

Multinational companies, backward linkages and labour demand elasticities

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Abstract

This paper investigates the link between nationality of ownership and wage elasticities of labour demand at the level of the plant. In particular, we examine whether labour demand in multinationals becomes less elastic with respect to the wage if the plant has backward linkages with the local economy. Our empirical evidence, based on a rich plant level dataset, shows that the extent of local linkages indeed generally reduces the wage elasticity of labour demand. This result is economically important and holds for a number of different specifications.

JEL Classification: F23, J23, L23

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1 Introduction

It has been well established in the empirical literature that workers in industrialised countries have experienced higher job insecurity over the last few decades, both in terms of higher volatility of employment spells and earnings (e.g., OECD 1997). “Globalisation” has been made at least partly responsible for these trends, certainly in the popular debate as well as among academics (e.g., Rodrik, 1997; Scheve and Slaughter, 2004). Of all the drivers of globalisation - trade, migration of workers, and foreign direct investment (FDI) - FDI is probably the most visible. It is also likely to be, at the margin, the most important aspect of globalisation in economic terms. For instance, over the last two decades global FDI flows have grown at least twice as fast as trade, now well exceeding \$500 billion and resulting in a total stock of more than \$8 billion (United Nations, 2004).

It is not surprising then, that the potential “footloose” nature of FDI in response to changes in production costs elsewhere has raised some concern about the jobs created through FDI, despite the generally higher wages associated with such employment (e.g., Lipsey and Sjöholm, 2004; Girma and Görg, 2007). As a matter of fact, these fears have recently come to the fore in the wake of a number of plant closures by high profile multinationals in Europe, often attributed to lower wages elsewhere. For example, the Japanese multinational Sony announced the closure of one of its plants in Wales in June 2005, with the resulting loss of 650 jobs due to the availability of lower production costs elsewhere.¹

It is important to note, however, that the potential “footloose” nature of FDI is only one possible response to changes in production costs.² Alternatively,

¹ <http://www.personneltoday.co.uk/Articles/2005/06/30/30593/Sony+slashes+650+UK+jobs.htm>

² Bernard and Sjöholm (2003) and Görg and Strobl (2003) find that multinationals have higher exit probabilities than comparable domestic plants, a finding in line with this argument.

multinationals may, rather than completely shutting down production, simply downsize their operations and shed labour in the light of the availability of cheaper labour elsewhere. Thus, if one is to capture the complete picture of lower job stability in multinationals then one arguably also needs to investigate differences in the wage elasticity of multinationals relative to the indigenous industry.

In this regard, there are only a few studies which compare the wage elasticity of labour demand in multinationals and domestic firms. Fabbri et al. (2003) discuss the issue and illustrate the theory with a standard neo-classical labour demand framework. Their idea is quite straightforward: multinationals are part of global production networks and, within these networks, can more easily transfer production in response to changes in costs (in particular wages). Using industry level data they find an increase in wage elasticities of labour demand (conditional on output) over time for low skilled US and UK manufacturing workers and argue that increased activity of multinationals may be partially responsible for this. By contrast Barba-Navaretti et al (2003) in a cross country firm level study of a group of European countries find that, in most countries, multinationals adjust their labour demand more rapidly than domestic firms in response to shocks, but have a more inelastic demand curve with respect to wages. They argue that multinationals have a more rigid demand for labour due to differences in skill structure.³

The current paper re-examines the link between nationality of ownership and the wage elasticity of labour demand, but specifically investigates whether efforts at integrating multinationals in the local economy through backward linkages can

³ The paper by Konings and Murphy (2001) is also somewhat related. They look at the extent to which multinationals substitute employment towards parent plants in response to wage changes. They find evidence of substitution between EU parent firms and their subsidiaries rather than towards low wage subsidiaries outside the EU. In addition, Slaughter (2001) looks at labour demand elasticities in the US to see whether increased openness to trade has increased the demand elasticity and found little support for this hypothesis.

reduce their volatile nature by affecting their elasticity of labour demand.^{4,5} Our argument that this is likely to be the case rests on the idea that locally purchased inputs may be more difficult to substitute for labour than other inputs. This may be plausible under the assumption that locally sourced inputs are to some degree "specific" due to, e.g., better quality and availability, or lower transport costs than imported inputs. To discuss these points in more detail we present a simple framework that highlights how such channels are likely to affect labour demand.

Using a rich plant level data set for manufacturing plants in the Republic of Ireland we then empirically investigate whether wage elasticities depend on the extent of local backward linkages and whether this is more important for foreign multinationals than for indigenous firms. Arguably, Ireland is a particularly interesting case study in this regard given that its manufacturing industry is heavily dependent on foreign multinationals, and also the fact that foreign plants account for about half of total employment. Moreover, Ireland has operated a number of explicit policy programmes to foster linkages between foreign multinationals and domestic suppliers (Ruane, 2001).

The remainder of the paper is structured as follows. Section 2 provides the theoretical background for our analysis and Section 3 describes the data. Section 4 outlines the empirical approach and presents the empirical results. Section 5 concludes.

2 Theoretical background

⁴ We do not consider plant exit in this paper.

⁵ Our paper is, hence, also related to the recent literature on productivity spillovers from FDI, which argues that spillovers are most likely to occur through multinationals' backward linkages with domestic suppliers (e.g., Driffield et al., 2002, Javorcik, 2004).

For much of the theoretical analysis below and for the empirical analysis in the remainder of the paper we focus on conditional labour demand elasticities where firms minimise the cost of producing a given output. The plant will have a fixed price and a u-shaped average cost curve due to fixed costs and increasing marginal costs.

In order to illustrate our argument as to why backward linkages with domestic suppliers may impact on labour demand elasticities, we summarise the neo-classical conditional labour demand model.⁶ The firm is a price taker for the n inputs and has a production function:

$$y = f(x_1, \dots, x_n) \quad (1)$$

The price of each factor i is w_i and total costs are $c = F + w_1x_1 + w_2x_2 + \dots + w_nx_n$. The Lagrangian function for cost minimisation is:

$$\ell = w_1x_1 + w_2x_2 + \dots + w_nx_n + \lambda[y - f(x_1, \dots, x_n)] \quad (2)$$

The share of any factor j in variable costs is s_j . The elasticity of substitution between labour (factor 1) and any other factor j is σ_{1j} .

The labour demand elasticity conditional on output is:

$$\eta_{11}^* = \frac{\partial x_1}{\partial w_1} \frac{w_1}{x_1} = \frac{\sum_{j \neq 1}^n \sigma_{1j} f_j x_j}{\sum_{i=1}^n f_i x_i} = \sum_{j=2}^n \sigma_{1j} s_j \quad (3)$$

From equation (3) we see that the elasticity of labour demand is determined the elasticity of substitution between labour and the other factor j , and the share of factor j .⁷

⁶ See also Fabbri et al. al (2003) who use this framework to motivate differences in labour demand elasticities between foreign and domestic owned firms, or Hammermesh (1993) for a more general discussion.

⁷ While equation (3) is well known it may be worth pointing out that while some of the literature using equation (3) assumes constant returns to scale, this is not necessary. See the working paper version of this paper (Görg et al., 2006) for a derivation of (3).

There are a number of issues with regard to (3) that are worth pointing out. First, with regard to labour's share in total cost, as we will see later when we look at unconditional labour demand elasticities the role of labour share is ambiguous. Also theoretical frameworks of multinational firms suggest that such firms will have high fixed costs, so that labour costs may be a small share of output but a much larger share of variable costs.⁸ For this reason one should be wary about looking at measures of labour intensity such as labour's share in output as a proxy for s , as it is labour's share in variable costs that is relevant to the demand elasticity.

Equation (3) also suggests that other things equal, if locally purchased inputs are more difficult to substitute for labour than other inputs (low σ) firms that purchase more local inputs will have smaller elasticities. This may be plausible under the assumption that locally sourced inputs are to some degree "specific" due to, e.g., better quality and availability, or lower transport costs than imported inputs. As an example, a multinational firm switching sourcing from a supplier abroad to a local is then in a better position to obtain specific design or quality standards, perhaps with the help of providing assistance to the local supplier in the first instance.⁹ Therefore, it may be less likely to substitute the locally sourced input for labour than the previously imported input.¹⁰

⁸ In Markusen, 2002 for example, affiliates whose parent has incurred significant advertising or R&D costs may have very high output per worker.

⁹ Moran (2001) provides plenty of case studies between foreign subsidiaries and domestic suppliers and provides evidence of such assistance.

¹⁰ An additional possible explanation is that firms that locate close to an input source do so partly because local inputs are more difficult to substitute for, and that these may often be inputs such as agricultural commodities in food and drink production etc. Think of a foreign owned producer of a food or drink product who would find it difficult to substitute away from labour with a software firm who has skilled labour which may be more substitutable. Kennedy (1991) provides evidence that backward linkages in the former industry are much higher than in most other manufacturing industries, including the computer industry. However, in the econometric analysis below we focus on within firm changes, rather than differences across sectors, hence this explanation is less relevant to our analysis.

One of Marshall's well known rules is that labour demand will be less elastic the more elastic is the supply of other inputs.¹¹ The intuition is that if the supply curve for another input (say capital) is steep, a rise in wages will increase the demand for and price of capital as firms substitute from labour into capital, but this will limit the degree to which firms will substitute. To illustrate we assume a firm has a Cobb-Douglas production function $y = x_1^{\alpha_1} x_2^{\alpha_2} x_3^{\alpha_3}$ with three inputs: labour, an imported input and a locally sourced input. These are denoted as x_1, x_2 and x_3 respectively. The steepness of the supply for other factors is measured by the elasticity of the price of factor j to a demand induced increase in the wage: η_{w_j, w_1} . Using a Cobb-Douglas for the production function in (2) the conditional labour demand is:

$$x_1 = z w_1^{\frac{-(\alpha_2 + \alpha_3)}{\alpha_1 + \alpha_2 + \alpha_3}} w_2^{\frac{\alpha_2}{\alpha_1 + \alpha_2 + \alpha_3}} w_3^{\frac{\alpha_3}{\alpha_1 + \alpha_2 + \alpha_3}} \quad (4)$$

Taking logs and differentiating where we allow the prices of the other factors to depend on the wage we get¹²:

$$\eta_{11}^* = -[s_2(1 - \eta_{w_2, w_1}) + s_3(1 - \eta_{w_3, w_1})] \quad (5)$$

A rise in wages (price of factor 1) will induce firms to substitute from labour into other inputs. To the extent that these are purchased in the domestic economy firms will increase the demand for such inputs and drive up the price, hence limiting the extent of substitution away from labour. Firms who substitute from labour into inputs sourced abroad would not expect the same to be true if a small country has little impact on the world price of that factor. In terms of equation (5) if we assume

¹¹ See Hicks (1968) Appendix to chapter XI for a formal derivation in the constant returns to scale case, and Hamermesh (1993) for a more general discussion.

¹² Görg et al. (2006) derive the result with a general production function and two inputs. In this case for

any factor i : $s_i = \frac{\alpha_i}{\alpha_1 + \alpha_2 + \alpha_3}$. The z is a constant that depends on the parameters of the model.

$\eta_{w_2 w_1} < \eta_{w_3 w_1}$ then other things equal, the firm with a higher share of imported inputs will have the greater demand elasticity.

Fabbri et. al (2003) argue that multinationals may have more elastic demand than domestic firms because firms with global production networks may be able to more easily import intermediate goods that could alternatively be produced by domestic labour. They argue that this is especially likely if a firm is vertically integrated internationally and different plants engage in intra-firm trade. To see how this argument fits into our framework we assume that the multinational subsidiary produces two outputs y_1 and y_2 where y_2 is an intermediate input which can be produced in the subsidiary or imported at a fixed marginal cost from another branch of the company and y_1 is output of the final good. We assume the firm has two separate production functions for the two goods within the plant for simplicity where b_1 is the fraction of the workforce producing the final good and $(1-b_1)$ the fraction producing the intermediate good. If we estimate the demand elasticity for the plant holding final output fixed this does not condition on output of the intermediate input. Output of this input will fall after a wage increase until the marginal cost at the new output level equals the original marginal cost. The overall elasticity estimate conditional on final output will be:

$$\eta_{ll}^* = b_1 \eta_{ll}^{*1} + (1-b_1) \eta_{ll}^2 \quad (6)$$

where η_{ll}^{*1} is the conditional demand elasticity for employment of the final good and η_{ll}^2 is the unconditional demand for the intermediate good which for a given elasticity of substitution may be substantially larger than the conditional elasticity. To illustrate we take the three factor Cobb-Douglas production function used earlier. From

equation (3) $\eta_{ll}^{*1} = -\frac{(\alpha_2 + \alpha_3)}{\alpha_1 + \alpha_2 + \alpha_3}$. If we totally differentiate the first order conditions

from the profit function: $\pi = px_1^{\alpha_1} x_2^{\alpha_2} x_3^{\alpha_3} - w_1 x_1 - w_2 x_2 - w_3 x_3$ we can solve for the

unconditional elasticity $\eta_{ll}^2 = -\frac{1 - \alpha_2 - \alpha_3}{1 - \alpha_1 - \alpha_2 - \alpha_3}$. This simple example illustrates that

since $\eta_{ll}^{*1} < \eta_{ll}^2$ in absolute value a firm with a higher share of labour devoted to the intermediate good will have higher demand elasticity other things equal¹³.

3 Description of the data

The preceding discussion illustrates that there are plausible reasons why one might expect the source of inputs to matter for foreign firms' labour demand elasticities. We now turn to examining this issue empirically. The data for our analysis are taken from the *Irish Economy Expenditure Survey* (IEE), undertaken annually by Forfas, the government agency with responsibility for enterprise development, science and technology. This is an annual survey of plants in Irish manufacturing with at least 20 employees, although a plant, once it is included, is generally still surveyed even if its employment level falls below the 20 employee cut-off point.

The survey provides plant level information on, *inter alia*, output, employment, nationality of ownership, as well as details on plants' expenditure on labour and other inputs.¹⁴ The response rate to this survey is generally estimated to be between 60 and 80 per cent of the targeted plant population. The data cover the

¹³ Görg et al (2006) derive the unconditional elasticity for the two factor case and a general production function that is homogeneous of degree r . The unconditional elasticity is

$\eta_{11} = -[\sigma s_2 + \frac{s_1}{(1-r)}]$ while the two factor analogue of the conditional elasticity is

$\eta_{11}^* = -\sigma s_2$. While s_i represents the share of variable costs in one case and output in the other clearly the unconditional elasticity may be much larger.

¹⁴ Note that the dataset does not allow us to distinguish skill groups for workers, thus we treat labour as homogeneous.

period 1983-1998 and provide an unbalanced panel for 2,675 plants. A look at the data shows that total exits over this period in our data only account for 3.3 percent of total plants.

Nationality of ownership is covered as a dichotomous variable indicating whether a plant is foreign or domestic owned. In this context one should note that Forfás defines foreign plants as plants that are majority-owned by foreign shareholders, i.e., where there is at least 50 per cent foreign ownership. While, arguably, plants with lower foreign ownership should still possibly considered to be foreign owned, this is not necessarily a problem for the case of Ireland since almost all inward foreign direct investment has been greenfield investment rather than acquisition of local firms (see Barry and Bradley, 1997). By way of summary statistics, Figure 1 shows the development of total employment in foreign and domestic plants in Irish manufacturing over the sample period. One should note that employment in foreign-owned plants has increased more rapidly than domestic employment, with a growth from around 58,000 to almost 100,000 employees in 1998.

[Figure 1 here]

The IEE survey also includes information on plants' expenditure on intermediate inputs and breaks this down into domestically sourced and imported intermediates and we use this information to calculate our measure of local sourcing. More precisely, we calculate a linkage indicator as the percentage of inputs sourced locally (see, e.g., Görg and Ruane, 2000; Kennedy, 1991; Cohen, 1973). Table 1 shows the development of total backward linkages in 1983 and 1998 respectively by NACE 2 digit industry.

[Table 1 here]

One should note, firstly, that foreign-owned plants on average have lower linkages than domestic plants, although there are some of exceptions (e.g., 19 - leather, in 1998). Moreover, the table highlights sectoral differences with the highest linkages occurring for domestic plants in sectors 30 (computers & office machinery) in 1983 and 15 (food & beverages) in 1998, and for foreign plants in sectors 27 (basic metals) in 1983 and 19 (leather) in 1998. As expected, there are significant differences in linkages between foreign and domestic plants, most noteworthy perhaps in sector 30 (office machinery) in 1983, although this difference has all but disappeared in 1998. The table also shows that for multinationals, backward linkages have generally increased over the 1983 to 1998 period. This may at least in part reflect the emphasis of the *National Linkage Programme* in Ireland on creating linkages between foreign multinationals and local suppliers (Ruane, 2001).

4 Estimating labour demand elasticities

4.1 Differences between foreign and domestic plants

The first step in our empirical analysis is to establish whether in our dataset there are differences in labour demand elasticities between domestic and foreign owned plants. In order to do so we specify the following dynamic conditional labour demand function for plant i in year t ,

$$\begin{aligned}
 l_{it} = & \alpha_1 l_{it-s} + \alpha_2 w_{it} + \alpha_3 y_{it} \\
 & + \beta_1 \text{foreign}_{it} + \beta_2 (w^* \text{foreign})_{it} + \beta_3 (y^* \text{foreign})_{it} + d_t + d_i + e_{it}
 \end{aligned} \tag{7}$$

where l , w , and y are logged values of employment, wages per head, and output, respectively. The variables d_t , d_i , and e are time specific effects, plant specific time invariant effects, and an i.i.d. error term, respectively; all unobservable to the

econometrician.¹⁵ Depending on observations per plant one may want to include up to t-s lagged dependent variable in the equation, since, arguably, labour demand may be dynamic in nature because of a non-smooth adjustment process in plants' employment policy (see, for example, Hamermesh, 1993). *foreign* in (7) is a dummy variable equal to one if a plant is foreign-owned and zero otherwise. This variable is interacted with w and y to allow for nationality of ownership differences in the wage and output elasticity.

In terms of estimation of equation (7) one should note that simply using OLS is likely to prove problematic. Specifically, employment is likely to be simultaneously determined with output and may also affect plant level wages if the plant is not a price taker in the local labour market. Also, the wage variable may not only capture labour costs but may also be a measure of firms' skill intensities. This is because a firm that uses higher skilled workers must pay higher average wages due to a composition effect, leading to another potential source of endogeneity in the estimation.

If such endogeneity biases were time invariant then simply first differencing the data would provide a possible solution. However, given the length of the panel of individual plants (up to 15 years) this is unlikely to be the case.¹⁶ One possible way of solving this problem would be to first difference equation (7) and apply a first differenced generalized methods of moments (GMM) estimator as developed by Arellano and Bond (1991). This estimator uses suitably lagged levels of the

¹⁵ A static version of the equation including only w and y can be derived from a Cobb-Douglas production function using labour and capital as inputs. The cost of capital is difficult to measure at the plant level. We assume that the cost of capital is the same for all plants in the economy and is, hence, captured by time dummies.

¹⁶ The inclusion of the lagged dependent variable would render a simple fixed estimator inappropriate in this context. In a transformation from the mean, the difference between the lagged dependent variable and its mean ($l_{it-1} - \bar{l}_i$) is by construction correlated with $e_{it} - \bar{e}_i$, as the mean \bar{e}_i contains e_{it-1} , which is correlated with l_{it-1} . See, for example, Baltagi (1995) for a discussion.

endogenous variables as instruments in the first differenced equation. However, this approach has been criticised recently since it has been argued that lagged levels of variables may only be weak instruments for the variables in first differences. In order to overcome this problem of weak instruments, while also controlling for plant specific fixed effects, Blundell and Bond (1998) suggest using a system GMM estimator which uses an additional set of moment restrictions to improve estimation.¹⁷ Accordingly, the estimator uses a stacked system of first differenced and level versions of the estimating equation, where for the former appropriately lagged values and for the latter appropriately lagged differences of the endogenous variables can serve as valid instruments. The validity of these instruments can be tested using a Hansen J test. The consistency of our estimates also rests on the assumption that there is no second order correlation of the residuals of the first-differenced equation. The standard procedure to verify this is to use an AR(2) test on the residuals developed by Arellano and Bond (1991) where the null hypothesis is that of no second order autocorrelation.

The results of estimating equation (7) are reported in Table 2. Column (1) provides the simplest model using only one lag of the dependent variable. As the Hansen statistic indicates, we reject the hypothesis of instrument validity. Also, we reject the hypothesis of no second order autocorrelation (AR(2)). Hence, this equation is clearly misspecified. Column (2) adds the second lag of the dependent variable which improves on autocorrelation, but still leaves us with an instrument set

¹⁷ The appendix provides an illustration of the “weak instrument” problem in first differenced GMM. As far as we are aware there is no formal test for weak instruments in the context of dynamic panel GMM and we hence follow an approach used by Bond et al. (2001). Estimating a first differenced version of equation (7) using OLS would upward bias coefficients on the lagged dependent variable, while a fixed effects (FE) transformation would lead to a downward bias. As the table in the appendix shows, using first differenced GMM a la Arellano and Bond (1991) produces coefficients on l_{t-1} that are close to the FE model. This suggests that the first differenced GMM model is biased downwards which can be due to weak instruments (Bond et al., 2001). The estimates produced by the system GMM estimator lie comfortably between OLS and FE estimates suggesting that it is more reliable.

that is not valid. Only in column (3) have we got a specification that has valid instruments where we fail to reject the hypothesis of no AR(2) and we hence use this as our benchmark specification.

Turning to the coefficients, we find from column (3) that the wage and output elasticities look economically sensible – they are negative and positive, respectively, and statistically significant in both cases. The point estimates are also well within the range of those generally found in the literature (e.g., Barba Navaretti et al., 2003). More importantly, the significant coefficients on the interaction terms suggest that multinationals respond differently to wage changes in terms of their demand for labour. Specifically, the wage elasticity for multinationals is higher (in absolute terms) than for domestic plants; a result found by Barba Navaretti et al. (2003) for Finland and Sweden. We do not find any statistically significant differences in the output elasticities, however. Overall, the results thus far suggest that it is more reasonable to estimate the effect of linkages on elasticities separately for domestic and foreign plants.

[Table 2 here]

4.2 Linkages and labour demand

If multinationals have higher labour demand elasticities than domestic firms it may indeed be the case that they are more likely to reduce labour demand than comparable domestic plants if labour costs increase. The issue now becomes whether further integration of multinationals through local linkages may provide a counter force to this, and as discussed in Section 2, there may be reasons to think that it does. In order to investigate this issue we examine whether labour demand elasticities depend on the degree to which multinationals are integrated into the local economy.

More specifically, we estimate a dynamic conditional labour demand function, similar to equation (7) as

$$l_{it} = \gamma_1 l_{it-s} + \gamma_2 w_{it} + \gamma_3 y_{it} + \lambda_1 link_{it} + \lambda_2 (link * w)_{it} + \lambda_3 (link * y)_{it} + d_t + d_i + e_{it} \quad (8)$$

where *link* is the measure of local linkages which is interacted with *w* and *y*. Hence, $\gamma_2 + \lambda_2 (link)_{it}$ represents the wage elasticity of labour demand, which by construction depends on the degree of local linkages. The crucial point of the analysis is, hence, whether λ_2 is statistically significantly different from zero, and whether it is different for multinationals and domestic firms. We check for the latter by including appropriate triple interaction terms.

Table 3 shows the results of estimating equation (8). Column (1) reports elasticities based on the full sample of plants, not distinguishing between foreign and domestic owned establishments. The results indicate that there is indeed a statistically significant impact of linkages on the wage elasticity of labour demand for all firms. However, allowing for different effects of linkages for domestic and foreign firms reveals some interesting differences across nationality of ownership. To do so we construct a triple interaction term of (*w * link * foreign*) while also including the interaction of (*w * foreign*) as in Table 2. The latter interaction term thus allows for differences in wage elasticities for foreign firms, while the former allows for a different effect of linkages on the wage elasticity for foreign firms.

The results in column (2) show that linkages have a statistically significant and positive effect on the wage elasticity for all firms (as apparent from the interaction of log wage * linkage). However, we also find from the triple interaction term (log wage * linkage * foreign) that the positive effect is higher for foreign firms at (0.058 + 0.023 =) 0.081 than for domestic firms at 0.058. The difference in results could

perhaps reflect the fact that domestic plants source different types of inputs locally, which may be easily substitutable for local labour, hence there may be less effect of increased linkages on the elasticity.¹⁸

Using the point estimates in column (2) implies that the wage elasticity of labour demand for a foreign owned plant with zero linkages is $(0.217 + 0.107\alpha)$ 0.324, whereas a foreign plant with a mean level of local linkages has a wage elasticity of 0.289. Increasing the degree of linkages by two standard deviations from the mean then implies a further reduction in the elasticity to 0.248. Hence, the estimated coefficients are not only statistically, but also economically, significant.¹⁹ One may want to notice also that even if a foreign plant had a linkage coefficient of 1 its wage elasticity would still be substantially higher (at 0.243) than that of a domestic plant with zero linkages (at 0.217). Hence, while linkages may help to reduce the elasticity they are not enough to explain away the higher elasticities in foreign than in domestic plants.²⁰

[Table 3 here]

Robustness checks

One possible concern with the estimation above is that labour demand elasticities may depend on size of the plant (Hamermesh and Pfann, 1996) and our results may therefore just reflect the fact that multinationals are generally larger than domestic plants, and that larger firms have higher linkages (as found by Görg and Ruane, 2001 and Alfaro and Rodriguez-Clare, 2004). We, therefore, provide a

¹⁸ Unfortunately our dataset does not distinguish different types of inputs, hence we cannot follow up this conjecture with further analysis.

¹⁹ In 1998, the mean ratio of locally sourced inputs over total inputs for foreign owned plants is 0.42 (see Table 1), the standard deviation is 0.25.

²⁰ Column (3) presents an alternative regression which only uses one lag of the dependent variable. However, as in Table 2, this specification is mis-specified and we reject the hypothesis of no second order autocorrelation.

robustness check to deal with the issue of plant size. Specifically, we classify plants into three size categories according to their average size over the sample period: small (employment less than 33rd percentile of the size distribution), medium (employment between 33rd and 66th percentile of the size distribution), and large (employment greater than 66th percentile of the size distribution) and estimate equation (8) on these different samples separately.

Columns (4) to (6) in Table 3 present these results. Our findings on the effect of linkages for multinationals still hold. While we indeed find that wage elasticities differ by size class we also find that for all size groups, increased linkages are associated with reductions in these elasticities for foreign firms, although the coefficient on the triple interaction term is, while still positive, statistically insignificant for large firms in column (6). Hence, our previous findings are not just reflections of the fact that we do not take into account size differences in the estimation of wage elasticities.

Another robustness check considers the unbalanced nature of our panel data which contains exit, so that if the probability of exit were correlated with the degree of local linkages and employment then our results may be biased. For example, foreign multinationals may have more sunk costs the more integrated they are into the local economy and hence may be less likely to exit. However, exiting plants are also likely to adjust their employment differently prior to exit. As argued in Section 3, there is very little exit in our data and, hence, it may be considered negligible in our analysis. Regardless, we report some additional specifications to ensure that our results are not biased due to plant exit. In this regard, Column (1) of Table 4 reports a regression on the sample of surviving plants only, thus excluding exitors, while column (2) includes a dummy equal to 1 for the whole lifetime of a plant that exits the

data, and interacts this dummy with all variables containing log wage and its interaction terms.

Note from column (1) that the results on the survivor sample is similar to that reported in column (2) of Table 3. Considering column (2), while we find that the dummy variable and interaction terms are all statistically significant (except the final four way interaction of wage, linkage, foreign and exit dummy), we also find that the positive and statistically significant coefficient on the triple interaction of linkage and wages for foreign-owned plants is robust to this specification. Hence, our result that higher local linkages decrease wage elasticities of labour demand is robust to the different ways of dealing with the potential bias introduced through plants exiting the dataset.

[Table 4 here]

5 Conclusions

This paper investigates the link between nationality of ownership and labour demand elasticities at the level of the plant. In particular, we examine whether labour demand in multinationals (or other domestic firms) becomes less elastic if a plant has backward linkages with the local economy, proposing the possibility that locally purchased inputs may be more difficult to substitute for labour than other inputs, due to the very nature of the inputs. Our evidence shows that the extent of local linkages indeed reduces the wage elasticity of labour demand for foreign owned plants. In robustness checks we find that the results hold when allowing for plant heterogeneity in terms of size and when taking account of exit.

While our labour demand estimations show that increasing the level of linkages may lead to economically significant reductions in foreign plants' wage

elasticities, it is also clear that even if a multinational sourced all of its inputs in Ireland it would still have a substantially higher elasticity than a comparable domestic plant. Hence, while linkages are important in explaining differences in elasticities they are not sufficient to explain away the fact that foreign plants have higher wage elasticities than domestic plants.

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Table 1: Development of backward linkages

(locally sourced inputs divided by total inputs)

NACE	Description	1983		1998	
		domestic	foreign	domestic	foreign
15	Food & beverages	0.77	0.67	0.80	0.69
16	Tobacco	0.47	0.32	0.38	0.64
17	Textiles	0.26	0.33	0.37	0.30
18	Wearing apparel	0.21	0.27	0.40	0.41
19	Leather	0.51	0.34	0.56	0.72
20	Wood & wood products	0.47		0.53	0.61
21	Pulp & paper	0.42	0.29	0.50	0.33
22	Publishing & printing	0.25	0.32	0.55	0.48
23	Petroleum	0.48		0.31	0.22
24	Chemicals	0.44	0.35	0.57	0.39
25	Rubber & plastics	0.33	0.27	0.46	0.37
26	Non metallic minerals	0.48	0.38	0.69	0.51
27	Basic metals	0.63	0.90	0.57	0.30
28	Fabricated metals	0.31	0.27	0.49	0.38
29	Machinery & equipment	0.46	0.33	0.48	0.37
30	Computers & Office machinery	0.92	0.23	0.46	0.39
31	Electrical machinery	0.31	0.35	0.49	0.34
32	TV and telephone	0.26	0.19	0.47	0.34
33	Medical & optical instruments	0.33	0.33	0.59	0.41
34	Motor vehicles	0.27	0.31	0.40	0.46
35	Other transport equipment	0.24	0.09	0.28	0.45
36	Not elsewhere classified	0.40	0.60	0.51	0.53
	Total	0.48	0.36	0.56	0.42

Source: own calculations from Irish Expenditure Survey

Table 2: Labour demand elasticities, foreign vs domestic

	(1)	(2)	(3)
log employment (t-1)	0.459 (0.006) ^a	0.561 (0.007) ^a	0.916 (0.007) ^a
log employment (t-2)		-0.014 (0.003) ^a	-0.073 (0.003) ^a
log wage	-0.518 (0.015) ^a	-0.449 (0.014) ^a	-0.435 (0.010) ^a
log output	0.489 (0.010) ^a	0.422 (0.008) ^a	0.457 (0.006) ^a
log wage (t-1)			0.334 (0.007) ^a
log output (t-1)			-0.322 (0.005) ^a
foreign dummy	0.957 (0.071) ^a	0.604 (0.061) ^a	0.214 (0.038) ^a
log output * foreign dummy	-0.131 (0.011) ^a	-0.056 (0.009) ^a	-0.008 (0.006)
log wage * foreign dummy	0.081 (0.015) ^a	-0.039 (0.015) ^a	-0.055 (0.008) ^a
Hansen test (p-value)	0.00	0.00	0.10
AR(2) test (p-value)	0.00	0.08	0.69
Observations	12474	9717	9717

System GMM estimation

Dependent variable: log(employment)

Standard errors in parentheses

^c significant at 10%; ^b significant at 5%; ^a significant at 1%

Table 3: Conditional labour demand including backward linkages

	(1)	(2)	(3)	(4)	(5)	(6)
	all firms	all firms	all firms	small firms	medium firms	large firms
log employment (t-1)	0.843	0.836	0.683	0.769	0.828	0.875
	(0.009) ^a	(0.003) ^a	(0.002) ^a	(0.002) ^a	(0.001) ^a	(0.002) ^a
log employment (t-2)	-0.069	-0.074		-0.086	-0.111	-0.104
	(0.005) ^a	(0.001) ^a		(0.001) ^a	(0.001) ^a	(0.001) ^a
log wage	-0.240	-0.217	-0.268	-0.193	-0.208	-0.312
	(0.015) ^a	(0.008) ^a	(0.009) ^a	(0.003) ^a	(0.002) ^a	(0.004) ^a
log output	0.214	0.212	0.273	0.192	0.193	0.219
	(0.008) ^a	(0.004) ^a	(0.005) ^a	(0.002) ^a	(0.001) ^a	(0.002) ^a
linkage	0.342	0.336	0.372	0.345	0.446	0.398
	(0.077) ^a	(0.025) ^a	(0.025) ^a	(0.020) ^a	(0.007) ^a	(0.012) ^a
log wage * linkage	0.074	0.058	0.008	0.115	0.002	0.094
	(0.021) ^a	(0.012) ^a	(0.012)	(0.005) ^a	(0.003)	(0.005) ^a
log output * linkage	-0.069	-0.071	-0.064	-0.089	-0.071	-0.088
	(0.012) ^a	(0.005) ^a	(0.005) ^a	(0.003) ^a	(0.001) ^a	(0.002) ^a
foreign dummy		0.118	0.186	0.722	0.253	0.182
		(0.017) ^a	(0.025) ^a	(0.008) ^a	(0.005) ^a	(0.010) ^a
log wage * foreign		-0.107	-0.135	-0.403	-0.022	0.022
		(0.008) ^a	(0.009) ^a	(0.005) ^a	(0.003) ^a	(0.004) ^a
log output * foreign		0.009	0.010	0.037	-0.030	-0.038
		(0.004) ^a	(0.005) ^b	(0.002) ^a	(0.001) ^a	(0.002) ^a
log wage * linkage * foreign		0.023	0.069	0.518	0.014	0.007
		(0.014) [*]	(0.014) ^a	(0.010) ^a	(0.005) ^a	(0.006)
log output * linkage * foreign		0.018	0.006	-0.163	0.007	0.027
		(0.004) ^a	(0.005)	(0.003) ^a	(0.002) ^a	(0.002) ^a
Hansen test (p-value)	0.06	0.36	0.14	1.00	1.00	1.00
AR(2) test (p-value)	0.96	0.94	0.04	0.19	0.11	0.31
Observations	9716	9716	12472	2556	3399	3761

System GMM estimation

Dependent variable: log(employment)

Standard errors in parentheses

^c significant at 10%; ^b significant at 5%; ^a significant at 1%

Linkage defined as inputs sourced in Ireland divided by total inputs

Definition of size classes:

small: employment less than 33 percentile (43 employees)

medium: employment between 33 and 66 percentile

large: employment larger than 66 percentile (99 employees)

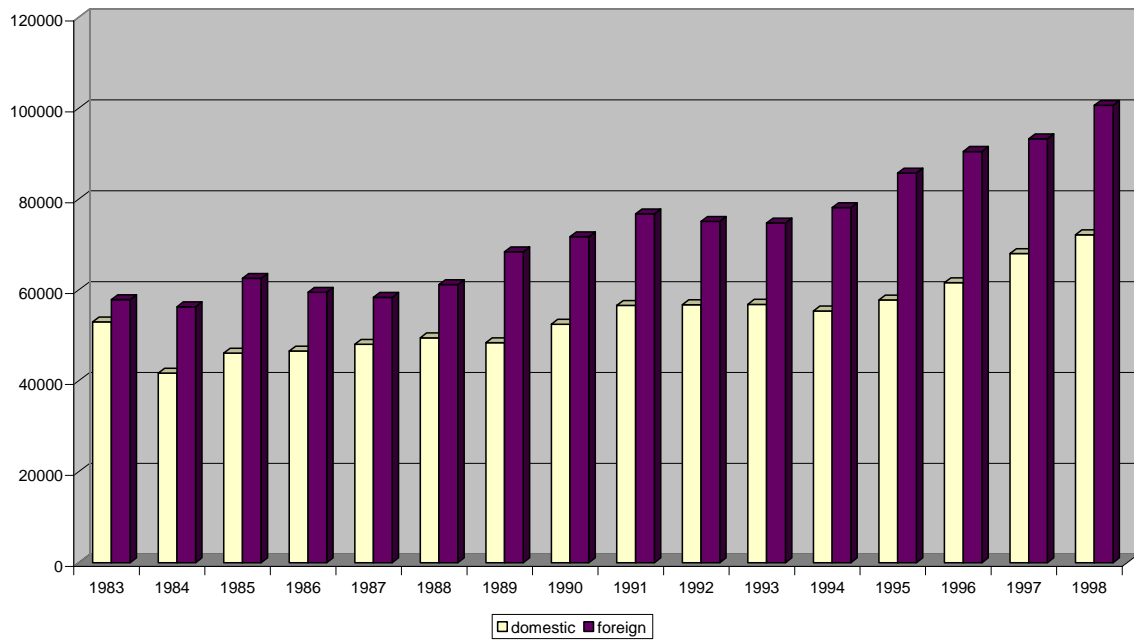
Table 4: Robustness checks: Considering exit in conditional labour demand

	Only survivors	all firms with exit dummy
log employment (t-1)	0.832 (0.001) ^a	0.821 (0.002) ^a
log employment (t-2)	-0.069 (0.001) ^a	-0.063 (0.001) ^a
log wage	-0.214 (0.006) ^a	-0.201 (0.007) ^a
log output	0.217 (0.002) ^a	0.202 (0.003) ^a
linkage	0.415 (0.013) ^a	0.212 (0.023) ^a
log wage * linkage	0.049 (0.008) ^a	0.052 (0.011) ^a
log output * linkage	-0.080 (0.003) ^a	-0.056 (0.005) ^a
foreign dummy	0.118 (0.012) ^a	0.214 (0.015) ^a
log wage * foreign	-0.120 (0.005) ^a	-0.121 (0.007) ^a
log output * foreign	0.012 (0.002) ^a	0.008 (0.003) ^a
log wage * linkage * foreign	0.038 (0.009) ^a	0.036 (0.013) ^a
log output * linkage * foreign	0.017 (0.003) ^a	0.012 (0.004) ^a
log wage * exit dummy		0.056 (0.018) ^a
log wage * linkage * exit dummy		-0.044 (0.012) ^a
log wage * foreign * exit dummy		-0.220 (0.012) ^a
log wage * linkage * foreign * exit dummy		0.019 (0.013)
exit dummy		0.069 (0.035) ^b
Hansen test (p-value)	0.38	0.32
AR(2) test (p-value)	0.93	0.89
Observations	8924	9444

System GMM estimation
 Dependent variable: log(employment)
 Standard errors in parentheses
^c significant at 10%; ^b significant at 5%; ^a significant at 1%
 Linkage defined as inputs sourced in Ireland divided by total inputs

Figure 1:

Employment growth by nationality of ownership



Appendix: Comparison of different estimators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ols	fe	dif	sys	ols	fe	dif	sys
log employment (t-1)	0.865	0.488	0.481	0.631	1.040	0.647	0.612	0.975
	(0.006) ^a	(0.006) ^a	(0.039) ^a	(0.026) ^a	(0.017) ^a	(0.011) ^a	(0.058) ^a	(0.037) ^a
log employment (t-2)					-0.088	-0.016	-0.003	-0.113
					(0.016) ^a	(0.008) ^b	(0.023)	(0.028) ^a
log wage	-0.143	-0.342	-0.272	-0.276	-0.449	-0.446	-0.501	-0.520
	(0.009) ^a	(0.008) ^a	(0.091) ^a	(0.046) ^a	(0.033) ^a	(0.009) ^a	(0.099) ^a	(0.071) ^a
log output	0.102	0.381	0.405	0.317	0.446	0.462	0.415	0.462
	(0.005) ^a	(0.005) ^a	(0.048) ^a	(0.027) ^a	(0.023) ^a	(0.006) ^a	(0.061) ^a	(0.069) ^a
log wage (t-1)					0.410	0.246	0.222	0.421
					(0.034) ^a	(0.010) ^a	(0.064) ^a	(0.062) ^a
log output (t-1)					-0.413	-0.186	-0.082	-0.343
					(0.024) ^a	(0.008) ^a	(0.065)	(0.069) ^a
Hansen test (p-value)			0.01	0.01			0.05	0.14
AR(2) test (p-value)			0.02	0.05			0.06	0.90
Observations	12474	12474	9717	12474	9717	9717	7752	9717

Dependent variable: log(employment)

Standard errors in parentheses

^c significant at 10%; ^b significant at 5%; ^a significant at 1%