Abstract

This paper contributes to trade and growth debate by decomposing and analysing the channels through which trade liberalization is expected to affect productivity growth at the firm level. We use a very rich plant-level dataset covering the period of before and after NAFTA was implemented (1993 to 2000). Our econometric approach estimates the productivity impact of import tariff reduction within NAFTA. Combining this approach with a difference-in-difference (DID) estimator allow us to capture an explicit econometric relationship between trade policy, economic integration and economic performance. Our results show that the reduction in import tariffs within NAFTA contributed to cumulative increase of 8 percent in labour productivity. The DID estimator shows that firms that were integrated with international markets prior to NAFTA and remained within that category throughout the period of analysis outperformed labour productivity growth in non-integrated firms by 20 percent per year.

Keywords: Firm-level productivity, Trade Reforms, Difference-in-Difference, Mexico
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1 Introduction

In the last two decades most developing countries, and in particular Latin American ones, have redefined their development strategies, moving away from import-substitution regimes towards policies promoting exports and FDI, i.e. global economic integration. This important shift has been accompanied by an intense academic debate analysing the relationship between the degree of global economic integration and domestic growth. Despite the general presumption about the positive impact from the former to the latter, the empirical evidence has failed to produce a definitive answer (Winters 2004, Baldwin 2000).

This paper contributes to this debate by deploying an appropriate approach to disentangle the various channels through which integration can affect economic performance in general and firm level productivity in particular. Our empirical analysis is based on Mexican firm level data (EIA) covering a period of economic integration with the US and Canada under NAFTA (1993-2000). Mexico provides an exemplary case study because of the nature and depth of its reforms and the degree of integration under the agreement. At this point, it must be stressed that we are interested in measuring the productivity impact of a process of economic integration that goes beyond a simple tariff reduction scheme, encompassing a set of institutional rules within which foreign trade and investment take place.

The present study is related to various strands of literature. The pioneer study by Roberts and Tybout (1996) analysed the firm and plant-level evolution of productivity dynamics in response to trade reforms and economic integration. More recently, the interest moved towards the identification of the different channels and mechanisms behind the impact of trade reforms on productivity (Aghion, Burgess, Redding, and Zilibotti 2004, Girma, Greenaway, and Kneller 2004, Pavcnik 2002, Tybout 2001). Our research also draws on the lessons learnt from the industrial organisation literature examining the impact of increased competition on industry dynamics (Olley and Pakes 1996). Finally, the present study explicitly builds on the recent theoretical literature on trade and Schumpeterian growth models with heterogeneous firms. These studies provide the theoretical underpinnings for understanding the mechanisms through which economic integration affects productivity dynamics at firm-level and their basic postulates and findings will be discussed more in details in section 2.

Based on the lessons learnt from the literature, the present study builds a conceptual framework to analyse the relationship between economic integration and firm-level productivity. This framework distinguishes four transmission mechanisms linking integration and productivity: (1) competition, (2) intermediate inputs, (3) exports and (4) FDI. We make use of a difference-in-difference estimation capturing the productivity growth differentials between integrated and non-integrated firms. We allow for a heterogeneous productivity impact between firms with different integration status: firms importing inputs, firms exporting final outputs and firms which are, importing inputs and exporting final produce, i.e. fully integrated. We find that NAFTA had a positive impact on firms productivity, in particular, our results show that the intermediate input and competition channels had the strongest impact. Although data restrictions do not permit a detail analysis of the FDI-productivity channel, we find evidence supporting a productivity premia associated with foreign participation/ownership.

The paper is organized as follows. Section 2 briefly develops the theoretical framework describing the different trade-productivity transmission channels. The data used for the empirical analysis as well as some descriptive statistics are presented in Section 3. Section 4 describes our econometric approach and shows the results of various specifications, this section also discusses potential endogeneity and selection problems as well as the difficulties to isolate the impact of NAFTA from the Peso devaluation of 1994. Finally, section 5 concludes.

2 Theoretical Background: Trade-Productivity Linkages

Economic theory predicts that trade reforms can affect firm level productivity through several channels. In this section we will describe these channels and set the basis for the theoretical framework that will guide our empirical analysis (see Figure 1). We must notice that there is not a unique and well defined model that we can make use of, but a number of different approaches aimed at capturing different mechanisms through which economic integration can impact firms’ performance.
2.1 Competition Channel

Trade liberalisation and tariff reductions are expected to increase the competitive pressures to which domestic firms are exposed to. This effect is expected to be stronger for import competing firms and import-competing sectors than for export oriented ones, however in a world of differentiated products and intra-industry trade, firms can be simultaneously import-competing and exporting.

The first studies to formally explore this argument and relate the increase of the competitive pressures to an improvement of intra-firm efficiency were Martin and Page (1983) and Martin (1978). These authors argued that an increase in competitive pressures would reduce the “X-inefficiency”, defined as the gap between the actual productivity and the maximum productivity achievable (Leibenstein 1966, Leibenstein 1978). The basic intuition behind their argument is that the efficiency of a firm is, ceteris paribus, a positive function of the managers’ efforts and this, in turn, is triggered by the exposure to foreign competitors. However this argument rest on a number of assumptions that are far from innocuous as critically discussed by Corden (1997).

Furthermore, increased competition can have an impact on firms’ productivity through its effect on size and size distribution; in fact, traditional trade models with homogeneous goods and identical firms assume that scale effects are the principal drivers of
productivity changes after trade liberalising reforms are implemented. Thus allowing firms to be heterogeneous, the import competing channel can drive changes in aggregate economic performance not only through “internal” restructuring but also through the “external” effect such as the market exit of less productive firms (Disney, Haskel, and Heden 2003). This is shown clearly in Melitz and Ottaviano’s (2003) model where the increased competition leads to an increase in the price elasticity of demand and pushes markups downward forcing less efficient firms to exit. At the same time the more efficient firms are pushed into export markets allowing them to expand their weight.

“...exposure to trade thus generates a type of Darwinian evolution within an industry...the most efficient firms thrive and grow - they export and increase both their market share and profits. Some less efficient firms still export and increase their market share but incur a profit loss. Some even less efficient firms remain in the industry but do not export and incur losses of both market share and profit. Finally, the least efficient firms are driven out of the industry.” (Melitz 2003)

2.2 Intermediate Inputs Channel

Economic theory suggests that liberalisation of intermediate inputs will increase productivity levels of domestic firms due to an expansion in the menu of available intermediate inputs. This allows individual producers to match more appropriately their technology or product characteristics with the intermediate input used (Feenstra and al. 1999). Another line of thought, linked to the endogenous growth models, suggests that the import of “tangible commodities facilitate the exchange of intangible ideas” (Grossman and Helpman 1991a, Grossman and Helpman 1991b). This model emphasises the learning effects of imports of intermediate inputs as a mechanism through which trade will impact productivity growth.

In Bernard, Eaton, Jenson, and Kortum’s (2003) model the impact of trade reforms on productivity is given via a reduction in the price of intermediates inputs (i.e. cheaper

\[ \text{Formally, economic theory provides us with models where specialised inputs are characterised by increasing returns (i.e. high initial capital and learning costs) and consequently the degree of differentiation is limited by the size of the market. In this model, the liberalisation of intermediate inputs will increase the varieties of available inputs, some of them more specialised and closer in terms of complementarity to the domestic ones.} \]

\[ \text{A formal test that would allow us to discriminate between the varieties versus learning effects hypothesis goes beyond the scope of the present paper.} \]
imported inputs replace domestic ones). In this case all firms benefit from the intermediate inputs price reduction but, more productive firms, that expand more on the export markets, tend to benefit relatively more than others. Therefore relatively more productive firms can expand their market share, resulting in a positive impact on aggregate productivity.

All the three models outlined here predict an increase in firm-level productivity as a result of trade integration because of an expanded access to imported intermediate inputs.

### 2.3 Exports Channel

The economic literature also suggests that the expansion of exports could work as another channel explaining the positive influence of economic integration on economic performance. However the notion that firms improve their productivity by exporting has been at the centre of a strong empirical debate. Various theoretical models predict only one way causality or the existence of a process of self selection into exporting: just more productive firms enter into export markets (Bernard, Eaton, Jenson, and Kortum 2003, Verhoogen 2004, Melitz 2003), and the higher their productivity the more export markets they will be able to serve (Eaton, Kortum, and Kramarz 2004). These predictions depend crucially on the assumption that entering into foreign markets requires incurring into a fixed cost that only larger and more productive firms can afford. Such assumption has been tested and found to be consistent with firm-level data in various empirical studies (Roberts and Tybout 1997, Bernard and Jensen 2004).

Nevertheless, the idea that firms will increase their productivity by means of exports has found some theoretical basis and cannot be dismissed a-priori. Indeed, the self-selection hypothesis is not at odds with the hypothesis that exporting is a channel for productivity growth. Grossman and Helpman (1991a) and Grossman and Helpman (1991b) assume that domestic entrepreneurs enlarge the stock of domestic knowledge by increasing their contacts with foreign buyers. Similarly, Fernandes and Isgut (2005), departing from Arrow’s (1962) learning-by-exporting model show that exporting activities have some learning externalities that decrease through time and increase with the level of exports. Finally, at least two other hypotheses have been explored to explain productivity improvements as a consequence of exports expansion. First, by having access to foreign markets, a firm can exploit economies of scale and is able to absorb better the negative shocks deriving from a contraction in domestic demand. Second, if the foreign markets are characterised by a higher degree of competition than domestic markets, it could be the case that exporters will be put under higher competitive
pressures than non-exporters, therefore, increasing their incentives to innovate and be more efficient in order to survive. If the outlined mechanisms are true, exporting firms would exhibit higher long term productivity growth than non-integrated firms (Wagner 2002).

As we have seen in this section, economic theory identifies different channels of transmission between trade reforms and productivity at the firm level. If these transmission mechanisms are at work, then post-reform firm productivity performance will be a function of the firm’s integration status. In other words, the productivity path followed by integrated firms will differ, ceteris paribus, from their non-integrated counterparts. Furthermore, given the nature of the trade-productivity linkages, we would expect a heterogeneous post-reform productivity growth pattern even among integrated firms. For example, firms that are only exporting will bear directly the effects of the exports channel without experiencing, at least not directly, the positive effects of the other linkages. A similar argument can be said about firms which are only importing, in which case the intermediate inputs channel is at work. Conversely, productivity performance of fully integrated firms, i.e. those which are exporters of final goods and importers of intermediate inputs, will experience the effect of both the intermediate and exports channels as a consequence of the reform. To try to capture the different channels of transmission, in the following sections we will analyse the data categorizing firms into one of four groups based on their integration status: fully integrated, just exporters, just importers and non-integrated firms.

3 Descriptive Analysis

3.1 Macroeconomic Overview: NAFTA and the Devaluation

The present study covers the period 1993 to 2000, a time characterized by major changes in the Mexican economy. In January 1994, the North American Free Trade Agreement (NAFTA), a trilateral treaty between Canada, Mexico and the US was enacted. In December of that same year, as a consequence of a balance of payment crisis, the Mexican Peso lost more than 60 percent of its value in terms of US dollars. This was the starting point of a profound economic crisis where GDP contracted by more than 8 percent and inflation passed from an annual rate of 7 percent in 1994 to 41 percent in 1995. The huge devaluation together with the contraction of the

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4Although FDI is part of our theoretical framework, we did not discussed it in detailed. The data set used in the present study (EIA) identifies the ownership status for only one year (1994), hence the link between FDI and productivity was left out of our empirical analysis.
domestic market stimulated exports of Mexican produce. As we can see from Figure 2, between 1994 and 1996, the importance of international trade in the Mexican economy (measured as the ratio of exports plus imports to GDP) almost doubled, passing from a pre-crisis/NAFTA level of 38 percent to 63 percent in 1996. From the export side, this boom during the period 1994-2000, was lead by manufacturing exports which accounted for 95 percent of total exports.

![Degree of Openness Diagram](image)

Figure 2: Mexico - Economic Integration (Source: Nicita 2004)

Some important elements emerge from Figure 2. First, the process of trade liberalisation in Mexico started since the 1980s. When trade liberalisation is measured as the reductions in tariffs, the most important part of the reforms were undertaken during the second half of the 80s (Durn, Peters, and Taniura 1997, Peters 2000). A second interesting point, is that the response of the economy to this first wave of liberalisation was rather slow with trade volumes showing a modest increase after large tariff reductions. On the other hand, the relatively small reduction in tariffs observed after NAFTA was followed by a substantial increase in the importance of trade volumes in the Mexican economy. These facts and the massive devaluation of the Mexican Peso months after NAFTA was enacted make us think that the Mexican economy increased substantially its degree of economic integration with the global markets (primarily the US market) as a combination of NAFTA and the Peso devaluation. In other words, the Peso devaluation pushed firms into the foreign markets which were opened via the
window of NAFTA; once many of the Mexican manufacturers underwent the sunk costs of entering the foreign markets, they remain integrated despite the revaluation of the Mexico Peso during the late 1990s. This could explain why we observe a sudden discontinuity in the degree of integration after the devaluation that is not reversed when the real exchange rate revalued. A second complementary explanation behind the pattern followed by openness is that NAFTA implied much more than a tariff reduction scheme, involving deep regulatory and institutional changes, representing a successful case of deep integration.\footnote{By means of an explicit econometric model linking tariff reduction and household real income, De Hoyos (2005) finds that measuring NAFTA just as the reduction in tariff brought about by the agreement would lead to the conclusion that the agreement had almost no impact on real incomes in the economy.}

3.2 Sectoral Asymmetries

To see how the post NAFTA/devaluation affected performance of Mexican Manufacturing firms, we use firm-level data from the Annual Industrial Survey (EIA) covering the period 1993 to 2000. EIA surveys more than 5,000 firms covering 85 per cent of total industrial production. The survey provides plant level information on characteristics like number of employees, hours worked, wages, value of production and sales, exports, value of intermediate inputs, inventories, investment, etc. (for more details see Iacovone 2007).

As we mentioned before, following the theoretical considerations discussed in section\footnote{Notice that this is not entirely true, indeed, for non-integrated firms to be completely isolated from direct linkages with foreign markets they would have to be part of a sector which does not suffers from import-competition and at the same time it is not receiving FDI. However, even using detailed data such as EIA, it is impossible to define if and to what degree a firm is “import-competing” using firm level data as both trade data and tariffs are typically set and reported at sectoral and not firm-level. Therefore we can identify import-competing sectors and firms belonging to them. Hence the import competition channel will have an effect upon both integrated and non-integrated firms according to...} we will allocate firms into one of the following four mutually exclusive integration status groups: (1) exporters, (2) importers, (3) fully integrated and (4) non-integrated firms. The first group consists of firms that are exporting into the foreign markets without importing intermediate goods; the second group is made up of firms which their only link with the global markets is via the imports of intermediate inputs. The third group encloses all those firms that sell at least part of their final produce in the foreign markets whilst importing at least part of their intermediate inputs; finally the last group is formed by firms which do not have a direct link with the foreign markets.\footnote{Notice that this is not entirely true, indeed, for non-integrated firms to be completely isolated from direct linkages with foreign markets they would have to be part of a sector which does not suffers from import-competition and at the same time it is not receiving FDI. However, even using detailed data such as EIA, it is impossible to define if and to what degree a firm is “import-competing” using firm level data as both trade data and tariffs are typically set and reported at sectoral and not firm-level. Therefore we can identify import-competing sectors and firms belonging to them. Hence the import competition channel will have an effect upon both integrated and non-integrated firms according to...}
Figures 3 and 4 show the differences in firm size and sector of production by integration status for a given year (1997). We can see that the majority of Mexican manufacturing firms are non-integrated firms, predominantly micro or small plants. Non-integrated firms tend to have an important presence in all manufacturing sectors with a relative reduced number of them in the “Chemical Products” and “Basic Metal” (see Figure 4). Comparing just integrated (exporter, importer or fully integrated) with non-integrated firms, the asymmetry in size between the two is remarkable with integrated firms having an average size six times larger than non-integrated firms.

Figure 3: Size Distribution by Integration Status

Regarding exporters, we observe that these firms are somehow different from other integrated plants (importers or fully integrated). In fact, exporters tend to be located in sectors similar to the non-integrated firms like “Food, Beverages and Tobacco” and “Textiles, Garments and Leather” (see Figure 4). Although exporters are, on average, slightly larger than non-integrated firms, these firms are primarily medium to small ones (see Figure 3). Exporting plants which buy all inputs from Mexico are closer to non-integrated firms in terms of sales, wages and labour productivity.

our definition. Nonetheless, a-priori, trade reform will have a smaller impact upon non-integrated firms relatively to integrated firms.

7Micro firms are defined as plants with less than 16 employees; small plants have between 16 and 100 employees.

8Medium firms are defined as firms with more than 100 but less than 250 employees.
Importers appear to be an interesting type of firms because, although they do not export at all, their average characteristics are close to the fully integrated plants. Their level of total sales doubles that of non-integrated firms with an average productivity 1/3 higher than firms that do not have a direct link with global markets. Firms importing intermediate inputs tend to be located in sectors producing “Machinery and Equipment” and “Chemical Products” (see Figure 4). Their average size is larger than exporting firms, though still smaller than the fully integrated firms (see Figure 3).

Finally, the fully integrated firms or firms that simultaneously export and make use of imported intermediate inputs are the largest ones with virtually no micro firms being part of this category. As we can see from Figures 3 and 4, the fully integrated group agglomerates large firms, plants with more than 250 employees, specialised mainly in two sectors: “Machinery and Equipment” and “Chemical Products”. Fully integrated firms tend to be localized in the same sectors of specialisation as the importing firms, suggesting a strong linkage between these two groups of firms. The linkage between fully integrated and importers could be explained by several reasons. For instance, increasing integration with the US economy may have transformed importers into suppliers of intermediates goods for fully integrated firms. In a sense, many of the importing firms may be “indirectly” exporting because they provide high-quality inputs to fully integrated firms. Unfortunately, we have no data to test formally this hypothesis, however the sectoral patterns of specialisation of these two types of firms provides informal evidence in support of this hypothesis.
3.3 Trade Shock, Integration Status and Labour Productivity

In this part of Section 3 we describe the changes in firm-level productivity that took place during a period of deep integration. As we mentioned above, integration was mainly brought about by a combination of NAFTA and the Peso devaluation. We have also shown that non integrated and exporting firms tend to be smaller than importing and fully integrated ones.

To explore how the patterns of integration might be correlated with firm size, in Figure 5 we show the time trend in the proportion of integrated firms (all three integration status groups) and their average size (measured as total employees). We can see that the proportion of integrated firms increased steadily from 1993 to 1997 (continuous line). On the other hand, apart from the change occurring between 1993 and 1995, the average size of integrated firms increased throughout the period. It is interesting to notice that the year 1994 is the only time when NAFTA was at work in the absence of a devaluation effect.\(^9\) Between 1993 and 1994 the average size of integrated firms remained constant while the proportion of integrated firms increased, therefore NAFTA (in the absence of a devaluation) helped relatively small firms to incorporate into the global markets. After 1995, when the devaluation effect was very strong, even smaller firms were pushed into the global markets, hence explaining the increase in the proportion of integrated firms and a reduction in their average size. After 1995, the changes in the distribution of size among integrated firms in the market can be attributable to a combination of NAFTA and the Peso devaluation.\(^{10}\) The simultaneity of these two events resulted in an expansion of integrated firms but this time the small ones (many of the exporters and to a lesser extent the importers) were not able to survive the crises, therefore the average size of the integrated firms increased. This increase in the average size among integrated firms after the trade reforms is consistent with trade model à la Melitz (Melitz 2003, Bernard, Redding, and Schott 2004, Melitz and Ottaviano 2003).

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\(^{9}\)Given that the Peso crisis took place on the 20th of December 1994, the devaluation’s effect is not captured by the data from year 1994.

\(^{10}\)The 1990s growth in the US economy may also be playing an important role in explaining the export boom during this period.
Figure 6 shows the performance in value added labour productivity per hour by integration status. Between 1993 and 1994 (the period of NAFTA without a Peso devaluation), average productivity in all integrated groups rose, with the fully integrated firms benefiting the most. After the Peso devaluation and until 1996 labour productivity of integrated and non-integrated firms decreased with the non-integrated firms experiencing the largest negative shock. Between 1996 and 2000, all integrated firms experienced a reduction in labour productivity as opposed to the non-integrated firms which were catching up. This is strong evidence suggesting that the post NAFTA/devaluation trade expansion had asymmetric effects on integrated and non-integrated firms, specially in terms of their productivity performance.
This section showed that there is a great degree of heterogeneity in size, sector of specialization and productivity between firms with different integration status. Exporting firms are similar in size to non-integrated firms although their level of labour productivity is higher with a level closer to the one exhibit by importing firms. Descriptive statistics also show that importers as well as fully integrated firms are concentrated in two capital intensive sectors: “Machinery and Equipment” and “Chemical Products”. Finally, the time trend in labour productivity showed that NAFTA marked a turning point in productivity performance between firms with different integration status.

The rest of the paper tries to find out how much of the differential in labour productivity trends between firms with different integration status can be attributable to the increase in trade integration observed between 1993 and 2000. In our empirical strategy we take 1993 as the base year (period before NAFTA), compare the productivity growth rate between integrated and non-integrated firms (allowing for heterogeneous effects across integration status) and attribute these difference to the reform. Since many other things can be influencing the productivity growth rates differentials, a formal econometric analysis is needed to control for observable and unobservable variables potentially influencing the patterns observed in Figure 6.

4 Empirical Strategy

In this section we formally evaluate the impact of NAFTA on firm level productivity. There are two possible approaches that we could have followed to disentangle the relationship between trade integration and firm-level productivity: (1) link tariff reduction with firm-level productivity whilst controlling for other possible effects, and (2) compare the differential in productivity growth rate between integrated and non-integrated firms before and after the reform controlling for observables and unobservable fixed effects. Both approaches have their advantages and limitations, hence in this study, we combine both of them in order to identify separately all the channels discussed in section 2.

Identifying the impact of trade reforms exploiting tariff reduction has one important advantage but also some serious drawbacks. On the positive side, this approach is able to isolate neatly the impact of an important element of trade reform like tariffs reduction from all other trade-related exogenous shocks (e.g. learning from integration). However, this advantage can be the source of its weakness. If we believe that trade reforms involve much more than just a reduction in tariff rates, focusing solely in tariff
variation would lead to an *under-estimation* of trade reforms’ impact.\textsuperscript{11} This appears to be a very important issue in the case of NAFTA where, as discussed in section 3, the changes in tariff rates were relatively modest. Instead, as it is argued in Kose, Meredith, and Towe (2004) and Lederman, Maloney, and Serven (2003), the major changes introduced by NAFTA took the form of new rules and institutions to promote integration among the trade partners.\textsuperscript{12}

Exploiting tariff reduction to identify the productivity impact of trade reform introduces a further technical problem involving the identification of tariff’s impact on intermediate inputs. In order to identify this link, we would need information on firm-specific inputs used and their correspondent tariff rate. In the absence of detailed information on the specific intermediate inputs used at firm-level, previous studies have assumed that firms within a sector are identical in terms of inputs shares and hence derive the inputs shares from existing input-output matrices, imposing. This last element makes the tariff changes strategy a highly restrictive one.\textsuperscript{13}

Although it is virtually impossible to identify NAFTA’s full productivity impact by focusing only on tariff variation, the information contained in the post-reform reduction in import tariffs is enough to identify the reform’s effect via the import-competing channel. As it was mentioned in Section 2.1, controlling for everything else, a reduction in import tariffs should increase domestic competition and hence boost labour productivity. The present study uses tariff variation to identify the link between NAFTA and labour productivity via the import-competing channel, nevertheless, we complement this approach with a semi-experimental one that is able identify all other trade-productivity channels discussed in Section 2.

\textsuperscript{11}During personal interviews conducted by the authors with academics and policy makers in Mexico, the argument that NAFTA’s changes were much larger than those that could be measured by the change in tariffs came out as a consensus.

\textsuperscript{12}An argument supporting the tariff reduction approach would state that a small tariff change that is perceived as permanent can have a larger impact than a larger change that is perceived as unstable. The “bilateral nature” of NAFTA made the tariff change much more credible than the unilateral tariff liberalisation that took place during the second half of 80s. Further, NAFTA is considered by some scholars “as a way of locking in previous policy reforms” (Tomz 1997, Whalley 1993). Therefore one can argue that the reduction in trade barriers could serve as a proxy for the legal and institutional change, nevertheless, the nature of the exact relationship between changes in tariffs and changes in institutions is not clearly defined.

\textsuperscript{13}Normally input-output matrices are produced for macroeconomic models therefore tend to be highly aggregate, this implies that the assumption about identical inputs shares for firms within the same sector is even more restrictive as sectors are defined in a rather aggregate manner. In addition, because of data limitation, often the researchers need to assume that the input-output shares remain constant over the time (Amiti and Konings 2005), an assumption that is especially implausible during a period of trade reforms.
As discussed in Section 2, theoretical models with heterogeneous firms suggest that trade reforms will impact asymmetrically on different types of firms. We expect integrated firms to be positively affected by the reforms relative to non-integrated firms, moreover the impact within integrated firms could be different depending on the firm’s integrated status. This idea is not only based on theoretical considerations but appears to emerge from the descriptive statistics presented in Section 3 suggesting that plants within different “integration status” show a different productivity evolution over time. Hence the crucial identifying assumption behind the quasi experimental approach adopted in this paper is that the reforms introduced by NAFTA had a different effect between pre-reform integrated and non-integrated firms.

Our strategy builds on the previous work by Pavcnik (2002) and López-Córdova (2003) analysing the impact of trade reforms in Chile and Mexico, respectively. While López-Córdova (2003) exploits tariff variation Pavcnik (2002) uses a quasi experimental approach (i.e. treatment versus control group). The mayor difference between these two closely related studies and the empirical approach followed in this paper are the following:

1. Pavcnik (2002) defined a firm as being integrated when it belonged to a “integrated” sector—at 4 digits of the ISIC classification—regardless of the firms’ integration status. On the contrary, thanks to data availability, in this paper we define the integration status at the firm level.

2. Within integrated firms, our approach allows for a heterogeneous impact of the reform among firms with different integration status, i.e. exporters, importers or fully integrated.

3. Our econometric approach controls for endogeneity in the firm’s integration status and attacks the attrition problem present in the Mexican industrial survey (EIA).

4.1 Econometric Approach

The objective of our empirical strategy is to understand the impact of NAFTA on firm-level productivity. For this purpose we use the value added per unit of hourly labour as productivity index. Our choice is based on the simplicity of this index’s interpretation and transparency. Also, there is a direct link between value added labour productivity and national welfare that makes this index attractive. However, the hourly labour as productivity index has also some drawbacks, the principal of them being that two firms may differ in their value-added labour productivity based solely on differences in their capital intensity rather than in their integration status. To address this issue, in our
regressions we control for the stock of capital per worker.

Let us define $\varphi_{it}$ as the value added per hourly worker in firm $i$ at time $t$, similarly let $X_{ijt}$ be a vector containing a set of firm-level characteristics, as well as industry and location fixed effects $j$; let $\tau_{it}$ be the domestic import tariffs under NAFTA, in other words, $\tau_{it}$ are the tariffs faced by foreign competitors of firm $i$ in time $t$. \(^{14}\) Productivity is assumed to be a function of a constant, time and integration status, the interaction between the former and the latter, import tariffs, the vector with covariates $X_{ijt}$, and a random component $\varepsilon_{it}$:

\[
\varphi_{it} = \alpha + \sum_{t=94}^{2000} \delta_t Time_t + \sum_{s=2}^{4} \beta_s Integration_{it}^s + \sum_{t=94}^{2000} \sum_{s=2}^{4} \delta_{t,s} \cdot Integration_{it}^s \times Time_t + \theta \cdot X_{ijt} + \psi \tau_{it} + \varepsilon_{it} \tag{1}
\]

Where $Time_t$, $t = (1994, \ldots, 2000)$, are year dummies capturing economy-wide macro-economic shocks; $Integration_{it}^s$, $s = (2, 3, 4)$, are a set of binary or indicator variables taking zero/one values depending on the integration status of the firm. The reference category are non-integrated firms during the pre-NAFTA year 1993. The time controls will capture overall trends affecting productivity with respect to the base year, 1993; on the other hand the integration status dummies will pick up the FE differences between firms that are integrated versus non-integrated firms (the excluded category). The interaction term between these two sets of dummy variables is what is known in the literature as the difference-in-difference (DID) estimator and should capture the treatment effect or impact of NAFTA. Finally we must note that all the continuous variables are expressed in logs, therefore the parameters of equation (1) can be interpreted as elasticities.

The flexibility of specification (1) allows the impact of NAFTA to be different across integration status and these effects are allowed to vary over time. The coefficients of interest are the treatment effects $\hat{\delta}_{t,s}$ and, if correctly estimated, they capture the differences in productivity growth between treated (integrated firms) and controls (non-integrated) firms. If trade reforms had a positive effect on the productivity of integrated firms these coefficients should be positive. These changes are always estimated with respect to our base year which is 1993, the year before NAFTA was enacted. Therefore, exploiting the heterogeneous impact introduced by NAFTA (both across firms with different integration status and over time), our coefficients, $\hat{\delta}_{t,s}$, capture the impact of

\(^{14}\) Notice that in the Mexican industrial survey, there is a perfect matching from firms to goods produced, i.e. each firm (as identified by the EIA) produces only one good.
the reforms on productivity separating the various trade-productivity channels without restricting the effect to take place only via tariff reduction.

Figure 7: Graphical Representation of the DID Estimator

A graphical representation of the DID estimator is portrayed in Figure (7). As it was mentioned before, the reference period is 1993, i.e. the year before NAFTA was implemented. The difference in labour productivity between integrated and non-integrated firms before NAFTA was implemented is captured by the integration dummies once firm and industry-level asymmetries are being wiped out by $X_{ijt}$ (two points further left in Figure (7)). The DID estimator attributes the post-NAFTA differences in productivity growth between integrated and non-integrated firms to the reform. Hence the DID estimator is equal to the increase (or decrease) in productivity differentials be-
tween treated and controls with respect to the period before the reform was implemented (i.e., the difference between the continues and upper discontinues lines in Figure 7). Analytically the DID is defined by the following expression:

$$\delta_{DID}^{Int} = \Delta \varphi_{Int} - \Delta \varphi_{NInt} = \text{After} - \text{Before}$$

$$= \left( \varphi_{Int}^{after} - \varphi_{Int}^{before} \right) - \left( \varphi_{NInt}^{after} - \varphi_{NInt}^{before} \right)$$

(2)

The DID approach makes two important assumptions which need to hold in order to properly identify the treatment effect (Wooldridge 2002, Blundell and Costa Dias 2000). The first assumption is that the treatment is not correlated with time-varying unobservables. The second assumption is that the macroeconomic shocks affect all firms in a similar fashion. The time dummies capture economy-wide macroeconomic changes, like the sharp devaluation of the Mexican Peso in December 1994. Intuitively, it is plausible that exchange rate movements will have different impacts on firms with different integration status, hence this could potentially introduce a bias into our treatment estimates. For example, in the very short-run, non-exporting firms that import intermediate inputs will experience a negative shock from the devaluation relative to non-importing ones, and quite the opposite can be said about exporting firms. Assessing the plausibility of these two assumptions is complex and we will discuss this further when presenting our results.

Bearing all the assumptions and limitations in mind, the DID is a powerful tool able to identify the impact of a particular policy on a specific outcome variable. The DID framework captures the impact of policy interventions controlling for firm-specific characteristics that are time-invariant (see equation 2). Therefore, all initial and time-invariant firm characteristics (e.g., quality of managers) that may have influenced the selection of the firm into a specific integration status would not influence our results.

Equation (1) captures separately the impact of each of the channels discussed in section 2. The competition channel is captured by the coefficient on tariffs $\psi$, and we would expect it to be negative as lower tariffs imply higher import competition. The impact of

$^{15}$Formally, as explained by Blundell and Costa Dias (2000), if the macro trends captured by the year dummy impacts asymmetrically “treated” and “non-treated” firms our estimated difference-in-difference coefficients, $\delta_{DID}^{Int}$ recovers not only the effect of the integration-treatment but also the differential effect of the macro-trend across the two groups. Define $\left( k^{int} - k^{Nint} \right)$, consequently it is possible that our estimates may be biased in the following way:

$$\hat{\delta}_{DID}^{Int} = \delta_{Treatment}^{Int} + \left( k^{int} - k^{Nint} \right) (Time_{after} - Time_{before}) / Bias$$
the imports channel is identified by the treatment effect on firms integrated via imports. We would expect this coefficient to be positive because, as a consequence of a process of trade integration, importing firms can expand the range and variety of their inputs at cheaper prices. The exports channel is captured by the treatment effect on firms that are integrated to the international markets via exports. The theory suggests that this coefficient should be positive if firms learn and improve their productivity through exporting. Finally, we also allow for the possibility of synergies between imports and exports channel. This would imply that the gains from trade reforms for firms that are both exporting and making use of imported intermediate inputs (e.g. ‘fully integrated’) are higher than the gains from the being integrated via the imports or exports channels separately. Accordingly, the coefficient capturing the treatment effect of firms that are fully integrated should be positive.

4.2 Results

4.2.1 Naive OLS

As a first estimate, we use all the firms in our sample to ran OLS for two different specifications of equation (1). All the results presented here correct for potential autocorrelation across firms using cluster-robust standard errors. Given the large number of model specifications and coefficients estimated, the detailed results are placed in Table 1 of Appendix A. We start off with a parsimonious version of equation (1) which includes only the treatment effects with no controls (first column in Table 1 of Appendix A). The second specification includes firm-level controls, industry and state fixed-effects, and import tariffs under NAFTA (second column in Table 1 of Appendix A).

Let us first concentrate in the the results for the dummy variables identifying the productivity effects of the three integration status ($\beta_s$ in equation 1). According to our parsimonious specification, in 1993, integrated firms (regardless of their integration status) had an average productivity higher than non-integrated firms. This result contrasts with the parameter estimated from the full specification (second column in Table 1 of Appendix A). Once all control variables are included, it is apparent that the initial integration premium was actually explained by differences in the values of the firm-level characteristics between integrated and non-integrated firms and not by integration per se. Firm characteristics such as size, capital per worker, investment in research and development, and foreign participation determine the initial productivity differential between integrated and non-integrated firms.
Although a firm’s integration status cannot account for initial productivity differentials, it might still explain differences in productivity growth across firms with different integration status, which is our variable of interest. In order to centre our discussion on the coefficients of interest, i.e. the treatment effects, in Figure 8 we plot the evolution of $\hat{\delta}_{t,s}$ over time.\footnote{The coefficients are taken from the full model, i.e. those reported in the second column of Table 1 of Appendix A.} Although we do not report confidence intervals for the plotted coefficients (the significance of the parameters is reported in Table 1 of Appendix A), Figure 8 captures possible time-trends followed by the treatment effects. From Figure 8 and Table 1 of Appendix A we can see that the treatment effects for importer and fully integrated are positive and significantly different from zero in all post-NAFTA years. On the other hand, the effect of NAFTA on productivity growth of exporters was not significantly different from the agreement’s effect on non-integrated firms’ productivity performance (the control group).

**Figure 8: Impact of NAFTA on Productivity by Integration Status - All Firms**

To put the treatment effects in context, our results show that during the post-NAFTA period, annual labour productivity of fully integrated firms grew between 12 percent and 26 percent faster than labour productivity in non-integrated firms. The treatment effect was somehow smaller for importers, with an annual growth differential between 12 percent and 20 percent with respect non-integrated firms. The results from the full specification highlight important elements of heterogeneity related with the integration status of the firm. Hence splitting integrated firms in different groups taking into account their integration status (i.e. exporter, importer, or fully integrated) and hence the channel through which they are linked to international markets allows us to capture...
heterogenous treatment effects that would otherwise be ignored. By lumping together all integrated firms regardless of their integration status other studies like Pavcnik (2002) and López-Córdova (2003) might have obtained average productivity effects that are biased.

### 4.2.2 Controlling for Potential Endogeneity of Treatments

As mentioned before, if the assumption of exogeneity of the treatment (being integrated within a period of trade liberalization) is violated and our treatments are correlated with some unobservable characteristics, the estimated coefficients will be biased. So far we have tried to alleviate this endogeneity problem by including firm-level control variables as regressors. If the decision to become integrated is correlated with any of the observable characteristics used as controls, our results are still consistent. However, the problem of endogenous treatment is especially acute in our case because we have to deal with what is an established finding in the literature: most efficient (and productive) firms self-select into export markets (Bernard and Bradford Jensen 1999, Melitz 2003). It is therefore reasonable to expect a (reverse) causal relationship from productivity levels to integration status. If this is true, then the coefficients presented in the previous section are biased.

In order to tackle this problem we re-estimate our model using a restricted sample which includes only firms that did not change their integration status throughout the period under analysis. We artificially avoid firms to self-select into a new integration status as a consequence of possible changes in productivity brought about by NAFTA. The results of these regressions are reported in the third column of Table 1 of Appendix A, and the coefficients of the treatment effects are depicted in Figure 9. The general result indicating a positive labour productivity effect as a consequence of trade liberalization holds. Both the treatment effects and the coefficient on import tariffs indicate a trade-induced boost in labour productivity growth above the performance of non-integrated firms. In fact, according to these new results, firms that were integrated before the implementation of NAFTA benefited more from the agreement (experiencing higher productivity increases) than firms that switched as a consequence of the reform. This explains the larger treatment effects coefficients shown in Figure 9. The principal dif-

---

17 The endogeneity problem can arise because one specific firm characteristic is driving selection into the treatment (e.g. improving the skills of the labour force allows firms to produce higher quality products and integrate into the international market), however by including firm-level characteristics we can alleviate this sort of problems.

18 Including this restriction reduces the sample to a third of its original size from almost 30 thousand observations to a little more than 10 thousand. We believe, however, that there are still plenty of degrees of freedom and enough variation in productivity in order to identify our coefficients of interest.
ference between the results controlling for endogeneity and the previous ones is that the treatment effects on exporting firms are now positive and significant thought not in every year. According to our results, firms that became exporters after the trade agreement (switchers) do not benefited from trade reform; however, firms that were exporters before NAFTA and throughout the period under analysis, experienced productivity gains comparable to firms integrated via other channels (importers or fully integrated). This is not entirely surprising because many of the ‘switchers’ can be defined as “accidental exporters” (or “marginal exporters”), i.e., firms that in the aftermath of the devaluation experienced a substantial increase in their competitiveness (in terms of US dollars) overnight. Both these drivers pushed these “accidental exporters” to the exporting sector immediately after the devaluation, however given their characteristics these firms could not survive on the competitive international markets and retired together with the revaluation of the real exchange rate.\(^\text{19}\)

Figure 9: Impact of NAFTA on Productivity by Integration Status - No Switchers

![](image)

### 4.2.3 Controlling for Exit-Selection Bias

In the previous sections we have not considered the problem of attrition, but we need to take into account that we only observe plants that decide not to exit. Assuming that our sample is representative of the entire population would imply the assumption that plants exit randomly. However, this assumption would contradict a large body of literature\(^\text{20}\) (Olley and Pakes 1996, Disney, Haskel, and Heden 2003, Pavcnik 2002). In fact, it is more reasonable to assume that plants decide to exit non randomly, hence our

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\(^{19}\)The revaluation of the real exchange rate took place around 1998, see Figure 4.2.4.

\(^{20}\)For a survey of studies analysing the determinants of exit see Siegfried and Evans (1994)
sample it is a non-random selection of the entire population. To handle this selection problem it is common to condition the principal regression of interest on a selection equation that models the probability that an establishment does not exit. In order to identify the probability of this selection some researcher make use of a structural model of firm exit (Olley and Pakes 1996, Pavcnik 2002). However it has been argued that a structural approach crucially depends on the assumptions of the model and modelling exit is, from a theoretical point of view, not a settled question (Griliches and Mairesse 1995). Following the approach of Disney, Haskel, and Heden (2003) we adopt a reduced form approach where the regressors in our selection equation echo the structural approach. The main hurdle for identification is to find variables that affect the probability of exit but do not influence productivity. In fact even if in theory identification could rely solely on the non-linearity of the inverse Mills ratio, many studies have shown that in practice identification would be hardly achieved without an exclusion restriction because the inverse Mills ratio is approximately linear over a wide range of its argument. For this reason if the same variables appear in the selection equation and in the principal equation multicollinearity problems will normally impede identification (Puhani 2000). Based on the structural model developed by Olley and Pakes (1996) we assume that investment affects the probability that a plants does not exit but it does not affect the productivity. The crucial assumption is that it takes time for investment to become productive, investment at time $t$ becomes productive only at time $t+1$ when it becomes part of the capital of the firm. Formally we estimate the following model:

$$
\varphi_{it} = \alpha + \beta \cdot X_{ijt} + \psi \tau_{it} + \rho \cdot \lambda(\hat{\gamma} Z_{ijt}) + \varepsilon_{it}
$$  \(3\)

$$
P(Y_{it}) = \kappa + \gamma \cdot Z_{it} + \psi \tau_{it} + \mu_{it}
$$  \(4\)

Where $Y_{it} = 1$ if firm $i$ does not exit in $t+1$

or $Y_{it} = 0$ if firm $i$ exit in $t+1$

Equation \(4\) is the selection equation where $Z_{it}$ is a superset of $X_{ijt}$ because it includes the investment variable that is not included in the regressors of \(3\) and $\lambda(\hat{\gamma} Z_{ijt})$ is the inverse Mills ratio.

Following Heckman (1979) we proceed in two steps. First, we estimate equation \(4\) with a probit. Second, we re-estimate our main equation \(3\) using the $\hat{\gamma}$ obtained from the

\(^{21}\)Following Olley and Pakes (1996) we used as exclusion restrictions a polynomial expansion of $I_{it}$ however the variables of order superior to one appear not to be significant
first step to construct the inverse Mills ratio. We re-estimate our model in two different ways. First, taking into account the issue of endogeneity and excluding from the sample the switchers (for detailed results see first column of table 2). Second, we apply the Heckman selection model to the entire sample (for detailed results see second column of table 2). In both cases the results are qualitatively very similar to the previous OLS regressions however in the reduced sample (see first column of table 2), when we exclude switchers, there is evidence of exit selection bias as the $\lambda$ is significantly different from zero while when we use the entire sample (e.g. including switchers) the $\lambda$ appear not to be significantly different from zero.

The results of the reduce sample (the one excluding the “switchers” presented in first column of table 2) and are worth analysing. In fact, these results suggest that, even if there is evidence of a selection bias (e.g. the $\lambda$ is significative), the corrected coefficients appear to be nearly identical to the coefficients of our original OLS proving that the selection bias is relatively small.

4.2.4 NAFTA or Devaluation?

A final point we need to discuss is the overlapping between the Peso’s devaluation and the implementation of NAFTA. We need to address this issue because this directly influences the reliability of our estimates, and also because from a policy perspective it is extremely important to distinguish between the two. The timing of the devaluation is particularly unfortunate for the analyst because NAFTA was enacted on January 1st 1994 and the devaluation occurred in December of that same year.

In order to evaluate if our results are really driven by NAFTA and not by the devaluation we will rely on two pieces of evidence. First, we have one year where NAFTA effects are not contaminated by the devaluation (1994). Second, we can compare our actual results with the results we would expect if the devaluation was the main driver of the productivity changes.

By analysing the results for the year 1994 we notice that the impact of NAFTA is positive and statistically significant in all our models for fully integrated firms. During 1994 their productivity grew more than the productivity of domestic firms about 15%. The same can be said for firms that made use of imported intermediate inputs. However, the opposite is true for exporters as in all the models the coefficients are statistically non significative. In other words, if we analyse the results from 1994 only, when NAFTA does not overlap with the devaluation, we find that the productivity of “fully integrated” plants and of importers grew substantially more than the productivity of domestic firms. It could be argued that one year is too short to evaluate the
benefits of NAFTA, and we would agree with this remark, in fact our objective here is simply to show that the results for the entire period (i.e. 1993-2000), when NAFTA and the devaluation overlap, are consistent with the results for the year when the effects of NAFTA are “non contaminated” by the devaluation.

The economic reasoning suggests us that the exchange rate devaluation should affect asymmetrically firms with different integration status. In particular, we expect that the impact on “exporters only” will be positive, while the impact on “importers only” negative. Unfortunately, the effect on “fully integrated” firms is harder to predict a-priori. Based on this reasoning we would expect the coefficients of “exporters only” to be upward biased, in particular during the period 1995-1998, with the the bias decreasing through time and disappearing by the end of the period in 1998-2000. Also, we would expect the coefficients of “importers only” to be strongly downward biased during the period 1995-1998, with the bias diminishing toward end of the period. In other word if the devaluation was driving our results a graph of the coefficients for “exporters only” should follow an inverse U-shape pattern while a graph of the coefficients for the “importers only” should follow a U-shaped pattern. However, figure 4.2.4 suggests that our results do not follow such patterns.

We can conclude that, on the basis of the economic reasoning and graphical analysis, we find no evidence that our results are driven by the Peso’s devaluation. However this is not a statistically test and we cannot exclude that our results are also influenced by the devaluation.

![Real Exchange Rate](image)

Figure 10: Real Exchange Rate (Source: Penn World Tables)

5 Conclusions

In this paper we have tried to answer two questions. Did NAFTA reforms made Mexican plants more productive? And through which channels? Differently from
previous studies we have been able to identify the trade integration status at firm level and not at sectoral level (Pavcnik 2002). Also, improving on previous studies analysing the impact of NAFTA we have attempted to identify an “overall NAFTA impact” and not just the impact of tariff changes (López-Córdova 2003). With these objectives in our mind and based on a large set of theoretical studies we have tried to identify and isolate the impact of various trade-productivity channels: import competition, access to intermediate inputs, exports channel and FDI.

Furthermore, in our empirical analysis we had to overcome two principal hurdles: endogeneity and potential sample selection bias. A further complication was generated by the timing of the Peso’s devaluation happened in December 2004 overlapping with the period of implementation of NAFTA enacted in January 1994. We have tried to tackle all these empirical issues and our results appear to be robust and not driven by these problems.

Our results are especially interesting under many dimensions because some of them confirm the findings of previous studies while other are rather innovative, even if in line with some of the more recent empirical works.

First, we confirm the importance of the import competition channel. As previously suggested in various empirical studies (Tybout and Westbrook 1995, Pavcnik 2002, Fernandes 2006) an increase in import competition, measured by a reduction of import tariffs under NAFTA, had a positive effect on stimulating the productivity of Mexican plants.

Second, we found that the impact of trade reforms is not identical for all “integrated” plants in general, consequently it is important to distinguish among firms based on the way these are actually integrated. In fact we found that firms that the benefits to firms that both make use of imported intermediates and export are normally larger than the benefits accruing to other types of integrated firms.

Third, in contrast with previous findings of López-Córdova (2003) but in lines with some recent studies (Amiti and Konings 2005), we found that imported intermediate inputs can be a crucial source of productivity growth for firms and trade reforms by enhancing access to these can be an important source to increase a country’s competitiveness. The importance of accessing intermediate inputs as a channel to access knowledge embedded in those inputs was underlined as a mayor source of productivity growth also in another study of Schiff and Wang (2002) analysing the impact of NAFTA.

Fourth, in line with various firm-level studies (Pavcnik 2002, Bernard and Bradford Jensen 1999) we cannot find evidence that exporting is a channel of productivity growth. However a possible explanation for the lack of evident improvements in the productivity
growth of exporters, differently from that of importers, could be that the extra market access for Mexican exporters after NAFTA has been small given that US tariffs were already particularly low; differently the changes for importers have been more substantial. Furthermore, with the boom in FDI and the expansions of exports after NAFTA many of the importers may have been in the new situation of having to supply MNCs or exporters with consequently much higher demand standards. The process of catching up with these new demands could be an important explanation behind the significant productivity growth of importers. Unfortunately we have no hard evidence to support this hypothesis except that discussed in our descriptive analysis (Section 3) where we found that in sectors typically producers of intermediate inputs (e.g. Machinery equipment, Chemical products) the number of importers only is particularly large.

Finally, consistently with various previous studies (Djankov and Hoekman 2000, Evenett and Voicu 2001) the FDI channel also appear to be an important source of productivity growth for plants acquired, or with participation shares, by MNCs. However, data limitation do not allow us to investigate this channel more in detail because the data only allow us to identify the foreign ownership of Mexican plants in the year 1994. For this reason we decided not to pursue further the study of the impact of FDI and the potential vertical and horizontal spillovers in the present studies, even if we are aware of their importance as drivers of the changes in the Mexican manufactures during this period.
References


A Appendix 1: Regression Tables
Table 1: Estimations of DID Model, with firm-level controls and controlling for endogeneity (Excluding Switchers)

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Firm Level Controls | NO | YES | YES |
| Industry FE       | NO | YES | YES |
| Region FE         | NO | YES | YES |
| Year FE           | NO | YES | YES |
| Robust Clustered SE | YES | YES | YES |

Adj. $R^2$ | .084 | .340 | .369 |
No. of obs   | 43931 | 31378 | 10963 |
F-test       | 46   | 73   | 36   |

Significance Levels: * $p < .10$, ** $p < .05$, *** $p < .01$
Table 2: Controlling for Exit Selection Bias - Excluding Switchers

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|                  | First Stage   |           |
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| Industry FE      | YES          | YES       |
| Region FE        | YES          | YES       |
| Year FE          | YES          | YES       |
| No. of obs.      | 10320        | 29408     |
| No. censored     | 67           | 168       |

Significance Levels:  * p < .10, ** p < .05, *** p < .01