

# PROFIT SHIFTING AND MEASURED PRODUCTIVITY OF MULTINATIONAL FIRMS

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# Profit Shifting and Measured Productivity of Multinational Firms

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## **Abstract**

This paper examines the differences in total factor productivity (TFP) between multinationals and domestic firms before and after tax rate changes to investigate whether the host country corporate tax rate has a significant influence on the measured TFP advantage of multinational companies. Using a sample of approximately 16,000 European firms (1998-2004), we find that a 10 percentage points cut in the statutory corporate tax rate would increase multinationals' measured TFP by about 10 per cent relative to domestic firms, consistent with profit-shifting by multinationals. At the sample mean, this would imply a 44 per cent increase in the TFP advantage of multinationals.

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*“The global integration of production cuts costs  
and taps new sources of skills and knowledge”*

Samuel Palmisano,

IBM Chairman, President and CEO

on the evolution of multinationals (Palmisano (2006))

## 1 Introduction

The divergence in productivity between multinationals and other companies is now well-documented in both developed and developing economies (Lipsey (2002)). Multi-national enterprises are not only more productive than purely domestic firms are, they also seem to be the major forces driving the international performance of European countries (Mayer and Ottaviano (2008)). But is the performance of these stars measured correctly?

In recent years, researchers have provided evidence that multinationals (MNCs) manipulate transfer prices and hence the value of sales and the costs of inputs to minimise their overall tax burden (Devereux (2007)). We argue that manipulation of transfer prices affects the measured productivity of MNCs. As there is intra-group trade and transfer-pricing manipulation is not prohibitively costly, measured productivity for international companies will be over-reported in low-tax countries, as sales will be over-recorded and the costs of intermediate inputs will be under-recorded. Hence, the productivity advantage of multinationals with respect to domestic entities will be overestimated in low-tax jurisdictions, and vice versa. We find that a 10 percentage points cut in the statutory corporate tax rate would induce affiliates of multinationals to increase their measured total factor productivity (TFP) by about

10 per cent relative to domestic firms. At the sample mean, the TFP advantage of international companies would increase by about 44 per cent.

There is increasing evidence that international companies engage in either over- or under-pricing of components shipped among various affiliates (Clausing (2003) and Bernard et al. (2006)). Despite a variety of contributions on the performance of MNCs, the effect of transfer-pricing manipulation on their reported productivity has not been studied so far. Our study fills this gap. It bridges two streams of literature, the research on productivity heterogeneity across firms and the investigation of profit-shifting. The novel aspect of our analysis is that we investigate changes in the measured TFP advantage of multinationals with respect to domestic firms following changes in the corporate tax rate. After a tax cut, multinationals have less incentive to shift profits abroad, while domestic enterprises should not change their behaviour, *ceteris paribus*. A direct comparison between multinational and domestic companies has not been used previously in the profit-shifting literature. We complement it with the use of company fixed effects to control for unobserved firm-level characteristics which might affect the productivity premium of international firms. The literature on the performance of MNCs rarely controls for unobserved firm effects as this would wipe out the multinational indicator which is mostly time-invariant in short panels.

Using ORBIS unconsolidated accounting data from 1998 to 2004, we find that the statutory corporate tax rate has a negative impact on the measured TFP of multinationals relative to domestic companies. The advantage of ORBIS is twofold.

Companies can be classified as either multinational or domestic. Additionally, OR-BIS allows us to compare entities and hence corporate tax rates across countries. This is unusual in the productivity literature where most of the contributions are country studies and the effects of taxes have been neglected.<sup>1</sup> Our sample consists of about 16,000 companies located in the European countries: Belgium, the Czech Republic, Finland, France, Italy, Norway, Poland, Spain, Sweden, and the United Kingdom.

The rest of this chapter is structured as follows. Section 2 briefly describes the most relevant literature on productivity of multinational companies and on profit-shifting. Section 3 describes the data. Section 4 presents the results and a number of extensions designed to show the robustness of our results. Section 5 concludes. A detailed description of the dataset construction is presented in the Appendix.

## **2 Related literature**

### **2.1 Productivity of multinational companies**

Heterogeneity in firms' productivity has been the subject of many studies encompassing developed, developing, and transitional economies.<sup>2</sup> Affiliates of multinationals are usually found to be superior to domestic companies in terms of both labour and total factor productivity. Estimates of the TFP advantage of MNCs

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<sup>1</sup>In a single country short panel, there might not be enough time-series variation in the tax rate to identify any effect.

<sup>2</sup>For reviews of the earlier literature, see Lipsey (2002) and Bartelsman and Doms (2000).

with respect to domestic firms range from 2.3 per cent to 15.5 per cent.<sup>3</sup>

Doms and Jensen (1998) is one of the earliest studies addressing productivity heterogeneity using longitudinal micro-level data. They focus on the US manufacturing sector and show that foreign-owned establishments have between 2.3 per cent and 3.7 per cent higher TFP than their purely domestic counterparts, even after controlling for observable characteristics such as size, age, state and industry. For the United Kingdom, Criscuolo and Martin (2009) analyse the TFP of 19,000 British manufacturing establishments between 1996 and 2000 using the Annual Respondent Database (ARD). They estimate that the establishments owned by MNCs are around 4.7 per cent more productive than purely domestic ones. Additionally, US-owned entities display the highest performance (4.4 per cent higher TFP than non-US MNCs). For Germany, Arnold and Hussinger (2005) find that the TFP distribution of multinationals stochastically dominates that of domestic companies.<sup>4</sup>

An important concern with these studies is the potential endogeneity of multinational status, if company-specific unobservable characteristics affect the probability of a particular unit of observation being owned by a multinational company. The literature has discussed many reasons why this could occur. For example, Criscuolo and Martin (2009) find that MNCs systematically take over more productive entities in the United Kingdom. In this chapter, we focus on changes in the TFP advantage

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<sup>3</sup>Castellani and Zanfei (2007) find that subsidiaries of multinationals located in Italy are 15.5 per cent more productive in terms of TFP than are domestic Italian companies. Their data correspond to the 1996 Italian subset of ORBIS.

<sup>4</sup>The authors use the Mannheim Innovation Panel (MIP) and the Bundesbank's Microdatabase on Direct Investment (MiDi).

of multinationals following changes in the corporate tax rate. Unlike previous studies concerned with the level of TFP advantage, we can simply use subsidiary fixed effects to address the endogeneity of multinational status.<sup>5</sup>

## 2.2 Evidence on profit-shifting

Multinational groups can shift income among affiliates resident in different countries in two main ways. First, they can alter the financing structure of the affiliates. Multinational groups have an incentive to finance affiliates in high-tax countries with debt, which may be provided by other affiliates in lower-taxed countries, because debt interest payments are deductible from the tax base. The second channel, which is the main focus of this chapter, is through transfer pricing. If subsidiaries within the same group trade with each other, then there is an incentive for the subsidiary in the higher-taxed country to underprice the goods that it sells to the subsidiary in the lower-taxed country, and to overprice the goods that it purchases from the subsidiary in the lower taxed country. Goods may include material inputs, intermediate products, or intangible goods such as royalties. The reverse is true for the subsidiary in the low-tax country.

The literature has found both direct and indirect evidence of the latter channel at the firm level. Clausing (2003) uses the Bureau of Labour Statistics data on US international trade export and import prices. The data allow one to distinguish

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<sup>5</sup>While investigating productivity spillovers from MNCs to domestic companies in Venezuela, Aitken and Harrison (1999) are able to control for company fixed effects. Their ownership indicator changes over time. The same is true for Fukao et al. (2006) and Girma and Görg (2007), who investigate TFP growth in establishments acquired by foreign companies in Japan and in the United Kingdom, respectively.

between intrafirm trade and ‘arm’s length’ trade. She finds that a 1 per cent lower statutory tax rate in the foreign country is associated with 0.8 per cent lower intrafirm export prices to, and 0.8 per cent higher intrafirm import prices from, the foreign country. In addition, Bernard et al. (2006) use the Linked/Longitudinal Firm Trade Transactions Database which links individual trade transactions to firms in the United States between 1993–2000. The data record whether the transactions take place at ‘arm’s length’ or between ‘related parties’. The authors create for each related party price, the price wedge which is equal to the difference between the log of a representative ‘arm’s-length’ trade price minus the log of the ‘related party price’. They find that a one percentage point decrease in the host country (average effective) tax rate is associated with an increase of 0.55 to 0.66 points in the price wedge. Other literature that finds evidence of transfer pricing includes Swenson (2001) and Overesch (2006).

Two recent contributions find indirect evidence of transfer pricing manipulation using European data. Weichenrieder (2009) finds indirect evidence of transfer price manipulation analysing German inbound FDI. He finds that an increase in the home country’s tax rate of 10 percentage points increases the return on assets for the German subsidiary by half a percentage point, which is roughly a 10 per cent increase. Huizinga and Laeven (2008) use the AMADEUS dataset, the European sub-sample of the ORBIS dataset. Their sample consists of subsidiaries located in Europe that belong to multinational groups whose parents are also located in Europe, and their parent companies. They find that European multinationals’ semi-

elasticity of reported profits with respect to the top statutory corporate tax rate is -1.3, while profit-shifting costs are estimated to be 0.6 per cent of the tax base.

### 3 Data

The sample is drawn from ORBIS, a database recording balance sheet and profit and loss account items for companies all over the world. The dataset is created by Bureau van Dijk (2007) and is based on the mandatory information from filed and publicly available accounts. The ORBIS unit of observation is an individual company, which may be a subsidiary of a larger group.

The comparison between the behaviour of MNCs and domestic firms when the corporate tax rate changes will be the source of our identification strategy: the total factor productivity advantage of multinationals relative to domestic firms is expected to increase after a tax cut.

To implement this comparison, firms must be classified as either multinational or domestic. This can be done in ORBIS, as it provides information on the shareholders and subsidiaries of the company, on shareholders' type (that is, individual or corporate) and country of residence. We classify firms as multinationals if they are owned by a corporate shareholder (with more than 50 per cent of their capital) either resident abroad or owning subsidiaries in at least one other foreign country. The rest of the companies for which adequate ownership information is provided are classified as domestic. For a more detailed description of how we derive the ownership structure of each firm, see Appendix 5.

We restrict our analysis to companies that are classified to the manufacturing sector to reduce conceptual and empirical problems in measuring productivity in the non-manufacturing sectors.<sup>6</sup> We eliminate very large multinationals and very small domestic companies in terms of total assets to obtain a sample of more comparable entities in both groups. We keep only companies with at least three consecutive years of observations between 1998 and 2004.<sup>7</sup>

The sample consists of 16,022 firms (85,606 observations) over the period 1998–2004. The geographical distribution of these companies is given in Table 1, where firms are divided between multinational and domestic entities. In Belgium, Finland, France, and United Kingdom the proportion of MNCs is not far from that of domestic firms. In Italy, Norway, Poland, Spain, and Sweden domestic companies represent nearly, or more than, two-thirds of all companies, depending on the country. The Czech Republic is an exception: about 67 per cent of the sample belongs to a multinational group.<sup>8</sup>

The literature suggests that companies owned by MNCs are systematically bigger than their domestic counterparts (Flanagan (2006)). Our sample is no exception. In every country, firms affiliated to an international group display on average a larger

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<sup>6</sup>Each country uses a specific industrial classification system for cataloguing the industries of the companies filing accounts with the official registries. All company accounts filed in a given country, therefore, indicate the company’s sector of activity with this national code. ORBIS matches this code with the NACE code (Rev 1.1) for each firm. For the manufacturing sector, the NACE code ranges between 15.00 and 40.00. For more information, see Appendix 5.

<sup>7</sup>See Appendix 5 for a more in depth analysis of how we created the sample.

<sup>8</sup>The results remain robust to the exclusion of the Czech Republic from the sample (see section 4.3).

size in terms of value added, fixed assets, and number of employees (see Table 2).<sup>9</sup>

In this analysis, changes in the statutory corporate tax rate identify the effect of profit-shifting by MNCs on their measured total factor productivity. As depicted in Table 3, the variations are mainly cuts. Belgium reduced its rate from 40 per cent to 34 per cent in 2003. More gradual cuts happened in the Czech Republic where the rate was decreased from 35 per cent in 1998 to 28 per cent in 2004, in France where the tax rate was reduced from 42 per cent to 34 per cent between 1998 and 2002, in Poland where the rate was lowered gradually by 17 percentage points and in Italy where the tax rate dropped in stages from 41.2 per cent to 37 per cent within the period 2000–2004. Smaller changes happened in Finland, United Kingdom, and Spain.

## 4 Empirical model and main results

The purpose of this study is to look at how the measured TFP of multinational companies is affected by transfer-pricing manipulation and hence by the host country's corporate tax rate. Total factor productivity can be affected by other country-specific factors for which one can control only partially. We consider a change in the statutory corporate tax rate. Multinationals can react to a change in the statutory corporate tax rate by increasing or decreasing the extent to which they shift profits abroad. Domestic firms do not have this opportunity. They cannot engage in the

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<sup>9</sup>The Czech Republic and Poland are exceptions when size is measured by the number of employees. Domestic companies in these transitional economies might still have a large labour force which is relatively unproductive, as suggested in Table 4. For robustness checks excluding the Czech Republic and Poland, see Section 4.3.

manipulation of transfer prices but, at the same time, they are affected by all the other host-country- specific factors (for example, infrastructure, regulations), which also affect the resident multinationals.

In our sample, tax rate changes occur at different points in time and in different countries. Additionally, some of the tax cuts did not happen in one year, but rather gradually over a longer period. In this study, we identify the effect of transfer pricing manipulation on multinationals' TFP using a dummy variable indicating multinational status interacted with the corporate tax rate of the host country. This approach has not been implemented previously in the profit-shifting literature. It is a robust method as, through the inclusion of domestic firms, it controls for unobserved factors affecting multinational and domestic companies at the same time. We further control for firm-level fixed effects which are likely to be correlated with MNC status.

#### 4.1 TFP measurement

We consider a conventional Cobb-Douglas production function of the form:

$$Y_{i,t} = A_{i,t} K_{i,t}^{\alpha_K} L_{i,t}^{\alpha_L} \tag{1}$$

where  $i$  indexes a firm, and  $t$  a year.  $Y_{i,t}$  is value added. Our main measure of value added is constructed as reported earnings before interest and taxes (EBIT) plus reported costs of employees. In our robustness checks we also consider sales minus costs of materials as an alternative measure of value added.<sup>10</sup>  $K_{i,t}$  is capital stock.

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<sup>10</sup>The UK companies do not report costs of materials. Hence, we drop them when using this

In our main specification, we measure capital as the book value of fixed assets, but we also consider the book value of tangible fixed assets as an alternative measure.  $L_{i,t}$  is the number of employees.

Taking logarithms of equation (1) and rearranging,

$$\ln(A_{i,t}) = \ln(Y_{i,t}) - \alpha_K \ln(K_{i,t}) - \alpha_L \ln(L_{i,t}) \quad (2)$$

Measurement of log TFP (that is,  $\ln(A_{i,t})$ ) requires estimates of the parameters  $\alpha_K$  and  $\alpha_L$ . The literature reports two main ways of obtaining these estimates.<sup>11</sup> The factor share approach calculates the parameters from cost share data for each firm.<sup>12</sup> Assuming that the firm maximises profits, the first order conditions for optimal input choices imply that  $\alpha_K = \frac{rK}{Y}$  and  $\alpha_L = \frac{wL}{Y}$ , where  $r$  is the cost of capital and  $w$  is the wage. Under the assumption of constant returns to scale, we also have  $\alpha_K = 1 - \alpha_L = 1 - \frac{wL}{Y}$ , so that this approach only requires data on wage bills and value added, both of which are available in ORBIS.

The production function approach estimates these parameters from a regression of log value added on log capital and log labour, and hence estimates log TFP as the residual of this estimated production function.<sup>13</sup>

The main results that we present in Section 4.2 are based on a version of the second measure of value added.

<sup>11</sup>See Van Biesebroeck (2008) for a review of the advantages and disadvantages of each method.

<sup>12</sup>See Caves et al. (1982).

<sup>13</sup>See for example Griliches and Mairesse (1998) and Klette (1999).

cost share approach, but we also present results for estimated production functions in Section 4.3 as a robustness check.

Imposing constant returns to scale in (2), we then obtain our main measure of log TFP as:

$$\ln(A_{i,t}) = \ln\left(\frac{Y_{i,t}}{L_{i,t}}\right) - \alpha_K \ln\left(\frac{K_{i,t}}{L_{i,t}}\right) \quad (3)$$

The parameter  $\alpha_K$  is measured separately for each country-industry pair, as the mean value of one minus the share of labour costs in value added for firms in that country and industry.<sup>14</sup>

Table 4 shows that the unconditional mean TFP and labour productivity of multinationals are significantly higher than those of domestic firms in all countries.<sup>15</sup> A mean-comparison t-test reveals that the MNCs' advantage relative to domestic companies in both total factor and labour productivity is significant at the 1 per cent level for all countries, except for Sweden where the difference in labour productivity is significant at the 5 per cent level.

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<sup>14</sup> Industry here is defined as a sub-sector of manufacturing industry. We have defined three sub-sectors on the basis of the NACE code (Rev 1.1). For more details, see Appendix 5. The values of  $\alpha_K$  range from 0.13 to 0.37 with an overall mean of 0.21. In column (4) of Table 21, we also run the regression with  $\alpha_K$  which is calculated at the country-industry level but differs between multinational and domestic companies. The resulting estimates do not change.

<sup>15</sup>As we would expect, the difference between TFP of multinational and domestic companies is higher in Table 4 than reported in the previous literature (see Section 2.1). This is because the literature conditions on other factors which we believe are not correlated with the tax factor (for example, R&D).

## 4.2 Main results

We estimate a regression model to assess how changes in the statutory corporate tax rate affect the measured TFP of companies owned by multinational groups relative to those of domestic companies:

$$\ln(A_{i,t}) = \beta_1(multi_i * \tau_{c,t}) + \beta_2(C_c * T_t) + f_i + \varepsilon_{i,t} \quad (4)$$

where  $c$  indexes a country,  $multi_i$  is a time-invariant dummy variable indicating that a firm belongs to a multinational group, and  $\tau_{c,t}$  is the statutory corporate tax rate in the home country in year  $t$ ;  $(C_c * T_t)$  are country-year dummy variables which control *inter alia* for different inflation rates in different countries;<sup>16</sup>  $f_i$  is an unobserved time-invariant company-specific effect which might be correlated with multinational status;  $\varepsilon_{i,t}$  is an idiosyncratic shock.

We allow the extent to which the productivity of MNCs differs from that of domestic enterprises to vary with the host country corporate income tax rate. As discussed earlier, we expect the productivity advantage of multinationals to increase following a reduction in the host country tax rate. This would be consistent with a negative value of the parameter  $\beta_1$ .<sup>17</sup>

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<sup>16</sup>This is a simpler alternative to deflating nominal values country by country. Country-year dummies also control for country-specific macro effects.

<sup>17</sup>This assumes that other relevant countries do not cut their corporate tax rate at the same time. The incentive for MNCs to transfer profits out of a country also depends on tax rates in the rest of the world. Huizinga and Laeven (2008) construct a weighted average of tax rates for all countries where an individual multinational has affiliates. We do not follow this approach here because our sample only has partial coverage of multinational groups (see data Appendix). Table 3 confirms that corporate tax rate changes were not synchronised across countries during our sample period.

We estimate equation (4) with a standard within-group estimator.<sup>18</sup> This allows us to control for unobserved firm-level fixed effects. The results are presented in column (1) of Table 5. The coefficient on the interaction term between the MNC dummy and the corporate tax rate is negative and highly significant. It implies that a 10 percentage points increase in the host country tax rate decreases the measured TFP of multinationals by about 10 per cent relative to domestic firms. This is approximately the difference between the corporate tax rate in Italy (37.4 per cent) and Sweden (28 per cent) in 2004. At the sample mean,<sup>19</sup> the result implies that the TFP advantage of multinationals would increase by about 44 per cent.<sup>20</sup>

### 4.3 Sensitivity analysis

The results presented so far are based on a TFP measure where value added is calculated as EBIT plus cost of employees, and the capital stock is measured by the book value of fixed assets. We first test whether our findings hold when we employ other measures of value added and capital. Column (2) of Table 5 reports results using value added calculated as sales minus costs of materials. Here the sample drops to 52,692 observations because UK firms do not report costs of materials. Column

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<sup>18</sup>Standard errors are clustered at the company level to allow for serial correlation within the firm. We also clustered at the country, country-sector, and country-global owner levels to allow for common country, country-sector, and country-global owner shocks. Coefficients remain significant at 1 per cent.

<sup>19</sup>See the last row of Table 4.

<sup>20</sup>At the sample mean, the initial TFP gap between multinational and domestic companies is seven (see last row of Table 4). After a 10 percentage points cut in the corporate tax rate, the total factor productivity of MNCs will increase by 10 per cent (see the coefficient estimate of column (1) of Table 4) to 34.1. The gap between the TFP of multinationals and domestic firms will increase to 10.1. This is an increase of about 44 per cent with respect to the initial gap.

(3) shows results where the capital stock is measured as the book value of tangible fixed assets. In both columns, the coefficient on the interaction term between the MNC dummy variable and the corporate tax rate remains negative, significant, and very close in magnitude to the main specification of column (1). So far we have presented results for an unbalanced panel of firms. Column (4) of Table 5 shows that the coefficient on the interaction of the MNC dummy variable and the tax rate remains negative and significant in a balanced panel where all firms have all seven years of data.<sup>21</sup>

As a further robustness check, we restrict the analysis to a sub-sample of countries which have implemented substantial cuts in their corporate tax rate (that is, France, Italy, Belgium, the Czech Republic and Poland). Column (1) of Table 6 shows that in this sub-sample, the coefficient on the variable of interest stays negative, significant, and very close in magnitude to the main specification of Table 5. A 10 percentage points increase in the corporate tax rate would reduce the TFP of multinationals relative to domestic firms by about 11 per cent. Columns (2) to (6) estimate equation (4) on separate sub-samples for these individual countries. The estimated coefficients remain negative and significant (except for Belgium), although with differing magnitudes. This is not particularly surprising as many other country-specific tax provisions (for example, CFC rules) and firm-specific factors (for example, location of affiliates) may affect the degree to which MNCs can engage in profit-shifting.

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<sup>21</sup>In this sample all firms from the Czech Republic are necessarily dropped, as we do not have Czech data for all seven years.

One feature we notice is that the estimated coefficient is consistently larger for the two transitional economies. Column (7) of Table 6 tests the robustness of our results to the exclusion of the Czech Republic and Poland. The key coefficient remains negative and significant although smaller in magnitude: a 10 percentage points cut in the corporate tax rate would here reduce the TFP of multinational companies by about 6 per cent.

Subsidiaries of multinational companies are known to be larger than the average domestic firm (Lipsey (2002)). In column (1) of Table 7, we rule out that the effect picked up by the multinational dummy is in fact a size effect. Whilst the negative impact of the tax rate for multinational companies remains strong and highly significant, it shows that the size effect is insignificant.<sup>22</sup> In the same table, we allow for domestic and multinational companies to be different across the economic cycle. Column (2) shows that the tax rate does not proxy the economic cycle.<sup>23</sup> Also, real productivity of multinational companies could respond differently to tax rate cuts. For example, multinationals might be quicker in increasing their productivity because they can adjust their investment decisions faster. Devereux and Griffith (2003) explain that conditional on the discrete investment choice (that is, where to locate), marginal investment decisions (that is, the size of investment) depend on the effective marginal tax rate (EMTR). The latter is a measure of the effect of

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<sup>22</sup>The size dummy takes value one when the  $\log(\text{total assets})$  is bigger than the sample median  $\log(\text{total assets})$  for at least four years. It is a time-invariant variable. The model in column (1) is also tested with a time-variant size dummy. The estimates do not change.

<sup>23</sup>To control for the economic cycle, we employ the World Bank Development Indicators on inflation, GDP growth, and unemployment rates.

taxes on the cost of capital. It accounts not only for the statutory corporate tax rate, but also for capital depreciation allowances and different forms of financing. In column (3) of Table 7 we allow for the effect of the EMTR<sup>24</sup> to be different between multinational and domestic entities. The coefficient on the variable of interest stays negative and not statistically different from one, but it increases in magnitude with respect to the benchmark specification of Table 5 where we do not control for the EMTR. Column (4) allows for a different  $\alpha_K$  between multinational and domestic companies. The key coefficient remains negative and even if lower, its magnitude is not significantly different from the estimate of the benchmark specification of Table 5.

If after a tax cut multinational companies systematically buy highly productive domestic entities, our estimates will be upward biased. To control for this effect, we identify companies involved in operations of mergers and acquisitions (M&A) during the sample period using a dataset called ZEPHYR.<sup>25</sup> Unfortunately, because of a lack of information, we are not always able to identify whether a company has changed its ownership status after an M&A deal. Therefore, in column (5) of Table 7 we drop all companies involved in some sort of M&A operations between 1998 and 2004. Our results remain strongly robust to the exclusion of firms which have potentially changed their ownership status in response to a change in the corporate tax rate.

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<sup>24</sup>For more details on how the EMTR is built, see (Devereux and Griffith (2003)). Effective marginal tax rates are taken from Devereux et al. (2008).

<sup>25</sup>ZEPHYR is also compiled by Bureau van Dijk as ORBIS. It is therefore possible to merge the two datasets and identify some but not all ownership changes occurred during the sample period.

In Table 8, we show that our results are not sensitive to the use of the factor share approach to measure TFP. As an alternative, we combine equations (3) and (4) and estimate an extended production function of the form

$$\ln\left(\frac{Y_{i,t}}{L_{i,t}}\right) = \alpha_K \ln\left(\frac{K_{i,t}}{L_{i,t}}\right) + \beta_1(\text{multi}_i * \tau_{c,t}) + \beta_2(C_c * T_t) + f_i + \varepsilon_{i,t} \quad (5)$$

In column (1) of Table 8, we report within-group estimates of equation (5). The coefficient of the key interaction term remains negative, highly significant, and very close in magnitude to the results of Table 5. The estimated value of  $\alpha_K$  is somewhat lower than suggested by the cost share data (see Footnote 14). The production function approach allows us to relax the constant returns to scale (CRS) assumption easily by adding the term  $\alpha_1 \ln(K_{i,t})$  on the right-hand side of equation (5). The results shown in column (2) of Table 8 confirm that our main findings hold when we do not impose CRS: a 10 percentage points cut in the tax rate would induce MNCs to increase their measured TFP by about 9 per cent.

In summary, tables 6 to 8 indicate that the effect of changes in the tax rate on the TFP gap between multinational and domestic companies is robust to various sensitivity checks.

## 5 Conclusions

We find evidence consistent with multinational companies shifting revenues into low-tax countries and shifting input costs into high-tax jurisdictions. This has implications for measured TFP. In particular, if MNCs engage in transfer-price manipulation, the difference in TFP between multinationals and domestic companies will tend to be underestimated in high-tax countries and overestimated in low-tax countries.

We estimate that a 10 percentage points increase in the host country tax rate decreases the measured TFP of multinationals by about 10 per cent relative to domestic firms. At the sample mean, this implies a 44 per cent increase in the TFP advantage of multinationals. This has potentially important implications when comparing measured TFP differences across countries with high and low corporate tax rates. If a high-tax country such as Italy were to reduce its statutory corporate tax rate (37.4 per cent) to the level of Sweden (28 per cent), multinational companies located in Italy would increase their measured TFP relative to domestic companies by about 10 per cent.

## Appendix B

In this appendix, we describe the construction of the dataset used in the empirical analysis. The starting point is the ORBIS database provided by Bureau van Dijk (2007) (2007 CD version) which records data for nine million companies around the world. The database includes information for each company on the country of residence, the industry, and the accounting date. It also provides broad information on balance sheet and profit and loss (P&L) account items.

We calculate value added per employee as either EBIT (**427**)<sup>26</sup> plus costs of employees (**435**), or as sales (**426**) minus costs of materials (**434**). We proxy the capital stock with either fixed assets (**404**), or tangible fixed assets (**406**) and we use data on the number of employees (**425**).

The database also provides information on the firms' ownership structure. This includes information on direct owners (including their shareholdings in the company), on the ultimate or 'global' owner (including its relevant direct and total capital ownership share), on companies' subsidiaries, if any, and the corresponding percentages of ownership. Only the most recently reported ownership information (usually for 2004) is recorded.

We exclude micro firms as defined by European Commission (2003) by including only companies with total assets (**412**) exceeding 2 million Euros for two consecutive years since 2001. This yields a starting sample of 931,324 firms from 1993 to 2005.

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<sup>26</sup>The ORBIS reference number for each item is in parentheses in bold.

Below, we describe how we derived the final sample from this initial dataset (see Table 9). We first illustrate how we use the ownership information. We then explain the treatment of financial data.

## **Ownership information**

We classify companies in our sample as either being part of a multinational group or as domestic entities. The latter are either stand-alone companies with no affiliates or they belong to a domestic group which has neither affiliates nor corporate global owners abroad. Firms are classified as being part of a multinational group if their ultimate owner (as reported in ORBIS) is a corporation and it is resident abroad, or if other corporate affiliates in the group are resident in a different jurisdiction. We allocate companies to their global owner (GO) directly if this information is provided by ORBIS. If this is not possible, we create a chain of ownership employing the data on the direct owners (DOs). The latter are classified according to their type: individual or corporate owners where the latter group includes banks, financial, industrial, and insurance companies. If these DOs are not found in the sample,<sup>27</sup> the ownership chain is interrupted and a global owner cannot be identified. In this case, we exclude the firm from the sample. If DOs are available, we first check their shareholding. If none of them holds more than 50 per cent of the firm's capital and the firm does not itself own subsidiaries abroad, then the company is classified as domestic. The same happens if the main DO is an individual, irrespective of whether they have the majority of the firm's capital. If the DO is found in our starting sample and it is both

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<sup>27</sup>To be identified by our procedure, direct owners have to be within the initial sample of 931,324 companies.

a corporation and independent,<sup>28</sup> then it is defined as the global owner. If it is not independent, then its DO (that is, second level owner) is identified and the process continues until no other corporate DO with more than 50 per cent shareholding can be identified. If the DO with a majority shareholding in the firm is a fund or an individual, then the last corporate DO in the chain is designated as the global owner.

## Financial data

From the initial sample of 931,324 firms, we remove companies for which only consolidated accounts are reported. This avoids duplication and allows us to distinguish among different affiliates. We then drop observations with number of employees, EBIT, cost of employees, or fixed assets either missing or equal to zero. We also eliminate observations with a negative value for the sum of EBIT plus cost of employees. Observations with accounting closing dates from July of year  $x$  until June of year  $x + 1$  are assigned to calendar year  $x$ . To ensure that the accounting period between two subsequent calendar years is close to twelve months, we drop observations that are less than 11 months or more than 13 months distant from the end of the previous accounting period. In the next step, we remove observations with clear mistakes. We sum the P&L account and the balance sheet sub-items (for example, current assets and fixed assets) which should add up to a core item (for example, total assets). Observations are dropped if the sum of these sub-items amounts to less than 95 per cent or more than 101 per cent of the corresponding core item. In

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<sup>28</sup>A company is defined as independent if it does not have any corporate shareholders owning more than 50 per cent of its capital.

addition, we eliminate observations with negative total assets, negative total liabilities (**423**), or interest payments (**437**).

At this stage, we merge the financial data with the ownership data. We only keep companies which we are able to classify as either domestic or multinational entities. Among MNCs, we keep only firms whose global owner is an industrial company.

To work with comparable production functions and to avoid problems in the definition of TFP, we focus only on the manufacturing sector by keeping firms with NACE code (Rev 1.1) between 15.00 and 40.00.<sup>29</sup> The coverage for some countries is quite poor before 1998 and in 2005. Hence, we only retain observations between 1998 and 2004, inclusive. Subsequently, we drop countries with very few firms (that is, less than 15 domestic or multinational companies). To make the domestic companies more comparable to the multinational companies, we eliminate very small entities in the first group and very large firms in the second one. Specifically, we drop domestic companies whose size in terms of total assets is smaller than the 5th percentile of the multinationals' size<sup>30</sup> distribution. We also drop multinational companies with total assets greater than the 95th percentile of the domestics' size distribution. We also drop outliers in the financial data. We define outliers with respect to two ratios: (i) fixed assets over employees and (ii) cost of employees over the sum of EBIT and wage bill (that is, value added). Every observation that falls in the top or bottom

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<sup>29</sup>To calculate TFP as in equation (3), we have divided the sample into three manufacturing sub-sectors. The first one includes companies with a NACE code (Rev. 1.1) between 15.00 and 20.00. The second group contains companies with NACE code between 20.00 and 30.00. The rest of the firms are grouped in the third sector (that is, NACE code between 30.00 and 40.00).

<sup>30</sup>Here size is measured as total assets.

1 per cent of those two ratios is dropped. Finally, we keep only firms with no missing values for EBIT and costs of employees for three consecutive years between 1998–2004 to limit the confounding effect of entry and exit from the sample. This reduces the number of countries. Some of them have less than 15 domestic firms or 15 multinationals in each year. These countries are dropped. As shown in Table 9, the final sample contains 16,022 firms for a total of 85,606 observations.

### **Time-varying ownership dummy**

During the sample period, some companies might have changed their ownership status from domestic to multinational or vice versa. More specifically, multinational companies might have taken over highly productive domestic companies after a cut in the corporate tax rate. In this case, the multinational dummy would be endogenous. As mentioned above, ORBIS does not contain time-varying ownership information. To track changes in the ownership dummy we use a dataset called ZEPHYR. It records M&A operations involving some of the companies in our regression sample as targets, acquirers, or vendors. ZEPHYR is also compiled by Bureau van Dijk as ORBIS and it is therefore possible to merge the two datasets with the potential to create changes in the multinational dummy. Unfortunately, ZEPHYR does not always contain enough information to know with certainty whether a firm has really changed its status from domestic to multinational or vice versa. In the robustness checks of Table (7), we then decided to drop companies involved in a M&A deal during the sample period.<sup>31</sup>

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<sup>31</sup>Table (14) describes the country distribution of these observations.

## **The Construction of Ownership Changes Using ZEPHYR**

In a M&A deal, a company can act as a target, an acquirer, or a vendor. To encompass all possible cases, we downloaded three different datasets from ZEPHYR. The first includes deals for which targets are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden (as in our regression sample), the second includes acquirers, and the third includes vendors located in the same countries.

All possible changes in ownership are summarised in tables (10) to (12). For our analysis, the cells on the south-west to north-east diagonals are the most interesting, as they record changes in the multinational dummy.

The number of deals reported in ZEPHYR increases substantially from 2002 onwards. In previous years, the coverage is less effective. This is reflected in Table (13) which shows a breakdown by years of the number of deals affecting companies in our sample. About 40 per cent of the M&A operations take place in the United Kingdom. Belgium, France, Spain and Sweden represent each about 10 per cent of the deals (see Table (14)).

Initially we downloaded deals between 1998 and 2004 in which targets are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table (15).

We use the information in this dataset to establish which companies in our regression sample have been part of a deal and, as a consequence, have changed their ownership status from domestic to multinational or vice versa. If a company in

ORBIS is also present in ZEPHYR as a target, it is possible to trace changes in its ownership in the way shown in Diagrams 1 and 2 below.

To identify the status of the target before the deal<sup>32</sup>, we first need to know the country of the vendor. Unfortunately, in the targets dataset about 50 per cent of the deals (129 out of 256 deals) do not report any information on the vendor. This means that the id number, the country, the name, and the parent of the vendor are missing. For these observations, it is impossible to identify what the ownership status of the target was before the deal.

If the country of the vendor is available and it is different from the country of the target, the latter can be classified as part of a multinational group before the deal (that is, Box 1 of Diagram 1). If the country of the target and the country of the vendor are the same, we need information on the ownership structure of both the vendor and the target, as shown in Diagram 1. Among the observations for which the country of the vendor is available (121), about 70 per cent record a country of the vendor which is the same as the country of the target. This could be interpreted as evidence that the company was part of a domestic group before the deal<sup>33</sup>. However, the vendor might in fact be part of a multinational group itself and (or) the target might have foreign subsidiaries. Since we do not have ownership information for companies before 2004, we are unable to establish the ownership status of the vendor and of the target. Consequently, we cannot distinguish between Box 2 and Box 3 in Diagram 1.

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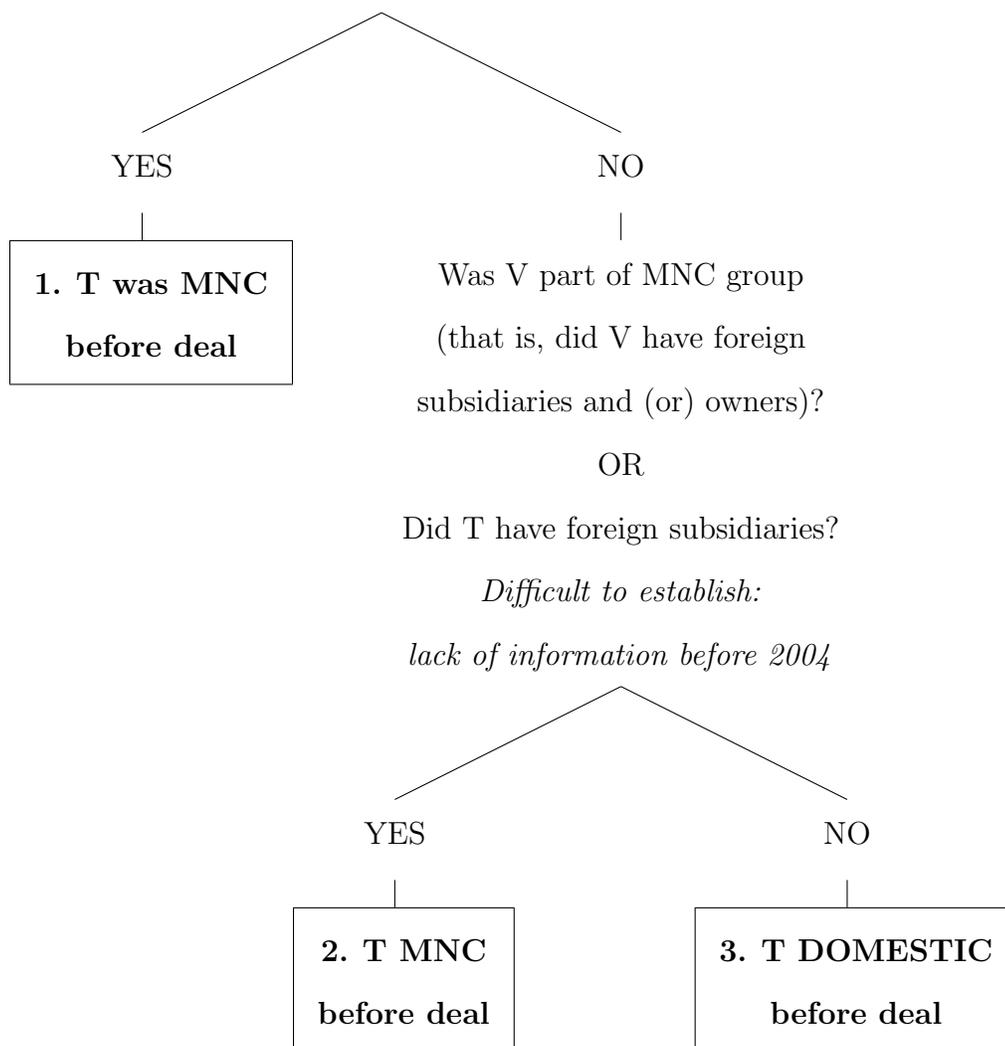
<sup>32</sup>This means identifying from which cell of the second column of Table (10) the firm starts.

<sup>33</sup>Also, if the vendor is an individual, the company could have been a stand-alone.

The ownership status of the target after an M&A operation could easily be approximated with its ownership structure available in ORBIS for 2004 (see Diagram 2). In summary, provided that the information on the country of the vendor is available, we can identify some of the cases in the third row of Table (10) (that is, when the target was a multinational entity before the deal). Unfortunately, without further assumptions we are unable to identify the fourth row (that is, when the target was a domestic entity before the deal). We cannot decide whether the firm was truly a domestic entity (that is, decide between Box 2 and Box 3 in Diagram 1) when the country of the vendor and the country of the target are the same. We could make an assumption. When the target and the vendor are resident in the same country, we could consider the former as being domestic before the deal occurred (see Table (15)).

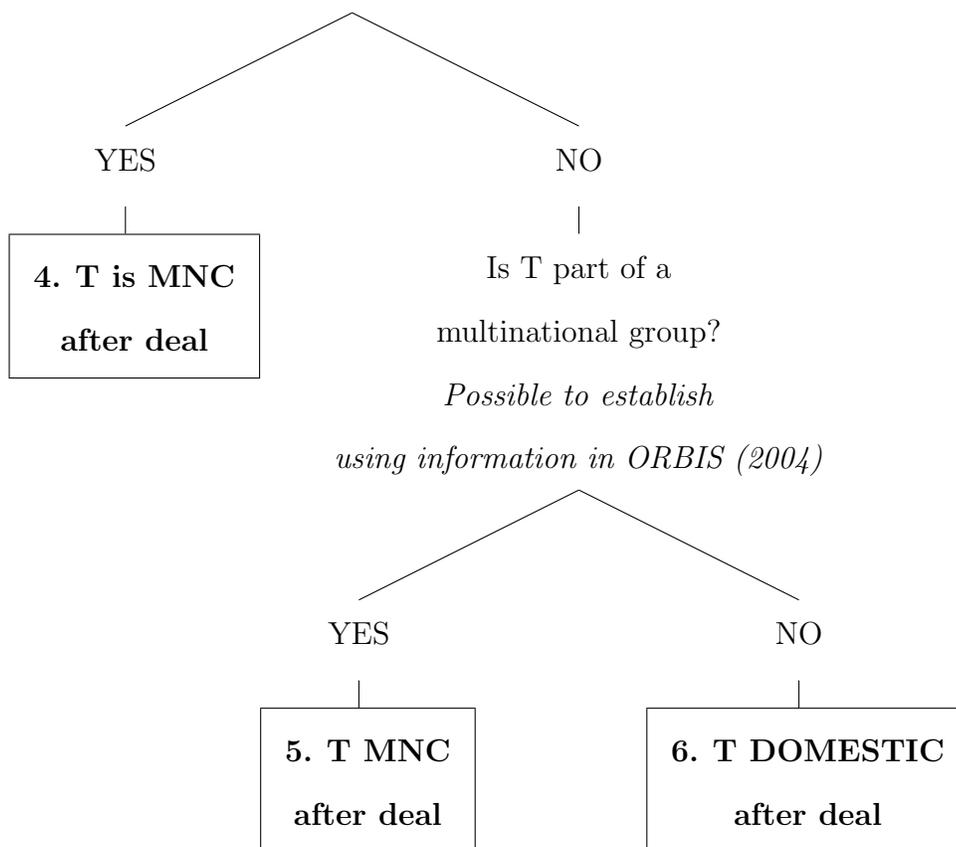
**Diagram 1. How to identify the ownership before a deal occurred**

Country of target (T)  $\neq$  country of vendor (V)



**Diagram 2. How to identify the ownership after a deal occurred**

Country of target (T)  $\neq$  country of acquirer (A)



### **ZEPHYR-acquirers**

The second dataset contains deals in which the acquirers are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table (16).

For the acquirers in ZEPHYR, it is hard to establish their ownership status before the deal because there is no information on the ownership structure before 2004. We

can only identify two cases. First, when the acquirer is classified as a domestic entity in ORBIS in 2004, by acquiring the firm the same company could have only been domestic before the deal. Second, when the acquirer is classified as multinational in ORBIS and at the same time it acquires a company located in the same country, it must have been multinational before the deal. For the acquirers classified as multinationals in 2004, and buying a foreign subsidiary, it is not possible to identify their ownership status before the M&A operation. They could have been domestic and become multinational purely through the acquisition recorded in ZEPHYR<sup>34</sup> or they could have already been part of an international group. In terms of Table (11), we are only able to identify some of the elements of the main diagonal. We could make a strong assumption. We could assume that the foreign subsidiary acquired is the only foreign subsidiary of the group. This would mean that the acquirer was a domestic entity before the deal and that it has become a multinational entity only because of the acquisition recorded in ZEPHYR.

### **ZEPHYR-Vendors**

The third dataset contains vendors involved in M&A operations between 1998 and 2004 and located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table (17).

If a company in ORBIS is also available in ZEPHYR as the vendor, we can easily establish its multinational status before the deal when the country of the target is different from the country of the vendor (see Box 7 of Diagram 3). In this case,

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<sup>34</sup>This would in fact be the most interesting case for our analysis.

the vendor was a multinational before the deal. After the deal, it can either remain part of a multinational group or become a domestic entity if the sold subsidiary was its only foreign subsidiary. We can distinguish between those two cases employing the ORBIS ownership structure for 2004. Problems arise when the countries of the vendor and of the target are the same. As shown in Diagram 3, we are unable to distinguish between Box 8 and Box 9 as we do not have information on the ownership structure of the vendor and of the target before 2004. Even if the target is located in the same country as the vendor, we cannot identify the latter as part of a domestic entity before the deal. If the target had foreign subsidiaries, the vendor would be part of a multinational group before the M&A operation.

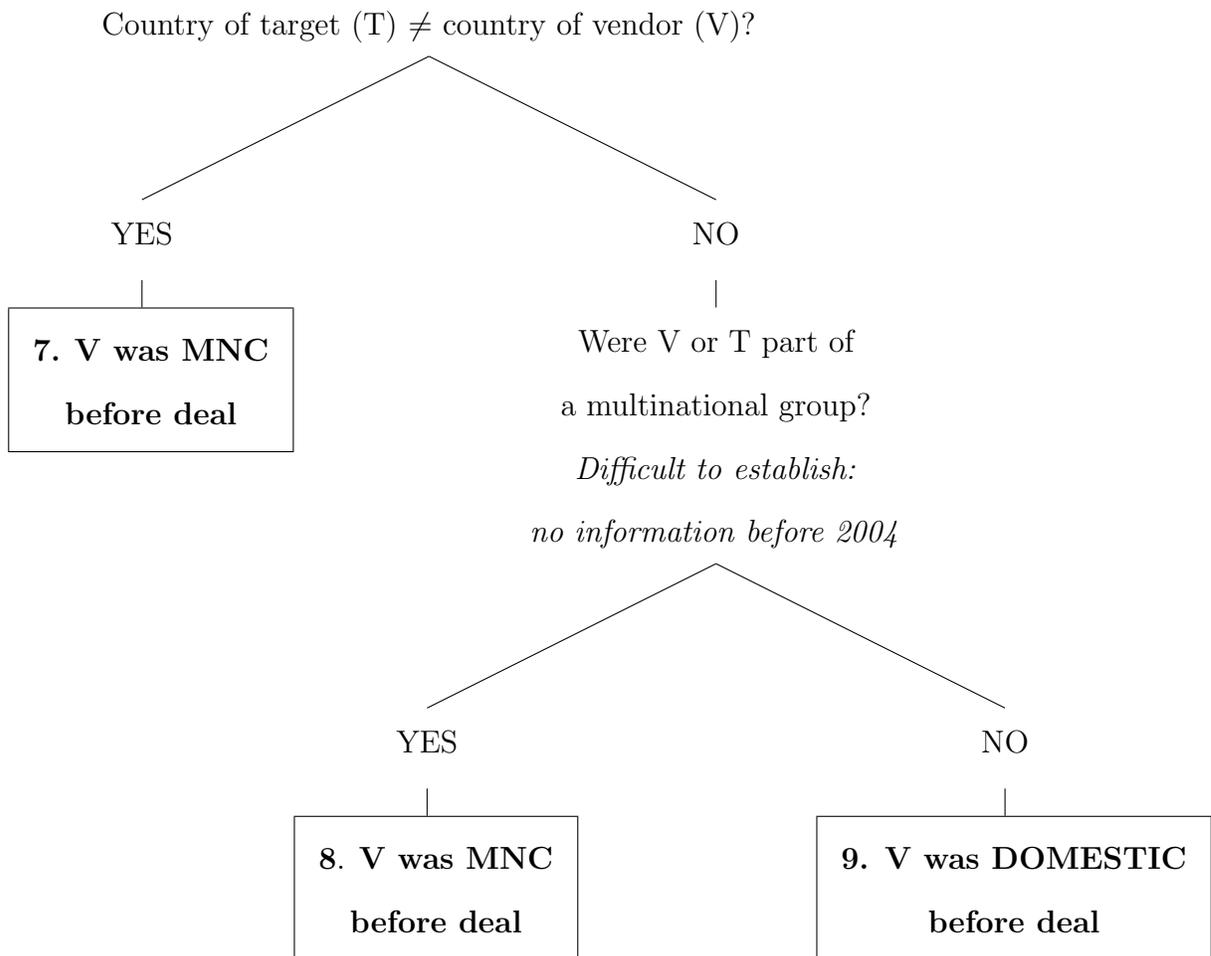
In summary, when a company is involved in M&A operations as a vendor, we can identify the third row of Table (12). We are able to identify some of the vendors which were part of a multinational group before the deal<sup>35</sup>. Unfortunately, because of the lack of information before 2004, we are unable to identify multinational companies which become domestic by selling domestic subsidiaries with foreign operations.

As for the targets dataset, we could make an assumption. When the target and the vendor are resident in the same country, we could consider the latter as being domestic before the deal occurred (see Table (17)).

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<sup>35</sup>This refers to the vendors which sell a foreign subsidiary, but not to the vendors which sell a target located in their country but with foreign subsidiaries.

**Diagram 3. How to identify the ownership before a deal occurred**



## Merging ZEPHYR with ORBIS

We merge the three datasets downloaded from ZEPHYR with ORBIS in order to create a changing ownership dummy. Tables (14) to (18) describe some of the characteristics of the new dataset. Table (19) summarises all the changes in the ownership structure that we are able to classify, including those identified through the assumptions outlined in the paragraphs above and summarised below<sup>36</sup>:

1. TARGETS dataset. When the target and the vendor are resident in the same country, we consider the former as being domestic before the deal occurred (see Table (15)).
2. ACQUIRERS dataset. The foreign subsidiary acquired is the only foreign subsidiary of what is classified in ORBIS as an international group in 2004. This means that the acquirer was a domestic entity before the deal and that it has become a multinational entity with the acquisition recorded in ZEPHYR (see Table (16)).
3. VENDORS dataset. When the target and the vendor are resident in the same country and the vendor is recorded as a domestic company in ORBIS, we consider the latter as being domestic before the deal occurred (see Table (17)).

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<sup>36</sup>Overall the changes classified using the aforementioned assumption are 119, about 28 per cent of the observations included reported in ZEPHYR and 0.14 per cent of the whole sample.

Table 1: Ownership Structure

Country	Domestic	MNCs	Total
Belgium	485	382	867
	<i>56</i>	<i>44</i>	
Czech Republic	40	81	121
	<i>33</i>	<i>67</i>	
Finland	112	117	229
	<i>49</i>	<i>51</i>	
France	1,434	1,381	2,815
	<i>51</i>	<i>49</i>	
Italy	1,575	514	2,089
	<i>75</i>	<i>25</i>	
Norway	361	131	492
	<i>73</i>	<i>27</i>	
Poland	209	141	350
	<i>60</i>	<i>40</i>	
Spain	2,272	558	2,830
	<i>80</i>	<i>20</i>	
Sweden	1,015	534	1,549
	<i>66</i>	<i>34</i>	
United Kingdom	2,666	2,014	4,680
	<i>57</i>	<i>43</i>	
Total	10,169	5,853	16,022
	<i>63</i>	<i>37</i>	

(i) Number of firms. (ii) Percentages in italics.

Table 2: Value Added, Fixed Assets, Number of Employees—Unconditional Means

Country	Value added		Fixed assets		Number of employees	
	MNCs	Domestics	MNCs	Domestics	MNCs	Domestics
Belgium	4,672	2,487	4,450	2,608	81	49
Czech Republic	3,636	3,009	6,388	4,417	197	270
Finland	6,374	4,205	4,734	4,227	107	86
France	5,029	3,413	3,430	2,041	95	72
Italy	3,857	2,862	3,064	3,426	78	61
Norway	4,686	3,188	3,790	2,643	70	55
Poland	3,353	2,823	5,663	4,060	205	227
Spain	4,206	2,156	4,597	3,017	80	50
Sweden	3,994	2,421	3,994	2,741	84	57
United Kingdom	4,642	3,904	3,770	2,944	98	99
Total	4,562	3,013	3,870	2,905	94	73

(i) Values for value added and fixed assets are in thousands of US\$ 2000 prices.

(ii) Values for the number of employees are headcounts. Value added is calculated as earnings before interest and taxes (EBIT) plus costs of employees.

Table 3: Statutory Corporate Tax Rates

Country	Rates (Per cent)	Years
Belgium	40	1998–2002
	34	2003–2004
Czech Republic	35	1998–1999
	31	2000–2003
Finland	28	2004
	28	1998–1999
France	29	2000–2004
	41.7	1998
Italy	40	1999
	36.7	2000
	35.3	2001
	34.3	2002–2004
	41.2	1998–2000
Norway	40.3	2001–2002
	38.2	2003
	37.3	2004
Poland	28	1998–2004
Spain	36	1998
	34	1999
	30	2000
	28	2001–2002
	27	2003
Sweden	19	2004
	35	1998–2003
United Kingdom	35.3	2004
	28	1998–2004
Sample Average	31	1998
	30	1999–2004
<b>Sample Average</b>	<b>34.3</b>	

Table 4: TFP and Labour Productivity–Unconditional Means

Country	TFP		% Difference	Labour productivity		% Difference
	MNCs	Domestics		MNCs	Domestics	
Belgium	38	32	18***	65	56	16***
Czech Republic	8	6	33***	36	18	100***
Finland	30	24	25***	68	53	28***
France	37	34	9***	63	56	12***
Italy	26	20	30***	63	56	12***
Norway	45	35	29***	83	65	28***
Poland	10	7	43***	44	28	57***
Spain	25	18	39***	64	50	28***
Sweden	21	18	17***	54	49	10**
United Kingdom	33	26	27***	56	44	27***
Total	31	24	29***	60	50	20***

(i) Values are in thousands of US\$ 2000 prices. Labour productivity is calculated as (EBIT plus costs of employees) / number of employees.

(ii) % difference is calculated as follows: (MNCs' productivity - domestics' productivity)/domestics' productivity.

(iii) \*\*\* 1% significance level and \*\* 5% significance level for a mean-comparison t-test where  $H_0$ :  $\text{mean}(\text{MNCs}) - \text{mean}(\text{domestics}) = 0$  and  $H_a$ :  $\text{mean}(\text{MNCs}) - \text{mean}(\text{domestics}) > 0$ .

Table 5: Main Results

	(1)	(2)	(3)	(4)
MNC dummy * corporate tax rate	-1.034*** (0.210)	-1.088*** (0.232)	-1.023*** (0.208)	-0.798*** (0.240)
Company fixed effects (Country*year) fixed effects	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Observations	85,606	52,692	84,306	39,991
Number of companies	16,022	10,041	15,824	5,713
R-squared	0.10	0.03	0.10	0.00

(i) Standard errors in parentheses and clustered at the company level. Model estimated using within-groups estimator.

(ii) Dependent variable: TFP as defined in equation (3). In all columns, except for column (2), value added is defined as earnings before interest and taxes (EBIT) plus costs of employees. In column (2), value added is defined as sales minus costs of materials. In all columns, except for column (3), capital is measured as fixed assets. In column (3), capital is measured as tangible fixed assets.

(iii) Column (4) reports results for a balanced panel where each firm has seven years of data. The Czech Republic drops out of this sample.

(iv) \*\*\* significant at 1%. \*\* significant at 5%. \* significant at 10%.

Table 6: Results by Country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FR, IT, BE, CZ & PL	France	Italy	Belgium	Czech Rep	Poland	All except CZ & PL
MNC dummy * corporate tax rate	-1.075*** (0.213)	-0.684*** (0.243)	-1.698*** (0.754)	-0.228 (0.346)	-4.873*** (2.406)	-2.866*** (0.821)	-0.622*** (0.193)
Company fixed effects (Country*year) fixed effects	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Year fixed effects		✓	✓	✓	✓	✓	
Observations	33,185	14,483	11,442	5,006	596	1,658	83,352
Number of companies	6,242	2,815	2,089	867	121	350	15,551
R-squared	0.10	0.01	0.06	0.03	0.04	0.38	0.00

(i) Standard errors in parentheses and clustered at company level. Model estimated using a within-groups estimator.

(ii) Dependent variable: TFP as defined in equation (3). Value added is defined as EBIT plus costs of employees. Capital is measured as the book value of fixed assets.

(iii) In column (1), the sample contains five countries which have substantially reduced their corporate tax rate: Belgium, the Czech Republic, France, Italy and Poland.

(iv) In column (7), the sample includes all countries of column (1) of Table (5) except the Czech Republic and Poland.

(v) \*\*\* significant at 1%. \*\* significant at 5%. \* significant at 10%.

Table 7: Variations of the Main Model

	(1)	(2)	(3)	(4)	(5)
MNC dummy * corporate tax rate	-1.094*** (0.217)	-1.067*** (0.228)	-1.203*** (0.252)	-0.730*** (0.199)	-1.031*** (0.212)
Size dummy * corporate tax rate	0.242 (0.210)				
MNC dummy * Inflation		-0.012*** (0.004)			
MNC dummy * GDP growth		0.001 (0.003)			
MNC dummy * Unemployment rate		-0.002 (0.004)			
MNC dummy * EMTR			0.297 (0.328)		
Company fixed effects	✓	✓	✓	✓	✓
(Country*year) fixed effects	✓	✓	✓	✓	✓
Observations	85,606	85,606	85,606	85,606	84,119
No of panel	16,022	16,022	16,022	16,068	15,753
R-squared	0.097	0.097	0.096	0.078	0.097

(i) Standard errors in parentheses and clustered at company level. Model estimated using a within-groups estimator.

(ii) Dependent variable: TFP as defined in equation (3). Value added is defined as EBIT plus costs of employees. Capital is measured as the book value of fixed assets.

(iii) The size dummy takes value 1 when the  $\log(\text{total assets}) > \text{median } \log(\text{total assets})$ . It is time invariant.

(iv) In column (4),  $\alpha_K$  is different for multinational and domestic firms.

(v) In column (5), the sample excludes companies which have undergone an M&A operation during the sample period.

(vi) \*\*\* significant at 1%. \*\* significant at 5%. \* significant at 10%.

Table 8: Production Function Estimation

	(1)	(2)
MNC dummy * corporate tax rate	-1.009*** (0.217)	-0.879*** (0.201)
Log(fixed assets / employees)	0.139*** (0.007)	0.435*** (0.013)
Log(fixed assets)		-0.380*** (0.012)
(Country*year) dummies	✓	✓
Company fixed effects	✓	✓
Observations	85,606	85,606
Number of companies	16,022	16,022
R-squared	0.04	0.10

(i) Dep. variable:  $\frac{EBIT+ wage\ bill}{no. employees}$ .

(ii) Columns (1) and (2) estimated using a within-groups estimator.

(iii) Standard errors in parentheses and clustered at company level.

Table 9: Creation of the Sample

Steps	Firms	Observations
Starting sample	931,324	12,107,212
Keep only unconsolidated data	809,715	10,526,295
Drop if variable requirements not met <sup>(i)</sup>	464,903	2,656,419
Drop long or short accounting periods	464,892	2,644,260
Drop accounting mistakes	462,862	2,588,187
Keep firms with known ownership status	120,243	697,303
Keep firms within the manufacturing sector	35,456	224,655
Drop if year < 1998 and year = 2005	34,876	174,094
Drop host countries with small sample sizes	29,466	154,725
Create comparable sample in terms of size	23,498	109,641
Drop outliers	21,804	94,930
Keep firms with three consecutive years of observations	16,022	85,606

(i) We drop observations with EBIT, cost of employees, fixed assets and number of employees either missing or equal to zero. We also drop observations with the sum of the cost of employees plus EBIT either equal to or smaller than zero.

Table 10: Matrix for Changing Ownership Status–Targets

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI; NPI(ii)	PI; NPI(ii)
	Domestic	NPI	NPI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions.

(ii) These cases are identifiable with certainty only if the country of vendor is different from the country of target. If the country is the same, we cannot decide whether the vendor was really domestic or part of an international group. We flag these unidentifiable cases with NPI.

Table 11: Matrix for Changing Ownership Status–Acquirers

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI; NPI(ii)	NPH
	Domestic	NPI	PI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions. NPH: not possible to happen.

(ii) These cases are identifiable with certainty only if the country of acquirer is the same as the country of target. We flag these unidentifiable cases with NPI.

Table 12: Matrix for Changing Ownership Status–Vendors

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI	PI; NPI(ii)
	Domestic	NPH	NPI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions. NPH: not possible to happen.

(ii) These cases are identifiable with certainty only if the country of vendor is different from the country of target. We flag these unidentifiable cases with NPI.

Table 13: Year Distribution of Deals in ZEPHYR

Year	MNCs	Domestic	Stand-alones	Total	Per cent
1998	9	3	0	12	2.87
1999	9	5	0	14	3.35
2000	11	6	2	19	4.55
2001	13	9	0	22	5.26
2002	52	56	14	122	29.19
2003	56	39	9	104	24.88
2004	71	45	9	125	29.90
Total	221	163	34	418	100

Table 14: Country Distribution of Deals in ZEPHYR

Country	MNCs	Domestic groups	Standalones	Total	Per cent
Belgium	22	17	1	40	9.57%
Czech Republic	5	0	0	5	1.20
Finland	16	10	2	28	6.70
France	20	15	4	39	9.33
Italy	16	7	5	28	6.70
Norway	11	7	2	20	4.78
Poland	2	3	3	8	1.91
Spain	16	14	14	44	10.53
Sweden	22	23	0	45	10.77
United Kingdom	91	67	3	161	38.52
Total	221	163	34	418	100

Table 15: ZEPHYR–Targets Dataset

	Deals	Firms	Observations
M&As only	276,562		
Targets in 9 countries(i)	80,504		
Time: 1998-2004	42,034		
Min final stake 50%	23,738		
Completed deals only	21,891	NA	25,478
Drop if id missing	12,844	12,619	13,298
Time: 1998-2004(ii)	10,428	10,260	10,789
After merging with ORBIS	NA	249(iii)	256
- <i>no info on country of vendor</i>		134	135
- <i>MNC to MNC</i>		24	24
- <i>MNC to Domestic</i>		12	12
- <i>Domestic to MNC</i> (iv)		38	40
- <i>Domestic to Domestic</i> (iv)		44	45

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden.

(ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005.

(iii) The numbers below do not add up to 249 but to 252, as the same company might report the country of the vendor in one deal and not report it in another one.

(iv) These observations were identified using the following assumption: when the country of the target and of the vendor are the same, the target is considered as domestic before the deal.

Table 16: ZEPHYR–Acquirers Dataset

Acquirers in Zephyr			
	Deals	Firms	Observations
M&As only	276,562		
Acquirers in 9 countries(i)	78,215		
Time: 1998-2004	40,913		
Min final stake 50%	22,930		
Completed deals only	21,541	NA	24,898
Drop if id missing	18,031	10,095	18,322
Time: 1998-2004(ii)	14,927	8,724	15,172
After merging with ORBIS	NA	130	136
- <i>no info on country of target</i>		2	2
- <i>MNC to MNC</i>		42	44
- <i>Domestic to MNC</i> (iii)		16	17
- <i>Domestic to Domestic</i>		70	73

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden.

(ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005.

(iii) These observations have been identified assuming that the foreign subsidiary bought in the deal has made a domestic company become part of a multinational group. This assumption is likely not to hold for many cases.

Table 17: ZEPHYR–Vendors Dataset

Vendors in Zephyr			
	Deals	Firms	Observations
M&As only	276,562		
Vendors in 9 countries(i)	36,424		
Time: 1998-2004	18,303		
Min final stake 50%	10,459		
Completed deals only	9,399	NA	12,701
Drop if id missing	6,824	4,781	7,837
Time: 1998-2004(ii)	5,674	4,101	4,989
After merging with ORBIS	NA	32	32
- <i>no info on country of target</i>		0	0
- <i>MNC to MNC</i>		14	14
- <i>MNC to Domestic</i>		1	1
- <i>Domestic to Domestic</i> (iii)		17	17

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden.

(ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005.

(iii) These observations were identified using the following assumption: when the country of the target and of the vendor are the same, the vendor is considered as domestic before the deal.

Table 18: Firms with at Least One Observation in ZEPHYR

Companies with information in Zephyr				
		as Target	as Acquirer	as Vendor
MNCs	213 (3.64%)	144	59	14
Domestic groups	152 (3.05%)	83	62	16
Stand-alones	33 (0.64%)	22	9	2
<b>TOTAL</b>	<b>398</b> <b>(2.49%)</b>	<b>249</b>	<b>130</b>	<b>32</b>

(i) Percentages of entire sample in parentheses.

(ii) The last three columns do not always add up to the second one as companies might act as target, acquirer, and vendor across years.

Table 19: Changes in Ownership-observations (number of companies)

		After the deal		
		MNC	Domestic	TOTAL
Before the deal	MNC	81 (79)	13 (13)	<b>94 (92)</b>
	Domestic	57 (54)	135 (126)	<b>192 (180)</b>
<b>TOTAL</b>		<b>138 (133)</b>	<b>148 (139)</b>	<b>286 (272)</b>

(i) The observations in the fourth row were identified using the following assumption: when the country of the target and of the vendor are the same, the firms are considered to be domestic before the deal.

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