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# Does Corporate taxation Deter Multinationals? Evidence from a Historic Event in Ireland*

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Abstract:
We use a unique exogenous corporate tax policy change in the Republic of Ireland to investigate how corporate taxation affects foreign direct investment at the extensive and intensive margin. To this end we construct exhaustive sectoral and plant level panel data and use difference-in-differences strategies. Our results do not provide strong evidence that the increase in corporate tax rates for exporters did affect the entry or exit of plants from the US or UK in Ireland. Entry rates of German firms seem to be negatively affected, however. At the intensive margin there is evidence that foreign plants in Ireland reduce the size of their operations in response to the tax change.

Keywords: multinational companies, foreign direct investment, corporate tax, Ireland, difference-in-differences.

JEL classification: F23, H25.

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## 1 Introduction

In 1981, Ireland increased its tax on profits generated from export sales from zero to ten percent. This change was not driven by national interests but was imposed by the European Economic Community in the wake of Ireland's accession to the EEC in 1973. This historic event, hence, provides an interesting natural experiment that can be exploited to gauge the responsiveness of foreign multinational corporations to changes in the corporate tax rate in the host country. This is what we set out to do in this paper, exploiting rich plant level data for domestic and foreign establishments in Ireland.[1]

There are, of course, a number of papers that have looked empirically at the relationship between corporate taxes and inward foreign direct investment.[2] However, our approach, which uses a clear natural experiment and an investigation with rich plant level data, provides a new perspective to this literature, and shows the importance of going to the micro level data to identify any effects. In the literature thus far, much of the evidence is based on aggregate data on foreign direct investment flows or stocks at the country or region level (e.g. Hines 1996, Swenson, 1994). Only more recently, have researchers started to look into this question using firm level data, which allows taking into account firm heterogeneity and avoiding aggregation bias (e.g., Desai et al., 2002, Becker et al, 2009, Davies et al., 2009).

The identification strategy used in much of the literature is generally based on cross-country or cross-regional variation in tax rates. In other words, the impact of the tax rate on investment is identified by looking at data for different countries or regions, and specifically by correlating differences in inflows of FDI with differences in tax rates across countries or regions.[3] This is potentially problematic, as the cross sectional units generally do not just vary with respect to profit taxation, but are different along a range of other characteristics as well, some of which may be observable to the researcher (e.g., size, or skill abundance) while, more problematically, others are not (e.g., institutional characteristics). Not adequately controlling for such observable and unobservable characteristics may bias results. In panel data such problems may be partly overcome, by controlling for unobserved differences in the cross-sectional unit. Even then, however, one issue remains.

While variation in tax rates within a cross-sectional unit may add identification, this variation over time may be difficult to justify as exogenous. An example may illustrate this argument. In 2007 the UK government announced a reduction in the corporate tax rate in order to improve its perceived lack of competitiveness.[4] In this case it is difficult to argue that this was an exogenous shock. Rather it appears that changes in the tax rate and changes in inward FDI

[1] The specific case of Ireland also provides us with a timely example, as Ireland's low corporate tax rate has been debated recently, with the then French president Sarkozy calling for increases in this tax rate ( "France resists Ireland's low corporate tax", *Financial Times*, 11 May 2011) while Irish observers generally argue that such an increase would be detrimental for foreign direct investment inflows ("State should protect corporate tax rate to retain US firms", *Irish Times*, 19 August 2011)

[2] See de Mooij and Ederveen, 2003 for a recent comprehensive overview of the empirical literature. There is also a theoretical literature that shows that the location of capital (including foreign direct investment from multinational enterprises) reacts to the level of profit taxation set by governments (e.g., Haufler and Wooton, 1999, Raff, 2004, Bucovetsky and Haufler, 2008)

[3] Davies et al. (2009) look at the incidence of tax treaties rather than tax rates. Their identification also comes from cross sectional variation, however.

[4] See for example "Corporate Tax: Benefit of rate cut to 28p challenged", *Financial Times*, 24 March 2007.

are due to some unobserved (to the researcher) third effects – in the present example this is "country competitiveness".

We argue that the characteristics of the corporate tax rate regime in the Republic of Ireland provide a unique identification strategy for looking at the effect of taxes on incoming foreign direct investment.

In the 1950s, the Republic of Ireland introduced a zero percent tax rate on profits generated from manufacturing exports (see Barry, 2011). This rate did not discriminate by nationality of ownership. However, it had the effect that many foreign multinationals commenced operations in Ireland in order to use the economy as an export platform, exporting in many cases all (or most) of their output (Barry and Bradley, 1997). For profits made from domestic sales of manufactured goods, the standard tax rate remained at between 40 to 50 percent (Conefrey and FitzGerald, 2009).

Ireland jointed the then European Economic Community (EEC) in 1973. As part of the negotiations leading up to this, Ireland secured a special guarantee that secured the continuation of the export tax relief.[5] However, in 1977 pressure was put on Ireland to change this tax rule as it was seen as distorting competition due to its focus on exporters. This was followed by intensive negotiations between Dublin and Brussels which eventually led to an announcement by the Irish government in 1978 that a change in the taxation of corporate profits was to be implemented in the early 1980s. From 1981 onwards, the tax holiday was replaced by a 10 percent corporate tax rate on all manufacturing activity. However, there was also a transition period for those firms who previously qualified for the export tax relief. For them, the old tax rules still applied up to 1990.[6]

This policy change provides us with a unique identification strategy. First of all, the change in the tax rate came about due to external pressure from the EEC. It was not part of the negotiations in the pre-accession period and was only announced in 1978. Hence, it was unforeseen by firms and investors, and can therefore be assumed to be an exogenous event. Hence, we have a set-up that is akin to a natural experiment. Second, we can distinguish a pre and a post-policy change period. In fact, we can distinguish three periods: Pre-policy announcement (before 1978), announcement period (1978-1980) and the implementation period (1980 and afterwards). For firms that benefitted from the transition period, we also check whether defining the policy change post 1990 is more appropriate.

We also exploit another important characteristic in the data analysis. The increase from 0 to 10 percent tax rate only applied to exporting firms in manufacturing. Manufacturing firms that did not export were not affected negatively. Given that foreign-owned firms in Ireland are highly export-intensive, we may use a comparison of foreign and domestic owned firms as an

[5] Specifically, Ireland negotiated an exception to Articles 92 and 93 of the Treaty of Rome which regulate state aids. It negotiated that in the application of these two Articles "it will be necessary to take into account the objectives of economic expansion and the raising of the standard of living" in the country. This was commonly interpreted as meaning that if export tax relief had to be abolished it would be replaced by something equally effective, hence, leaving investors unaffected. (See "Ireland to fight possible EEC ban on export incentives", *Irish Times*, 21 September 1977; quotation from the newspaper article).

[6] See "Ireland to fight possible EEC ban on export incentives", *Irish Times*, 21 September 1977; "Corporation tax to be cut to 10% for all manufacturing firms", *Irish Times*, 21 December 1978.

identification strategy. Barry and Bradley (1997) show, using industry level data for 1993, that the average domestic firm exports 39 percent of its total output, while this export ratio is 85 percent for foreign multinationals. This picture becomes even starker when looking at US multinationals: they have an export ratio of 96 percent. Furthermore, using firm level data for 1991 to 1998, Ruane and Sutherland (2005) show that, among firms with more than three employees, 96 percent of foreign-owned firms in Ireland export, with an average export intensity of 85 percent. By contrast, only 60 percent of their domestic Irish-owned peers export, with an export intensity of 35 percent.

To exploit this policy change, we use a difference-in-differences (DD) strategy. We also employ a trend-adjusted DD (TA-DD) approach that has the advantage compared to a standard DD estimator in that it allows for differential trends in levels of unobservables. We implement the DD and TA-DD approaches by exploiting the fact that due to their high export orientation, foreign multinationals may be differently affected than the average domestic firm.

The use of firm level data provides us with another novel advantage of our approach. It allows us to distinguish the operations of firms at the extensive and the intensive margin. In terms of the former, we investigate the impact of the tax policy change separately on entry and exit rates at the three digit NACE industry and the plant level. Most of the literature only considers either the extensive margin (Becker et al., 2009 and Devereux and Griffith, 1998), or is not able to distinguish extensive and intensive margin in aggregate data (e.g., Hines, 1996). We are also not aware of any study that distinguishes entry and exit at the extensive margin. For the intensive margin we estimate the effect in an empirical model of plant employment growth. The only study that we are aware of that also distinguishes the extensive and intensive margin is Davies et al. (2009). However, they do not consider exit as a channel through which adjustments at the extensive margin may take place. Also, since they look at the operations of Swedish-owned affiliates abroad, their identification strategy is based on cross-country variations in tax rates.

Overall, our results suggest that foreign multinationals indeed reacted to some extent to the export tax changes. More specifically, at the extensive margin there appears to have been no reduction in attracting foreign direct investment from the US or the UK to Ireland or in leading to increases in exit rates. This may not be that surprising, as it is theoretically not clear that small changes in tax rates should have any substantial effect on firm location decisions, as long as other characteristics of the host country remain unchanged.[7] However, we also find that German firms appear to be somewhat affected. Their rate of entry is significantly lower after the announcement and implementation of the policy change.

We also find evidence that adjustment is taking place at the intensive margin. Foreign plants experience a fall in employment growth rates in response to the alterations in the export tax regime, which may suggest that they relocate operations from Ireland towards other locations elsewhere. These effects are particularly strong for plants owned by US and German multinationals, which are by far the most export oriented.

[7] For example, agglomeration economies may make firms less sensitive to changes in tax rates (e.g., Baldwin and Krugman, 2004, Borck and Pflüger, 2006, Brülhart et al., 2012).

The remainder of the paper is structured as follows. In the following section we describe our data source and provide some basic summary statistics. In Section 3 we econometrically investigate the effect of the tax policy changes at the extensive margin, examining entry and exit rates at the sectoral and plant level. This is followed by an analysis of the intensive margin, as identified by specifying employment levels and growth equations. Concluding remarks are provided in the final section.

## 2 Data

Data used in our analysis are obtained from Forfás, the Irish policy and advisory board with responsibility for enterprise, trade, science, and technology. Specifically, our data source is the *Forfás Employment Survey* which is an annual plant level survey, conducted since 1972 with information on the nationality of ownership, NACE sector of production, the start-up year and the level of employment each year.

One of the main advantages of the *Employment Survey* compared to other datasets is its coverage. The response rate to the survey is argued by Forfás to be essentially 100 per cent so that the data can be seen to cover the entire population of manufacturing plants. 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.[8]

Given the exhaustive nature of the *Employment Survey* we can use it to calculate entry and exit, as well as employment levels in manufacturing. An entry is defined as a plant appearing in the dataset for the first time in $t$. An exit is defined as a plant dropping out of the dataset in $t$ and not reappearing. We use this information in our analysis of the effect of the tax policy change on firm entry and exit at the three digit NACE industry level. We use this information to calculate sectoral entry and exit rates. The former is defined as the ratio of the number of new entrants in three digit industry $j$ in time $t$ over total incumbents in industry $j$, while the exit rate is similarly the number of exitors in time $t$ over total number of incumbents.[9]

Unfortunately, the *Employment Survey* does not provide information on output or, more importantly, export activity of firms. Hence, we cannot define exporters and non-exporters. However, as shown by Ruane and Sutherland (2005), almost all foreign owned firms are exporters, while the share of exporters among domestic firms is far less. Hence, we make use of the fact that foreign firms are predominantly exporters, while domestic firms to a much larger extent are domestic market orientated. We use this as our main identification strategy.[10]

We present in Table 1 the aggregate picture of entry and exit for the whole manufacturing sector, distinguishing foreign and domestic owned plants. Overall, total entry rates (summing

[8] The foreign indicator variable is time invariant. This is not necessarily a problem for the case of Ireland since almost all foreign direct investment in Ireland, certainly over the time period analysed, has been majority-owned greenfield investment rather than acquisition of local firms; see Barry and Bradley (1997).
[9] These definitions follow the industrial organization literature, see, for example, Dunne et al., 1988.
[10] Note that we are not assuming that domestic firms do not export at all. Our identification rests on the assumption that the average domestic firm is less likely to be an exporter than the average foreign owned firms, hence we may expect that foreign owned firms are likely to react differently to the tax change.

rates for domestic and foreign plants) account for between 3 to 7 percent of total incumbents, while exit rates are slightly higher at between 4 to 10 percent. These figures are roughly comparable to similar calculations for the UK by Disney et al. (2003).

It is difficult to detect any clear pattern related to the tax policy change in 1981 or the announcement thereof in 1978. Entry rates in the 1978 – 1980 period seem to be higher than previously for both foreign and domestic firms, which may suggest an anticipation effect whereby firms enter in order to be able to avail of export tax relief until 1990. Compared to that period, rates of entry appear lower after 1981 when the new tax policy was implemented. However, exit rates for foreign plants appear largely unchanged. By contrast, the incidence of domestic exit increases from 1980 onwards, but this appears to be a trend that is continued even into the early 1990s. These are, of course, aggregate data which also hide sectoral differences.

*[Table 1 here]*

## 3 The extensive margin: Tax policy and plant entry and exit

*Methodology*

In order to attempt to identify an effect of the tax policy change on entry and exit rates we turn to estimations that are couched in a difference-in-differences (DD) framework. We distinguish groups of plants that are expected to be affected by the policy change and comparison groups that may not be affected, or be affected differently.

The basic specification of our DD model for the extensive margin is

$$Y_{jit} = \gamma_1 foreign_i + \gamma_2 tax\_change_t + \gamma_3 foreign_i * tax\_change_t + \beta \overline{Y}_{ijt} + d_j + d_t + \varepsilon_{ijt} \quad (1)$$

where $Y_{jit}$ is the entry rate (or exit rate, respectively) in three digit industry $j$ for plant group $i$ (foreign or domestic) at time $t$.

We postulate that foreign-owned plants are differently affected by the policy change. While the change did not discriminate by nationality, the elimination of the export tax holiday affects exporters in a different way than non-exporters. Hence, a possible identification strategy is to investigate differences between foreign and domestic firms, as foreign-owned firms are much more likely to export than domestic firms (see Barry and Bradley, 1997).

The right-hand-side variable $foreign_i$ is an indicator equal to one for foreign and zero for domestic plants. The potential differences in changes in entry and exit rates between the treated (foreign) and control group (domestic) of firms are captured by $\gamma_1$.

$tax\_change_t$ indicates the "treatment period". We distinguish two treatment periods and defined two dummies accordingly. One (*tax_change_78*) captures the announcement period and is equal to one between 1978 and 1980. The second (*tax_change_80*) is a dummy that is equal to one after the actual implementation of the change in tax rates, i.e., it is set to 1

between 1981 and 1984, thus allowing for four years of adjustment after the implementation of the policy change in 1980. The difference in the dependent variable before and after the respective treatment is given by $\gamma_2$.

The interaction of ($foreign_i$ * $tax\_change_t$) provides an indicator variable that is equal to one if an observation is in the treated group after receiving the treatment. The coefficient $\gamma_3$ is, hence, the DD estimate of the tax change for firm group *i*.

The identifying assumption necessary to interpret $\gamma_3$ in this way is that in the absence of the tax policy change, the evolution of the dependent variable between the pre- and post-treatment periods would, on average, have been the same for the two groups of firms. In other words, $\gamma_3$ would be 0 in the absence of the tax policy change. Or, to put it differently, the error term $\varepsilon_{ijt}$ is uncorrelated with ($foreign_i$ * $tax\_change_t$).

In order to ensure that this assumption holds, we include full sets of three digit industry ($d_j$) and year ($d_t$) dummies to control for time-invariant sector specificities and year effects. This may, however, not be enough, as there may be plant-group specific dynamics in the dependent variable that may induce a correlation between the interaction term and the error (Abadie, 2005). This would be the case if entry or exit rates of foreign plants reacted differently to changes in the macroeconomic environment pre- and post-treatment than those of domestic plants. In order to control for this, we include $\overline{Y}_{ijt}$, which is the average rate of entry (or exit) for plant group *i* calculated at the beginning of the pre- and post-policy change period, respectively. This, hence, captures plant-group specific effects that differ before and after the policy change.

The inclusion of these controls, in particular the time dummies, allow us to capture one other policy change that may otherwise impact on our results: Ireland also joined the European Exchange Rate Mechanism (ERM) in 1979 (see Honohon and Murphy, 2010). This may be seen by some as having improved Ireland's competitiveness as it allowed for devaluations of the currency. While we do not account for this explicitly in the analysis, we may argue that such changes in the exchange rate are captured by our time dummies.[11, 12]

While the DD approach controls adequately for unobservable time invariant plant-group specific effects and observable effects captured by the covariates identification may still be hampered by unobserved time varying characteristics. In order to take this into account we allow for fixed time trends in a trend-adjusted difference-in-differences (TA-DD) estimation,

[11] Implicitly, we assume that such year-on-year fluctuations in the exchange rate did not have any differential effects on foreign and domestic firms. If it did, then we may understate the possible effects of the tax rate. In a robustness check, which is not reported in the paper to save space, we also included the real exchange rate (obtained from the World Bank Development Indicators database) instead of time dummies in the regression model. This does not change our main results. The real exchange rate itself is negative in the entry and positive in the exit regressions.

[12] We also examined the coefficients on the time dummies to determine whether the oil shock in 1979 may have reduced the exports of foreign firms substantially. However, there was no detectable pattern in this regard.

$$\Delta Y_{jit} = \kappa_1 foreign_i + \kappa_2 tax\_change_t + \kappa_3 foreign_i * tax\_change_t + \alpha \overline{Y}_{ijt} + d_j + d_t + \nu_{ijt} \quad (1a)$$

where Δ is the first differences operator. All covariates are identical to those in the DD model (1).

In all estimations, the period of analysis is 1973 to 1984. This, thus, captures five years pre-treatment, three years (1978-1980) announcement period and four years (1981 – 1984) after the implementation of the policy change.

*Results for entry rate*

Table 2 shows the regression results for the empirical model with the entry rate as dependent variable. Columns (1) and (3) are estimations of the simple DD model in equation (1), while columns (2) and (4) are based on the TA-DD model in equation (1a), i.e., where the dependent variable is defined in first differences rather than levels. The entry rates are calculated separately for domestic and foreign plants at the three digit industry level.

Columns (1) and (2) show the estimations of the parsimonious models in equation (1) and (1a), respectively. Note, firstly, that we find a positive and statistically significant coefficient on the foreign ownership dummy in column (2). This indicates that the growth of the entry rate in foreign-owned firms is higher, ceteris paribus, than in domestic firms.

We also find that the coefficient on the *tax_change_78* variable is statistically significant and positive. While this suggests that the entry rates and growth thereof of both domestic and foreign plants are higher in the announcement period, the nature of the estimation technique does not allow us to attribute this solely to the policy change; it may just be driven by any unobserved factors that affected both types of plants equally in the post-treatment period. There is no clear-cut result on the implementation dummy (*tax_change_81*).

Most importantly, the estimations do not allow us to identify an strong effect of the tax change on entry rates from the *foreign*tax_change* interaction terms. While the coefficients on the announcement and implementation period dummies are both negative – consistent with a negative effect of the tax change on foreign entry – they are mostly not statistically significant.

In the analysis thus far, the foreign dummy captures firms from different nationalities. However, as Table 3 shows, we have considerable heterogeneity in nationality of ownership in our data. By far the majority of observations in our data over the period analyzed are accounted for by three nationalities: UK, US and Germany. In order to explore this further we, in a next step, distinguish foreign firms by nationality of ownership. Almost 40 percent of observations relating to foreign-owned plants are British, while the US accounts for one quarter of observations.

In order to account for possible differences in nationalities, we calculate entry rates at the three digit industry level for five different nationality groups: Irish, US, UK, German, and

Rest of the World. We distinguish the US, UK and Germany from the rest as these are by far the largest group of investors in Ireland. The US and German firms also tend to be the most export oriented, while British firms also focus strongly on the Irish market. As Barry and Bradley (1997) show, the export ratios for German and US firms are 92 and 96 percent respectively, while the average export ratio for British firms is 39 percent.

Another important reason for the nationality distinction relates to the tax regime. The US and UK adopt a credit system to avoid double taxation, while Germany operates an exemption system (see De Mooij and Ederveen 2003 for details).[13] Hence, one may expect that, all other things equal, German firms react most strongly to the tax change, since they export heavily and benefited most from the zero percent tax rate.

*[Tables 2 and 3 here]*

Results in columns (3) and (4) are broadly in line with this conjecture. We do find statistically significant and negative effects on entry rates for German and RoW firms. They, thus, seem to be discouraged from entering Ireland by the announcement and the implementation of the change in the tax regime.

Entry rates of UK and US firms, do not seem to be strongly affected, however, certainly when relying on the TA-DD estimation in column (4) which provides stronger identification than the DD estimation in levels in column (3). This is in line with a view that the corporate tax rate may not be as important as other characteristics of the economy for new entrants from these two countries. In particular, in the Irish context, undoubtedly the accession to the European Economic Community was an important attraction for foreign investors (Barry and Bradley, 1997). This possibility of using Ireland as an export platform to access the larger European market remained unchanged during our period of analysis. This, in conjunction with the observation that Ireland's tax rate at 10 percent was still highly competitive compared to alternative host countries in the European Community may explain why the tax rate has had no measurable impact on foreign plant entry from the UK and the US.[14]

*Results for exit rate*

In this section we consider the second aspect of adjustment along the extensive margin, viz, plant exit. Note that the analysis of entry rates was based on aggregating our plant level data up to the three digit industry level. In this way we, of course, lose a lot of information at the plant level and our results may be subject to aggregation bias. In terms of looking at entry, however, the aggregate data is the only possible route of investigation for us. We do not have plant level data on potential entrants that choose not to enter the Irish economy but only observe those plants that do enter.

[13] An exemption system stipulates that foreign income is only taxed in the host country; it is exempt from home country taxes. In a credit system, taxes are liable for world-wide income generated by the firm, but taxes paid in the host country are credited against the total liability in the home country.

[14] For example, over that period the main rate of corporate tax in the UK was at 52 percent, with a rate for firms with "small profits" of 40 – 42 percent. See http://www.hmrc.gov.uk/stats/corporate_tax/rates-of-tax.pdf (accessed 16/01/12).

This is different in terms of plant exit. In our data, we can reliably identify exit at the plant level, and we can compare those plants that exit with those that do not. We use this information in the further analysis, where we model the decision of a plant to exit. We may consider this to be a more reliable analysis of plant exit than the aggregate analysis.

In contrast to the analysis thus far, where we consider entry of new firms, we in what follows only include plants that established in Ireland before 1980. The reason is that these are plants that are affected by the policy change, while plants that enter after 1980 (i.e., after the policy change) already face the new tax regime at entry.

In order to implement the plant level analysis we adapt equation (1) to represent plant level observations,

$$exit_{kit} = \gamma_1 foreign_i + \gamma_2 tax\_change_t + \gamma_3 foreign_i * tax\_change_t + \beta \overline{Y}_{kt} + d_k + d_t + \varepsilon_{kit} \quad (2)$$

where the dependent variable is a dummy equal to one once plant *k* exits and zero otherwise, *i* is firm group defined as above and *t* is time. $\overline{Y}_{kt}$ is now defined as the average employment growth in plant *k* before and after the policy change to account for plant specific dynamics in the probability of exiting.

Given the binary nature of the dependent variable, we estimate the model using a probit estimator and report marginal effects in Tables 4 and 5.[15] Table 4 is based on the definition of the tax change variables for the announcement and implementation periods, as in Table 2. However, one may wonder whether the definition of the treatment period as post 1980 is the correct one for the analysis of exit. As pointed out above, firms that established in Ireland before the policy change (i.e., before 1981) were given a transition period in which the old tax regime still applied to them. This period lasted until 1990, when these firms were also subjected to the new tax rate. One may, therefore, argue that old firms may not exit immediately after 1980 but may wait until the transition period has elapsed and leave after 1990. We investigate this issue in Table 5, where we define the treatment period as from 1990 to 1995, and use data from 1973 until 1995 for the analysis.[16]

What is clear from columns (1) and (2) in Table 4 is that we now no longer find any evidence that the probability of exit is higher for foreign firms after the increase in the tax rate. Quite the contrary: for German-owned firms we find a decrease in the probability of exiting both after the announcement and after the implementation of the policy change. This suggests that German firms are more likely to remain in Ireland than comparable domestic firms, which may indicate that they stay in order to benefit from the tax incentive during the transition period.

[15] We also, as a robustness check, estimated the equation using a complementary log-log model, which can be considered the discrete time version of the proportional hazard models. See Jenkins (2005) for an excellent overview of complementary log-log and proportional hazard models. These estimations provide similar results in terms of signs and statistical significance. Hence, in order to save space, we do not report them here, but they can be obtained upon request.

[16] One needs to keep in mind, however, that the identification of such a delayed effect is difficult, as many unobservable factors may also have changed between 1980 and 1990.

Whether this leads to higher exit rates of German firms after 1990 is something we look at in Table 5, columns (1) and (2). However, we fail to uncover any statistical evidence that exit rates increased after the transition period ran out in 1990. The interactions of the US and RoW nationality dummies with the tax change dummy are always statistically insignificant, both in Tables 4 and 5.

*[Tables 4 and 5 here]*

Hence, the estimations thus far do not provide any evidence that the policy change lead to increased exit rates among the "treated group" of foreign plants, i.e., those that export heavily.[17] This result may suggest that investing abroad involves substantial sunk costs which leave firms reluctant to relocate their operations completely, after an increase in the tax rate.

In columns (3) and (4) of Tables 4 and 5 we split our sample according to scale economies in the industry. The rationale is that in industries with high economies of scale, incumbents may be less likely to leave as they have made significant sunk costs at entry. This may not be the case in the other industries, therefore, plants there may be more likely to exit as a response to the tax change. We measure the importance of economies of scale using a proxy for minimum efficient scale in the industry. This is measured as the plant average employment size in the three digit industry.[18] We classify industries as high MES industries if this value is higher than the median for all industries.

Results in columns (3) and (4) of Table 4 do not show any strong differences between the two industry groups. The only difference is that the lower exit rate for German firms during the announcement period is only statistically significant for sectors with low levels of scale economies, while the effect in the implementation period is only significant in industries with high levels of economies of scale. This suggests that German firms with low scale economies are able to deter exit after the announcement of the policy change, and are not affected by its implementation. German firms in industries with high scale economies are more likely to stay in Ireland than comparable firms after the implementation of the tax change.

Results in Table 5 (columns 3 and 4) bring to the fore some interesting differences, however. In industries with low scale economies, firms from the UK, Germany and Row (but not US) are less likely to exit than comparable firms after the end of the transition period. In industries with high scale economies, we find no statistically significant effects for US, UK and German firms, though we do find that RoW firms are more likely to exit than comparable firms.

Note that the results in Table 4 and 5 also indicate that the probability of exit for some foreign plants is, on average, higher than for domestic plants. This is shown by the statistically significant and positive coefficients on the foreign nationality dummies. The finding is in line with a common result in the literature, that foreign firms are more likely to exit than comparable domestic firms (see Görg and Strobl, 2003 for Ireland).

[17] In a robustness check, we also estimate the model including as additional covariate plant age in order to control for that aspect of plant heterogeneity. This does not affect our results and is, hence, not reported here to save space.

[18] We use the same measure in an earlier paper (Görg and Strobl, 2002) which also looks at plant entry using the same data set.

## 4 The intensive margin: Tax policy and plant employment growth

Thus far we have looked at adjustment along the extensive margin by examining entry and exit rates at the industry and plant level. Changes in tax policy may, of course, also have an effect on the intensive margin. While firms may decide not to relocate their operations completely after an increase in the tax rate (due to high sunk costs), they may decide to downscale operations and expand in other locations instead. In order to allow for such possibilities we now turn to estimating the impact of the change in the tax regime on employment growth at the plant level.

In order to do so we adapt the empirical model to represent plant level observations,

$$\Delta Y_{kit} = \gamma_2 tax\_change_t + \gamma_3 foreign_i * tax\_change_t + \beta \overline{Y}_{kt} + d_k + d_t + \varepsilon_{kit} \qquad (2)$$

where Y is employment in plant k, $\Delta$ denotes the difference between $t$-1 and $t$, $k$ is firm, $i$ is firm group defined as above and $t$ is time. $\bar{Y}_{kt}$ is now the average employment level in plant $k$ before and after the policy change. The foreign ownership dummy is now obsolete as this variable is time invariant and is, hence, captured by the full set of plant fixed effects, $d_k$.

As in the estimations for exit, we only include plants that were established before 1980 in our analysis. Estimation results are reported in Tables 6 and 7, based on the definition of the tax change variable for the period 1981 – 1984 and the alternative definition, 1991 – 1994, respectively.

The coefficients on the interaction term of the (foreign dummy * tax change) variable suggest negative and statistically significant effects of the tax change on employment growth in foreign plants compared to purely domestic plants, both in columns (1) and (2) of Tables 6 and 7. In Table 6, we find an effect in both the announcement and implementation period. Based on the regression coefficient, the effect appears much more pronounced in the latter period, however. Taken together, this supports the hypothesis that these plants are affected by the tax change and therefore down-scale operations in Ireland.[19]

*[Tables 6 and 7 here]*

Distinguishing foreign firms by their nationality shows that all firms, excepting those from the UK, are negatively affected by the tax change. The different outcome for the UK companies may be due to the special characteristics of these firms, as discussed above. The export intensity of British firms is similar to that of Irish firms and much lower than that for other foreign-owned firms. This lower reliance on exports may in particular explain why surviving British firms are less affected by the abolition of the export tax relief.

The results in Table 6 do not vary strongly depending on the level of minimum efficient scale. In Table 7, however, we find that the negative growth effects mainly occur in industries with

[19] Unfortunately, we cannot look at whether these plants shift operations abroad, since no information on activities of Irish-based firms in other countries is available to us.

high levels of economies of scale. This suggests that these firms adjust via the intensive margin to the tax change.

Taken together, these estimations provide evidence that the tax change had a negative effect on foreign plants at the intensive margin – i.e., their growth has been lower than it would have been in the absence of the increase in the tax on export profits. As to the magnitude of the effect, the coefficient in Table 6, column (1) suggests that after the tax increase, employment growth for the average foreign firm is reduced by 0.117 percentage points. Our data indicate that the average employment growth for foreign firms in our sample is 0.064, with a total standard deviation of 0.418.[20] Hence, the negative effect of the tax change is economically large.

## 5 Conclusions

In this paper we examine how an exogenous change in corporate tax policy affected the behavior of foreign multinationals in Ireland. To this end we construct exhaustive sectoral and plant level panel data and use difference-in-differences and trend-adjusted-DD strategies to identify any effects.

One important result is that there is no statistically significant detrimental effect of the tax change on the entry or exit rates of firms from the US or the UK. This suggests that fears that Ireland may become unattractive as a base for new foreign firms, certainly for these two countries, cannot be substantiated by our analysis. This may be explained by other characteristics that attract multinationals, in particular the fact that even after the tax change, the Irish corporate tax rate was still relatively low compared to that of neighbouring countries.

However, we also find that one group of firms, namely those originating from Germany appear to be somewhat affected. Their rate of entry is significantly lower after the announcement and implementation of the policy change. This is consistent with a deterring effect of the increase in the tax rate for exporting firms.[21] We also find that German firms already located in Ireland show lower rates of exit than comparable firms after the tax change. This may indicate that they remain in the country in order to benefit from the tax incentive during the transition period. We do, however, not find that they are more likely to exit after the end of the transition period in 1990.

Looking at the intensive margin we do find that employment growth rates of already existing plants are adversely affected by the change in tax policy. Foreign plants downsize their operations after the increase in the tax rate. This is true for all foreign firms with exception of those from the UK. This indicates that the change in the tax rate has had some negative effects on foreign multinationals already located in Ireland.

[20] The within standard deviation is 0.367, the between standard deviation 0.436.

[21] The difference between US and UK on the one hand and German firms on the other hand may be due to the tax regime – Germany operates an exemption system, while the US and UK adopt a credit system. Hence, German firms may be expected to benefit most from the tax relief.

Existing studies generally confound adjustments at the extensive and intensive margin in aggregate data. While inward FDI into a state or country may be less if taxes are higher, they cannot distinguish whether this is due to lower entry, higher exit, or downsizing of existing operations. This, however, is important from a policy perspective, as different policy responses may need to be implemented for the different channels of adjustment. For example, if governments aim at building up new industries in high-tech sectors (as was arguably the case in the Ireland), a focus on entry seems important. If the focus were on maintaining or expanding employment, exit and firm growth may become more important.

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**Table 1: Aggregate entry and exit rates (in percent)**

| year | foreign entry | foreign exit | domestic entry | domestic exit | # of firms |
|---|---|---|---|---|---|
| 1973 | 0.63 | 0.15 | 2.64 | 1.35 | 4585 |
| 1974 | 0.84 | 0.38 | 2.74 | 1.99 | 4781 |
| 1975 | 0.47 | 0.80 | 2.86 | 2.70 | 4892 |
| 1976 | 0.76 | 0.64 | 3.56 | 2.55 | 5023 |
| 1977 | 0.72 | 0.82 | 4.88 | 2.39 | 5389 |
| 1978 | 0.84 | 0.65 | 5.74 | 2.34 | 5684 |
| 1979 | 0.55 | 0.51 | 6.43 | 2.16 | 6020 |
| 1980 | 0.90 | 0.48 | 6.14 | 2.72 | 6432 |
| 1981 | 0.69 | 0.77 | 5.99 | 3.14 | 6841 |
| 1982 | 0.30 | 0.54 | 4.38 | 3.60 | 7049 |
| 1983 | 0.30 | 0.91 | 3.60 | 4.67 | 7283 |
| 1984 | 0.34 | 0.88 | 4.36 | 4.78 | 7869 |
| 1985 | 0.55 | 0.85 | 5.06 | 5.19 | 8208 |
| 1986 | 0.50 | 0.62 | 4.67 | 6.17 | 8424 |
| 1987 | 0.33 | 0.61 | 3.87 | 5.59 | 8420 |
| 1988 | 0.45 | 0.55 | 4.23 | 5.88 | 8608 |
| 1989 | 0.55 | 0.64 | 3.55 | 5.47 | 8481 |
| 1990 | 0.45 | 0.61 | 2.64 | 5.14 | 8398 |
| 1991 | 0.37 | 0.69 | 1.99 | 5.35 | 8311 |
| 1992 | 0.40 | 0.86 | 2.43 | 5.53 | 8227 |
| 1993 | 0.46 | 0.52 | 3.03 | 4.98 | 8246 |

*Source*: own calculations based on *Employment Survey* data

## Table 2: Regression results for entry rate

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| *Dependent variable:* | $Y_{jit}$ | $\Delta Y_{jit}$ | $Y_{jit}$ | $\Delta Y_{jit}$ |
| | | | | |
| tax_change_78 | 0.0772*** | 0.0421** | 0.0395** | 0.0730*** |
| | (0.0183) | (0.0186) | (0.0173) | (0.0276) |
| tax_change_81 | 0.00483 | -0.0199 | -0.0233* | 0.0767*** |
| | (0.00919) | (0.0218) | (0.0134) | (0.0243) |
| foreign * tax_change_78 | -0.0208* | -0.0240 | | |
| | (0.0115) | (0.0155) | | |
| foreign * tax_change_81 | -0.00681 | -0.0154 | | |
| | (0.00887) | (0.0133) | | |
| us * tax_change_78 | | | 7.99e-05 | -0.0203 |
| | | | (0.0241) | (0.0233) |
| uk * tax_change_78 | | | -0.0224 | -0.0104 |
| | | | (0.0167) | (0.0148) |
| germany * tax_change_78 | | | -0.0483** | -0.0544*** |
| | | | (0.0208) | (0.0176) |
| row * tax_change_78 | | | -0.0413*** | -0.0432** |
| | | | (0.0157) | (0.0206) |
| us * tax_change_81 | | | -0.0231* | -0.0112 |
| | | | (0.0122) | (0.0149) |
| uk * tax_change_81 | | | -0.0149* | 0.00155 |
| | | | (0.00804) | (0.0137) |
| germany * tax_change_81 | | | -0.0292* | -0.0220* |
| | | | (0.0160) | (0.0118) |
| row * tax_change_81 | | | -0.0265** | -0.0319** |
| | | | (0.0133) | (0.0144) |
| Foreign | -0.00985* | 0.0169** | | |
| | (0.00503) | (0.00668) | | |
| US | | | -0.00603 | 0.0117 |
| | | | (0.0100) | (0.0113) |
| UK | | | -0.0194*** | 0.00562 |
| | | | (0.00682) | (0.00813) |
| Germany | | | -0.00789 | 0.0292*** |
| | | | (0.0137) | (0.00741) |
| RoW | | | 0.00804 | 0.0272*** |
| | | | (0.0103) | (0.00941) |
| $\bar{Y}_{ijt}$ | 0.253*** | -0.0362 | 0.237*** | 0.00896 |
| | (0.0231) | (0.0505) | (0.0236) | (0.0192) |
| Observations | 1,900 | 1,898 | 3,361 | 3,335 |
| R-squared | 0.234 | 0.051 | 0.148 | 0.022 |

Regression includes year and three digit industry dummies and a constant
*Y* is entry rate for three-digit sector level and plant group *i*.
Robust standard errors clustered at three digit industry– plant group level in parentheses
** significant at 5%; *** significant at 1%

**Table 3: Distribution of nationality of ownership**

| Owner Nationality | Percent of observations |
|---|---|
| UK | 39.24 |
| US | 25.33 |
| Germany | 11.93 |
| Netherlands | 5.07 |
| France | 3.93 |
| Switzerland | 2.66 |
| Sweden | 1.97 |
| Canada | 1.52 |
| Denmark | 1.38 |
| Italy | 1.20 |
| Japan | 1.20 |
| Belgium | 1.08 |
| Rest | 3.49 |
| Total | 100.00 |

*Source*: *Forfas Employment Survey, data for 1973 - 1984*

**Table 4: Regression results for plant level probability of exit**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | *all* | *all* | MES = 0 | MES = 1 |
| *Dependent variable:* | $exit_{kit}$ | $exit_{kit}$ | $exit_{kit}$ | $exit_{kit}$ |
| | | | | |
| tax_change_78 | 0.151*** | 0.151*** | 0.166*** | 0.127** |
| | (0.0004) | (0.0377) | (0.0552) | (0.0499) |
| tax_change_81 | 0.152*** | 0.152*** | 0.157*** | 0.144*** |
| | (0.0272) | (0.0273) | (0.0385) | (0.0389) |
| foreign * tax_change_78 | -0.00279 | | | |
| | (0.00275) | | | |
| foreign * tax_change_81 | -0.00421** | | | |
| | (0.00208) | | | |
| us * tax_change_78 | | -1.60e-05 | -0.000899 | 0.000597 |
| | | (0.00700) | (0.00986) | (0.00908) |
| uk * tax_change_78 | | 0.00102 | -0.00440 | 0.00785 |
| | | (0.00444) | (0.00478) | (0.00787) |
| germany * tax_change_78 | | -0.00938** | -0.0103** | -0.00741 |
| | | (0.00422) | (0.00514) | (0.00658) |
| row * tax_change_78 | | -0.00273 | -3.11e-05 | -0.00530 |
| | | (0.00641) | (0.00957) | (0.00792) |
| us * tax_change_81 | | -0.00211 | 0.00513 | -0.00672 |
| | | (0.00512) | (0.0104) | (0.00442) |
| uk * tax_change_81 | | -0.00283 | -0.00287 | -0.00255 |
| | | (0.00310) | (0.00428) | (0.00415) |
| germany * tax_change_81 | | -0.00713* | -0.00485 | -0.00871** |
| | | (0.00412) | (0.00681) | (0.00411) |
| row * tax_change_81 | | 0.00300 | 0.00538 | 0.00198 |
| | | (0.00650) | (0.00962) | (0.00906) |
| Foreign | 0.0126*** | | | |
| | (0.00284) | | | |
| US | | 0.00211 | 9.12e-05 | 0.00450 |
| | | (0.00505) | (0.00655) | (0.00738) |
| UK | | 0.0211*** | 0.0264*** | 0.0148*** |
| | | (0.00454) | (0.00674) | (0.00560) |
| Germany | | 0.0174** | 0.0167 | 0.0178 |
| | | (0.00806) | (0.0105) | (0.0119) |
| RoW | | -0.00102 | 0.00324 | -0.00512 |
| | | (0.00434) | (0.00674) | (0.00499) |
| $\bar{Y}_{ijt}$ | -0.00215*** | -0.00237*** | -0.00127*** | -0.00402*** |
| | (0.000366) | (0.000379) | (0.000458) | (0.000636) |
| Observations | 58,896 | 58,896 | 38,770 | 20,126 |

Regression includes year and three digit industry dummies and a constant
Dependent variable is dummy = 1 if plant *k* exits
Robust standard errors clustered at three digit industry– plant group level in parentheses
** significant at 5%; *** significant at 1%

**Table 5: Regression results for plant level probability of exit, 1990**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | *All* | *all* | MES = 0 | MES = 1 |
| | | | | |
| tax_change | 0.304*** | 0.336*** | 0.356*** | 0.283*** |
| | (0.0637) | (0.0659) | (0.0923) | (0.0917) |
| foreign * tax_change | -0.00524 | | | |
| | (0.00406) | | | |
| us * tax_change | | -0.00256 | -0.00797 | 0.00524 |
| | | (0.00804) | (0.0106) | (0.0122) |
| uk * tax_change | | -0.0112** | -0.0223*** | 0.00318 |
| | | (0.00563) | (0.00540) | (0.0102) |
| germany * tax_change | | -0.00350 | -0.0277*** | 0.0355 |
| | | (0.0105) | (0.00514) | (0.0253) |
| row * tax_change | | 0.00704 | -0.0186** | 0.0394** |
| | | (0.00983) | (0.00781) | (0.0190) |
| Foreign | 0.0136*** | | | |
| | (0.00220) | | | |
| US | | 0.000530 | 0.000345 | 0.00100 |
| | | (0.00347) | (0.00525) | (0.00432) |
| UK | | 0.0307*** | 0.0434*** | 0.0188*** |
| | | (0.00390) | (0.00630) | (0.00441) |
| Germany | | 0.00765 | 0.0104 | 0.00426 |
| | | (0.00496) | (0.00728) | (0.00625) |
| RoW | | 0.00367 | 0.0130** | -0.00296 |
| | | (0.00333) | (0.00574) | (0.00354) |
| $\bar{Y}_{ijt}$ | -0.00565*** | -0.00545*** | -0.00424*** | -0.00716*** |
| | (0.000438) | (0.000437) | (0.000560) | (0.000675) |
| Observations | 105,829 | 105,829 | 69,469 | 36,360 |

Regression includes year and three digit industry dummies and a constant
Dependent variable is dummy = 1 if plant *k* exits
Robust standard errors clustered at three digit industry– plant group level in parentheses
** significant at 5%; *** significant at 1%

**Table 6: Regression results for the intensive margin (employment growth)**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | *All* | *all* | MES = 0 | MES = 1 |
| *Dependent variable:* | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ |
| | | | | |
| tax_change_78 | 0.00568 | 0.00572 | 0.00403 | -0.0639*** |
| | (0.00681) | (0.00680) | (0.00852) | (0.0115) |
| tax_change_81 | -0.0933*** | -0.0930*** | -0.0923*** | -0.109*** |
| | (0.00694) | (0.00693) | (0.00870) | (0.0115) |
| foreign * tax_change_78 | -0.0530*** | | | |
| | (0.0115) | | | |
| foreign * tax_change_81 | -0.117*** | | | |
| | (0.0102) | | | |
| us * tax_change_78 | | -0.0813*** | -0.0871*** | -0.0748** |
| | | (0.0223) | (0.0335) | (0.0299) |
| uk * tax_change_78 | | -0.0163 | -0.0371 | 0.00239 |
| | | (0.0176) | (0.0258) | (0.0241) |
| germany * tax_change_78 | | -0.114*** | -0.119*** | -0.102** |
| | | (0.0308) | (0.0416) | (0.0457) |
| row * tax_change_78 | | -0.0738*** | -0.128*** | -0.0294 |
| | | (0.0222) | (0.0336) | (0.0296) |
| us * tax_change_81 | | -0.229*** | -0.200*** | -0.242*** |
| | | (0.0196) | (0.0297) | (0.0263) |
| uk * tax_change_81 | | -0.0207 | -0.0497** | 0.00399 |
| | | (0.0156) | (0.0236) | (0.0209) |
| germany * tax_change_81 | | -0.161*** | -0.158*** | -0.159*** |
| | | (0.0277) | (0.0394) | (0.0388) |
| row * tax_change_81 | | -0.138*** | -0.170*** | -0.110*** |
| | | (0.0193) | (0.0301) | (0.0252) |
| $\bar{Y}_{ijt}$ | 0.0470*** | 0.0512*** | 0.0709*** | 0.0145* |
| | (0.00527) | (0.00529) | (0.00663) | (0.00879) |
| Observations | 54,968 | 54,968 | 35,808 | 19,160 |
| R-squared | 0.023 | 0.025 | 0.024 | 0.029 |

Regression includes year and plant fixed effects and a constant
*Y* is employment in plant *k*.
Foreign ownership dummies are time invariant and dropped due to plant specific effects
Robust standard errors in parentheses
** significant at 5%; *** significant at 1%

**Table 7: Regression results for the intensive margin (employment growth), 1990**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| *Dependent variable:* | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ | $\Delta Y_{jit}$ |
| | All | All | MES = 0 | MES = 1 |
| tax_change | -0.00209 | -0.00186 | 0.00336 | -0.112*** |
| | (0.00773) | (0.00773) | (0.00962) | (0.0129) |
| foreign * tax_change | -0.0467*** | | | |
| | (0.00863) | | | |
| us * tax_change | | -0.0851*** | -0.0803*** | -0.0873*** |
| | | (0.0141) | (0.0214) | (0.0189) |
| uk * tax_change | | -0.00377 | -0.000829 | -0.00924 |
| | | (0.0164) | (0.0262) | (0.0212) |
| germany * tax_change | | -0.0507** | -0.0408 | -0.0577* |
| | | (0.0214) | (0.0299) | (0.0306) |
| row * tax_change | | -0.0365** | -0.0255 | -0.0441** |
| | | (0.0154) | (0.0247) | (0.0199) |
| $\bar{Y}_{ijt}$ | 0.0120** | 0.0144*** | 0.0249*** | -0.00193 |
| | (0.00520) | (0.00525) | (0.00674) | (0.00836) |
| Observations | 93,531 | 93,531 | 60,962 | 32,569 |
| R-squared | 0.017 | 0.017 | 0.017 | 0.021 |

Regression includes year and plant fixed effects and a constant
$Y$ is employment in plant $k$.
Foreign ownership dummies are time invariant and dropped due to plant specific effects
Robust standard errors in parentheses
** significant at 5%; *** significant at 1%