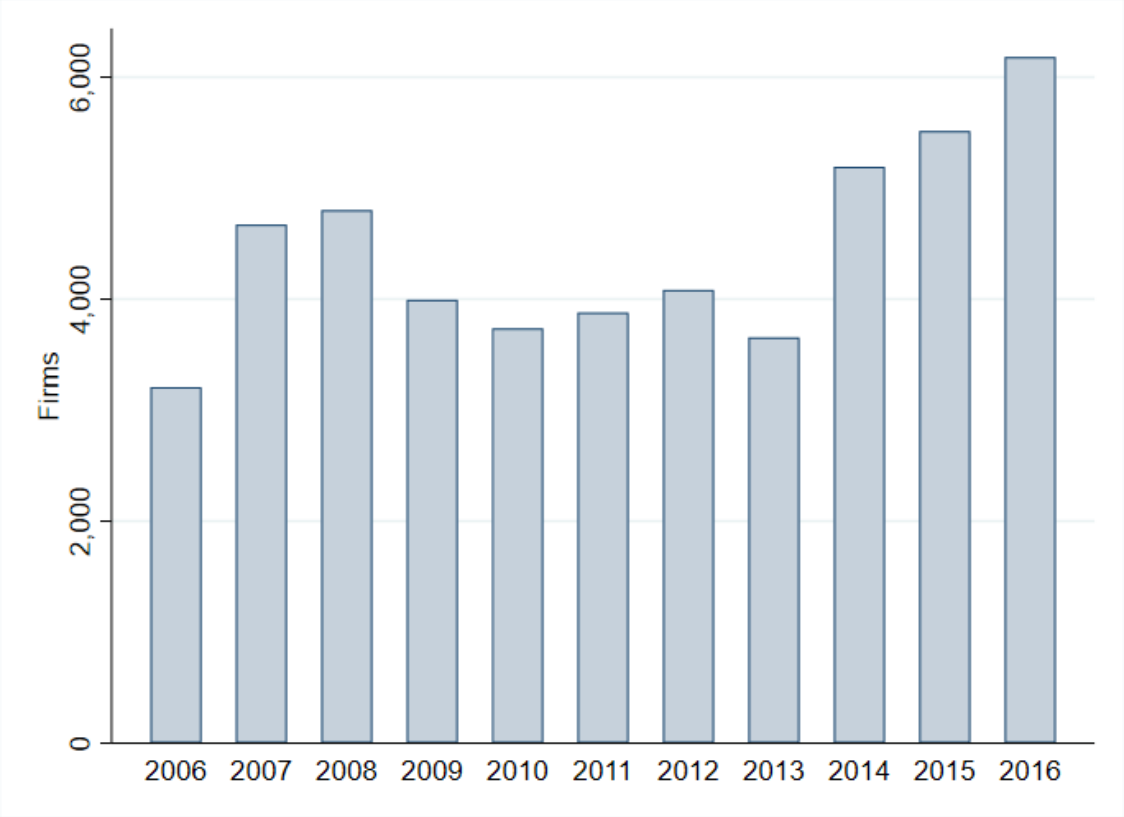


Figure 6: Distribution of firms' first former MNE worker by year, firms under 10 workers



## 9.2 On causality

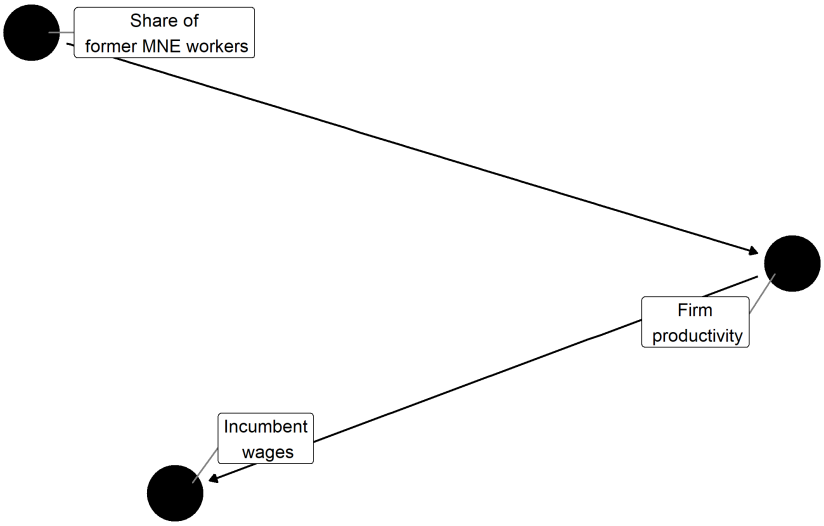



Figure 7: The basic causal path that I wish to examine

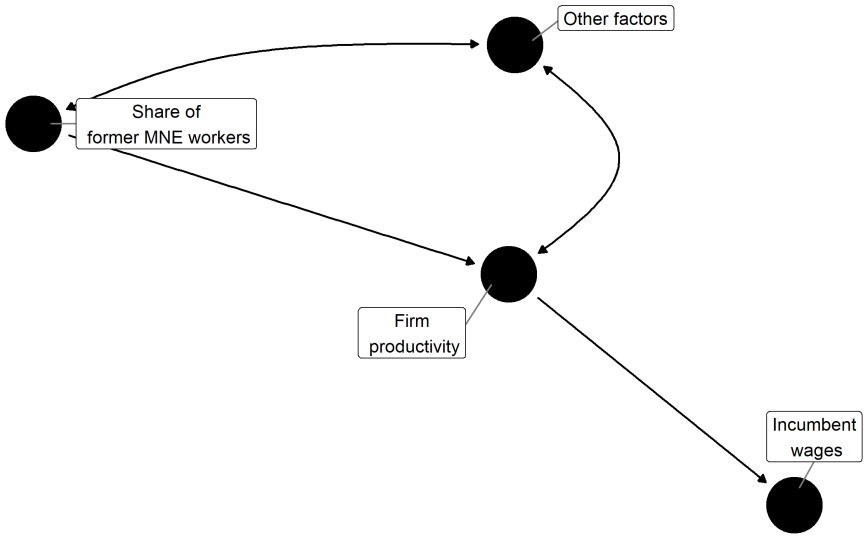



Figure 8: Incumbent productivity and the share of former MNE workers (a source of productivity ) are both affected by many other factors. Holding as many of these other factors constant, I examine whether higher shares of former MNE workers is consistent with increased worker productivity. Incumbent wages are assumed to be directly caused by firm productivity. I assume that, once I have controlled for other factors, the share of former MNE workers directly affects firm productivity.

## 9.3 Variable descriptions

$Wage_{ijt}$ - Individual wages refer to an employee's total taxable pay for the year in euros. I use total income earned by an employee for the full year (regardless of whether it came from more than one job). I deflate wages using the Consumer Price Index.
$lnY_{ijt}$ - Log of $Wage_{ijt}$
$S_{jt}^{M}$ - Share of the firm's workforce with previous experience in an MNE.
$S_{jt}^{D}$ - Share of the firm's workforce hired from another domestic establishment (with no previous experience with an MNE).
$Age_i$ - Worker age
$Size_j$ - Log firm size, measured by number of workers.
$For_{ijt}$ - Non-Irish is defined as anyone with non-Irish nationality. Nationality is recorded by the Irish Employment Affairs and Social Protection when assigning someone with an identification number. The nationality recorded must be supported by documentation such as a birth cert or passport from the person's country of origin.
$Weeks_{ijt}$ - Weeks worked refers to the 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.
Regions - The regions used in creating fixed effects correspond to the three digit EU NUTS 2016 regions for Ireland. These eight regions are: 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, Dún Laoghaire–Rathdown, Fingal and South Dublin), Mid-East Region IE062 (Kildare, Meath, Wicklow, Louth), Midlands Region IE063 (Laois, Longford, Offaly, Westmeath).