The Impact of NAFTA on Economic Performance: A Firm-Level Analysis of the Trade and Productivity Channels *

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Abstract

We evaluate the firm-level productivity impact of NAFTA using a difference in difference econometric approach. We allow for different impacts of trade reforms (treatment) across firms depending on their integration status. Integrated firms are defined as just exporters, just importers of intermediate inputs, or firms that are simultaneously importing and exporting. The reforms introduced by NAFTA had a positive effect upon productivity of integrated firms, thought the magnitude of this impact differed across firms with different integration status. Firms actively trading in the global markets showed a productivity performance around 10 per cent above their non-integrated counterpart. Our results are robust to different model specifications and they hold when integration is defined at the firm as well as at the industry level.

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 countries, have redefined their development strategies, moving from protection and import-substitution towards integration with global economy, promotion of exports and FDI. This important policy shift has been accompanied by an intense academic debate analysing the relationship between economic integration and growth. Despite the general presumption about the positive impact of economic integration on growth, the empirical evidence has failed to produce a definitive answer (Winters 2004, Baldwin 2000).

This paper aims to contribute to this debate in two ways. First by analysing an important case of trade reforms, the case of Mexico under NAFTA. Secondly, by deploying a different approach to disentangle the various channels through which integration can affect economic performance in general and firm level productivity in particular.

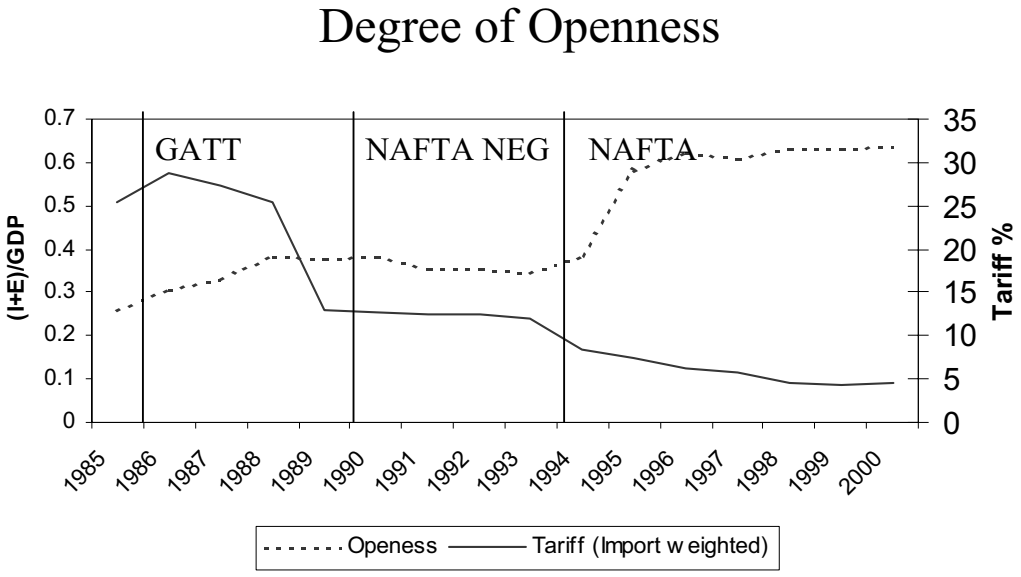


Figure 1: Mexico - Economic Integration (Source: WDI)

Mexico provides an exemplary case study because of the nature and depth of its reforms and degree of integration under NAFTA (see Figure 1).

The present study is related to various strands of literature. First, pioneer firm and plant-

level studies analysed the evolution of productivity dynamics in response to trade reforms and integration. These studies traditionally focused on the identification of the impact of trade reforms and openness on productivity (Roberts and Tybout 1996). More recently, interest moved towards the identification of the different channels and mechanisms at work to explain the impact of trade reforms upon productivity (Aghion, Burgess, Redding, and Zilibotti 2004, Girma, Greenaway, and Kneller 2004, Pavcnik 2002, Tybout 2001). Second, our research draws on the lessons learnt from the industrial organisation literature examining the impact of increased competition on industry dynamics (Olley and Pakes 1996). Finally, our research explicitly builds on the recent literature on trade (Melitz 2003, Yeaple 2005, Bernard, Eaton, Jenson, and Kortum 2003, Bernard, Redding, and Schott 2004) and Schumpeterian growth models with heterogeneous firms (Aghion, Bloom, Blundell, Griffith, and Howitt 2002, Aghion, Blundell, Griffith, Howitt, and Prantl 2004, Aghion, Burgess, Redding, and Zilibotti 2004). All of these studies provide important theoretical underpinnings for understanding the mechanisms through which economic integration affects productivity dynamics at firm-level.

Our point of departure is the classical FHK productivity decomposition, breaking down overall changes in aggregate productivity into its two main determinants: internal and external (Foster, Haltiwanger, and Krizan 1998). The internal (or "within component") is defined by changes occurring within the firm, i.e. adoption of new technology, shifts in the input mix, sales in foreign markets etc. On the other hand, the external restructuring tells us how much of the changes in productivity can be attributable to market shares reallocation among existing, plus the component due to the firms exit and entry process taking place. In a second stage of the analysis we estimate the effect that trade integration had upon the internal and external restructuring effects [1]. To estimate the relationship between firms' productivity and integration we use a difference in difference approach that enables us to control for firm and time-specific unobservables. Our approach is novel in the way it distinguishes the different integration effect for the different integration status: only exporting final goods, only importing intermediate inputs, exporting and importing. Finally a binary choice model is used to estimate the relationship between integration and the probability of abandoning the market .

The paper is organized as follows. Section 2 briefly develops the theoretical framework describing the different transition mechanisms between trade integration and firm productivity. The data used for the empirical analysis as well as some descriptive statistics are presented in section [2] 3. Section 4 is divided in three parts, in the first one we show the productivity decomposition results followed by the difference in difference estimation, the last part of

[1] Preliminarily for this version of the paper we just focus on internal restructuring

[2] A detailed description of the data will be presented in the appendix of the paper

section 4 presents the probit analysis for market exit [3]. 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 (see figure 2) and set the basis for the "theoretical background" that will guide our empirical analysis. We must notice that there is not a unique and well defined model that we can make us of but a number of different models that aim at capturing different mechanisms through which economic integration can have an impact upon firms.

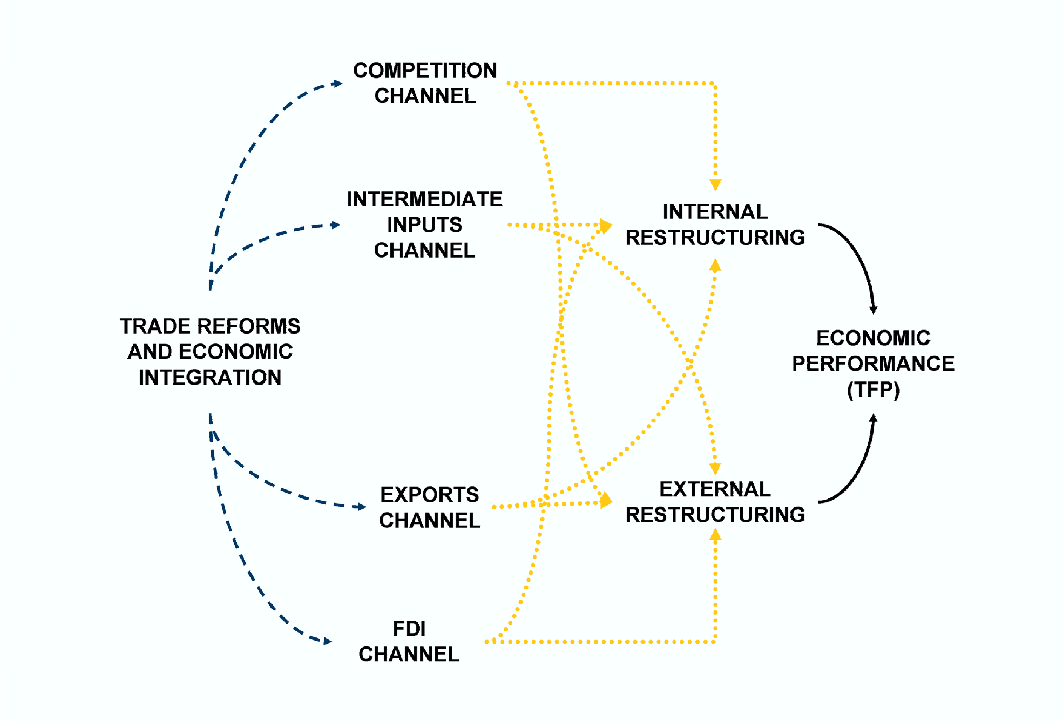


Figure 2: Trade-Productivity Linkages: Conceptual Framework

2.1 Competition Channel

Trade liberalisation and tariff reductions are expected to increase the competitive pressures to which domestic firms are exposed. This effect is expected to be stronger for import

[3] In this preliminary version the results from this estimation are not presented

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 ones.

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). They argue that an increase in competitive pressures will reduce the "X-inefficiency", defined as the gap between the actual productivity and the maximum productivity achievable (Leibenstein 1978, Leibenstein 1966). The basic intuition of their argument is that the efficiency of a firm is, ceteris paribus, a positive function of the managers' efforts.

Further, increased competition can have an impact upon 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 reforms.

When we allow firms to be heterogeneous, the import competing channel can drive changes in aggregate economic performance not only through "internal" restructuring but also trough the "external" effect like the exit from the market 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 which allows 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

Another important channel through which trade reforms can affect economic performance is the "intermediate inputs channel". In this section we will explain the mechanisms through which this can happen.

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 needed (Feenstra and al. 1999).[4] 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 from the imports of intermediate inputs as a mechanism through which trade will impact on productivity growth.

All these models would therefore predict an increase in firm-level productivity reflected in its *internal* restructuring component. Finally, 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 imported inputs replace domestic ones) which allow the relatively more productive firms to expand their "share" with an impact on aggregate productivity that would show up in the "external restructuring" component.

2.3 Exports Channel

The economic literature also suggests that the expansion of exports could work as another channel explaining a positive influence from economic integration upon economic performance and firm level productivity. However the notion that firms improve their productivity by exporting has been at the centre of an empirical debate. Various theoretical models predict only one way causality or the existence of a *self selection into exporting*: more productive firms will 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 are dependent crucially on the assumption that entering into foreign markets requires incurring into a fixed costs that only larger and more productive firms can afford.

At the same, the idea that by exporting firms will increase their productivity has found some theoretical basis and cannot be discharged apriori. Indeed, the self-selection hypothesis is not in contradiction 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 the increase with level of exports. Finally, at least two

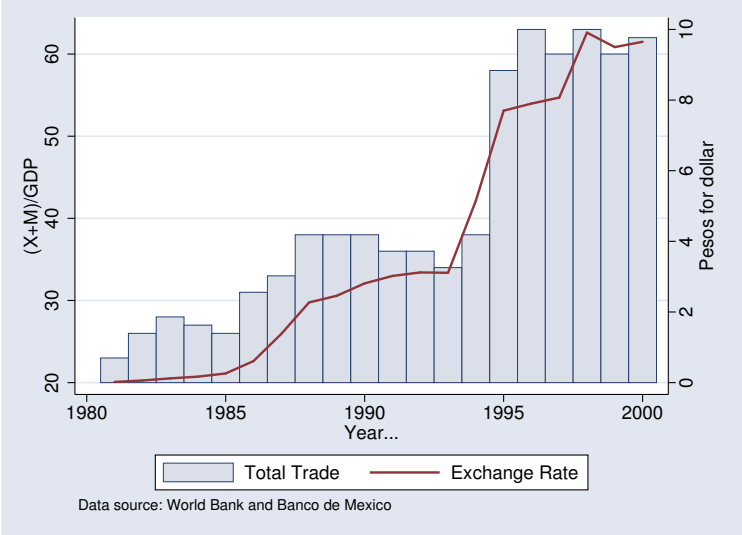
[4]More formally, the theory provides us with models where specialised inputs are characterised by increasing returns (i.e. high initial capital and learning costs) and consequently the degree of differentiation is limited by the extent of the market. In this model, the liberalisation of intermediate inputs will increase the varieties of available inputs, some of them more specialised and complementary to the domestic ones.

other hypotheses have been explored to explain a possible productivity improvement 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 negative shocks driving from a contraction of 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 will have more incentives to innovate and be more efficient; hence their long term productivity growth would be higher than non-exporting firms (Wagner 2002).

3 Data

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 agreement 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 devalued more than 60 per cent (see Figure 3). This was the starting point of a profound economic crisis where GDP contracted more than 8 percent and inflation passed from an annual rate of 7 per cent in 1994 to 41 per cent in 1998. The huge devaluation together with the contraction of the domestic market stimulated exports of Mexican produce. As we can see from Figure 3, between 1994 and 1996, the importance of international trade in the Mexican economy (measured as the ratio of exports plus imports to GDP) almost double, passing from a pre-crisis/NAFTA level of 38 per cent to 63 per cent in 1996. This export boom during the period 1994-2000, was lead by manufacturing exports, accounting for 95 per cent of total exports.

Figure 3: Total Trade and Exchange Rate Performance



To see how this important increase in manufacturing exports in particular, and more integration in general, affected Mexican firms' productivity, the present study uses firm-level data from the Annual Industrial Survey (EIA) covering the period 1993 to 2000.[5] EIA surveys more than 5,000 firms covering 85 per cent of total industrial production. The survey includes a wide range of firm level information like number of employees, hours worked, production for domestic and foreign markets, value of inputs, inventories, etc. (for more details see Appendix B)

In Table 1 we show the total number of firms in the EIA dataset, separating them into those ones that only exporter (they do not import intermediate inputs), only importer intermediate inputs (they do not export), those ones that import intermediate inputs and at the same time export the final product and finally those firms that are not integrated in the foreign market. Throughout the period the number of firms in EIA is reducing, specially after 1996. The effect of the Peso devaluation and NAFTA upon the integration status (i.e. exporter, importer or both) is quite clear between 1994 and 1996, when the number of exporters increases while the number of importers shrinks. Another important aspect to notice is the post-1996 reduction in the number of firms in all categories except for those companies that are well integrated into the foreign market, i.e. firms that simultaneously export their final good and import part of their intermediate inputs. As we explained in Section 2, all these changes had an *a-priori* effect upon productivity performance.

Table 1: Industrial Data Description

Year	Number of Firms	Only Exporters	Only Importers	Exporters and Importers	Non-Integrated
1993	6,552	773	1,752	1,201	2,825
1994	6,525	875	1,747	1,211	2,693
1995	6,430	1,168	1,352	1,442	2,468
1996	6,314	1,353	1,212	1,579	2,170
1997	5,767	929	1,081	1,998	1,759
1998	5,539	866	1,029	1,703	1,941
1999	5,452	883	1,055	1,801	1,704
2000	5,329	754	943	2,081	1,545

Source: EIA

To explore the possible market redistribution effects of the macroeconomic changes outlined above, in Figure 4 we show the proportion of integrated firms and their average size (measured as total employees) as well the proportion of exitors by integration status. From the left part

[5]The Mexican Institute of Statistics, INEGI, gathers firm-level data through the *Encuesta Industrial Anual* (EIA).

of Figure 4 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 through out 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.[6] Therefore, we can say that between 1993 and 1994 NAFTA helped relatively small firms to incorporate into the integrated sector, hence increasing the proportion of exporting firms in the market (see Table 1) and at the same time reducing their average size. After 1995, the increase in the proportion of integrated firms in the market can be attributable to a combination of NAFTA and the *Peso* devaluation.[7] The simultaneity of these two events also resulted in an expansion of integrated firms but this time the small ones (many of the "only exporters" or "only importer") were not able to survive the crises, therefore the average size of the integrated firms increased. Regarding exiting of firms during the period, from the right part of Figure 4 we can see that there was a marked increase in the number of firms exiting the market after the crisis with the great majority of them being non-integrated firms. Leaving the atypical year 1996 out of the analysis, we can notice a positive trend upon the exit rate through out the 1990s. This is true for integrated and non-integrated firms and might be the outcome of a higher degree of competition triggered by trade reform.

Figure 4: Exporters, Firm Size and Exitors

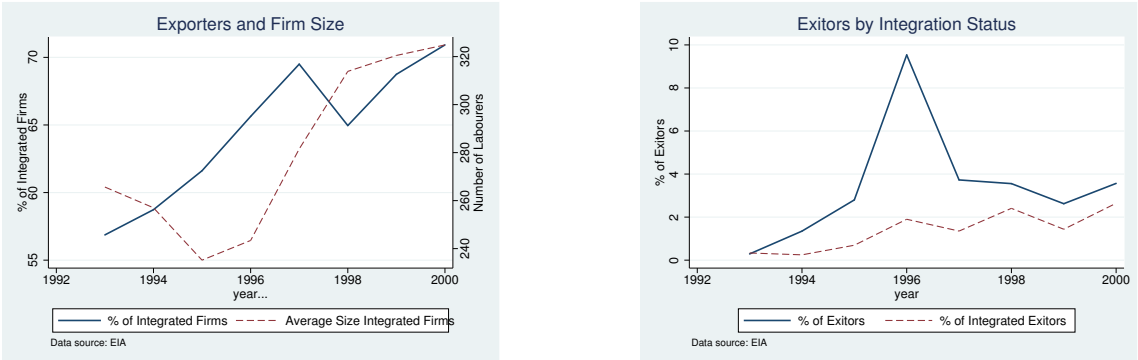


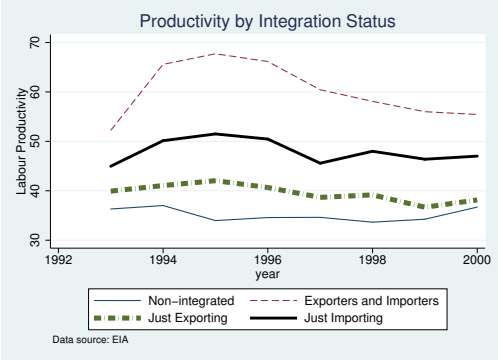
Figure 5 shows two graphs. In the left part we can see the productivity performance among the four groups already defined. In the right part of Figure 5, we show the productivity of exitors compared with stayers. The time trend in productivity by integrated status is revealing. Between 1993 and 1994 (the period of NAFTA without a Peso devaluation),

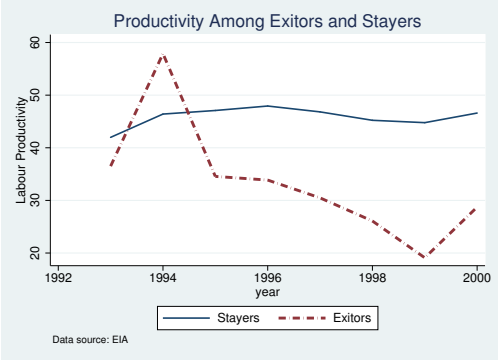
[6]Given that the Peso crisis took place on the 20th of December 1994, the devaluation's effect is not capture during this time.

[7]The 1990s growth in the US economy may also be playing an important role in explaining the export boom during this period.

average productivity in all four categories rose, with the more integrated firms (importers and exporters) benefiting the most. After the peso devaluation and until 1996 productivity of the "only exporters" increased as opposed to the negative trend showed in the other three groups. After 1996, all integrated firms experienced a reduction in productivity where as the non-integrated firms were catching up. From the left part of Figure 5 it is conspicuous that exitors' productivity gap with respect stayers widened through out the period with the exception being 1994. Moreover we can see that the huge increase in exits occurring in 1996 was predated by the massive negative shock in productivity in 1995 among exitor firms.

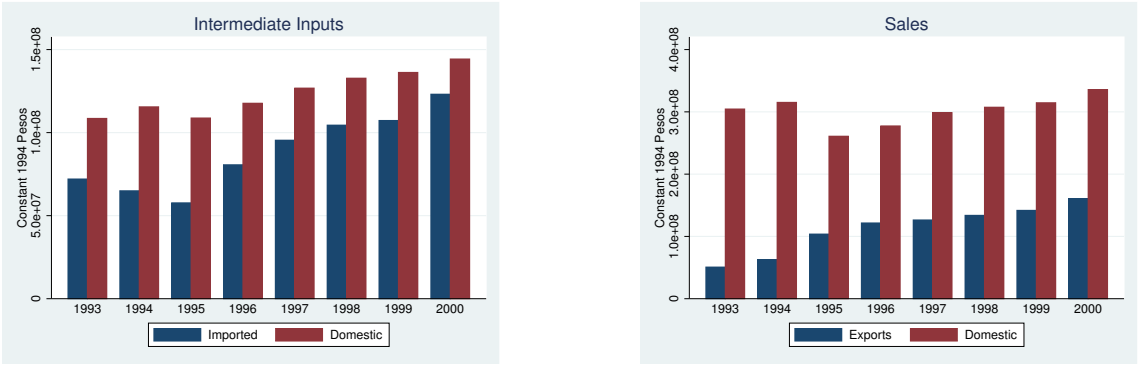
Figure 5: Productivity Performance by Exporters and Exitors





To show the possible impact of trade reform upon integration, in the left part of Figure 6 we show the time trend in real imported and domestic intermediate inputs. Real exports increased through out the period, with the proportion of exports to total sales passing from an average of 15 per cent in 1993 to 36 per cent in 2000. The composition of the intermediate inputs mix also changed in favour of the imported intermediate inputs. This is particularly the case after 1995 when imported intermediate inputs increased at a steady pace. The trends in exports and imported intermediate inputs show the important integration process that took place during the years following NAFTA.

Figure 6: Real Intermediate Inputs and Sales Performance



The descriptive statistics presented so far are quite informative and suggest a relationship between productivity performance and changes in the degree of integration (driven by the concomitant NAFTA and devaluation). Nevertheless, at this point we cannot conclude that the observed changes in productivity is entirely explained by trade integration or trade policy. A formal econometric analysis is required to control for other concurrent changes taking place.

4 Empirical Analysis

4.1 Productivity Decomposition

The overall changes in labour productivity, can be decomposed into "internal" and "external" productivity changes. Let us define productivity of sector j at time t as being equal to the sum of productivity across individual firms (φ_{it}) in j, weighted by their inputs share (ω_{it}): $\phi_t = \sum_{i \in \Omega_j} \omega_{it} \varphi_{it}$.

Foster, Haltiwanger, and Krizan (1998) (henceforth FHK) proposed the following decomposition for the change in productivity between t and $t-k$:

$$\Delta\phi_t = \overbrace{\underbrace{\sum_{i\in\Omega_j^S}\omega_{it-k}\Delta\varphi_{it}}_{\text{Within effect (G1)}}}^{\text{Internal restructuring}} + \underbrace{\sum_{i\in\Omega_j^S}\Delta\omega_{it}\Delta\varphi_{it}}_{\text{Covariance term (G2)}} + \overbrace{\underbrace{\sum_{i\in\Omega_j^S}\Delta\omega_{it}(\varphi_{it-k}-\overline{\varphi}_{t-k})}_{\text{Between effect (G3)}} + \underbrace{\sum_{i\in\Omega_j^N}\omega_{it}(\varphi_{it}-\varphi_{t-k})}_{\text{Entry effect (G4)}} - \underbrace{\sum_{i\in\Omega_j^X}\omega_{it-k}(\varphi_{it-k}-\overline{\varphi}_{t-k})}_{\text{Exit effect (G5)}}}^{\text{External Restructuring}} \quad (1)$$

The FHK decomposition allow us to identify five different components. The first term (G1) is the productivity change of surviving firms also referred to as *"internal restructuring"* or *within* effect. The second term (G2) is a covariance term that will be positive when the market shares of firms with increasing (decreasing) productivity expand (contract). The latter three terms (G3, G4 and G5) are normally referred to as *"external restructuring"* . The third term (G3) is equal to the change in market shares of surviving firms weighted by the difference between their productivity and the average productivity in the sector at the final period. This term is positive if survivors, with above than average productivity, expand their market shares (i.e. efficient intra-sectoral reallocation) and negative otherwise. The fourth term (G4) is the component of the productivity changes due to the new entrants and will be positive whenever their productivity is above the average otherwise entry productivity effect will be negative. The final term (G5) is the change due to the exit, this will have a positive impact upon sectoral productivity if the these firms' productivity levels are below the sectoral average.

How can trade reforms affect productivity? To begin with we need to distinguish two different sources of productivity changes. Changes in productivity deriving from the *within* include elements like innovation, re-organisation of production process, changes in management strategy, etc. Because these changes are *within* the surviving firms they are referred to as "internal restructuring" (Disney, Haskel, and Heden 2003). On the other hand, productivity changes can derive from "market selection" mechanisms leading to the expansion of some firms and contraction of others as well as the entry and exiting of firms. This changes are *between* firms and are referred to as "external restructuring" due to the process of market selection whereby most efficient firms gain market shares, low productivity firms exit and are replaced by higher productivity entrants (Disney, Haskel, and Heden 2003). Often these two sources of productivity changes are not distinguished, but we find that there are compelling reasons to distinguish them. In fact, from a theoretical point of view the determinants of these two different sources of productivity changes can be different and distinguishing them

is important both on theoretical grounds and for policy recommendations. Furthermore, from an empirical perspective we can easily decompose our productivity index in order to distinguish between these two sources as suggested above.

The reasons to decompose productivity growth into its components are important and well summarized in Levinsohn and Petrin (1999). The question to be answered is why does it make sense to distinguish between "internal restructuring" from "external restructuring"?[8] Or, put in a different way, is it relevant to answer the question *when industries improve do firms get better*? There are indeed various reasons why this distinction is relevant. First, this distinction has a policy relevance because policies that promote the "internal restructuring" (i.e. subsidized credit for innovation promotion) may affect negatively the "external restructuring". Second, the costs of restructuring can be high when the "external restructuring" is dominant. This will, indeed, create winners and losers and quite likely it will have a strong impact in terms of labour turnover and displacement. These changes will have a significant effect upon the political economy of the reforms. Third, this distinction is important for assessing the long-run growth prospects of an industry. If the principal source of growth is internal restructuring, then there are no limits to the growth in the long-run as in theory the possibility of improvement is unbounded. Viceversa, if the main source of growth is external restructuring, and we abstract from the possibility of entry, the long-run growth prospects are bounded by the efficiency level of the most efficient incumbent firm. Finally, from an analytical perspective, if the dominant source of growth is the "internal restructuring" we can be able to explain this fairly well using a model with a representative firm, otherwise we ought to make use of analytical models that have room for heterogeneous firms (Levinsohn and Petrin 1999).

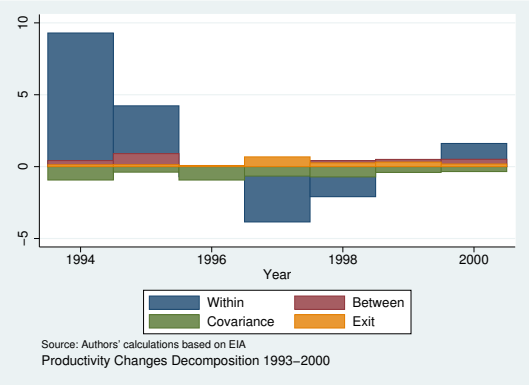
In Figure 7 we show the results of the productivity decomposition exercise using Mexican manufacturing data for the period 1993-2000 and decomposing the value added labour productivity[9]. Within-firm productivity changes are important and positive only between year 1993 and 1994, after this period, the *within* effect is always negative and particularly large between 1996 and 1998. The "reallocation component" (term G3 in equation 1) is positive throughout most of the period as well as the exit effect, however their magnitude is much

[8] In their paper Levinsohn and Petrin use a different terminology and refer to the "internal restructuring" as "real productivity case" and to "external restructuring" as "rationalization case"

[9] In this paper we will be focussing on the labour productivity. Using this as measure of performance has both its advantages and disadvantages. We use labour productivity based on value added (VALP - i.e. value added labour productivity) because this measure is considered as the most appropriate index of labour productivity because this is not influenced by variations in the intensity of intermediate inputs used (OECD 2001). The principal advantages of VALP is that it is simple to derive and easy to understand, this simplicity however hides an important shortcoming. In particular this index is influenced by variation in capital intensity and will varies when nothing else change except the capital-to-labour ratio

smaller in this year-by-year decomposition[10].

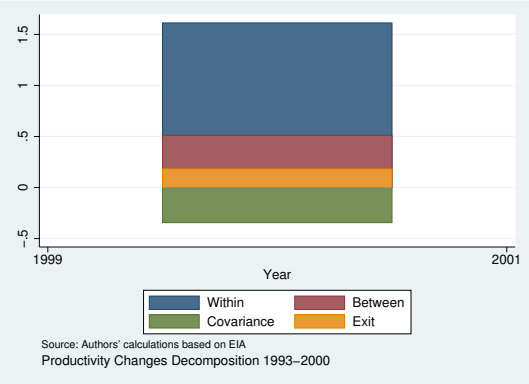
Figure 7: Aggregate Productivity Decomposition



The first emerging result of this decomposition is that the short term the "within-firm component" is, for most of the years, the principal driver of the productivity changes, however this is is also highly volatile and its net impact throughout the entire period is not positive. The second finding is that both "external reallocation" as well as exit component appear to be much smaller in their year by year contribution, but appear to be consistently positive throughout this period, throughout the entire period these emerge as important determinants of the aggregate productivity changes. The findings that "internal" changes appear to be much more volatile and larger in the shorter period is consistent with our expectations that in the short term the principal drivers of productivity changes are the variations within the firms. Opposite is the behaviour of the "external" determinants as these changes tend to occur more slowly because of the frictions and adjustment costs. Also, we can analyse the same decomposition across the entire period. The result is presented in Figure 8 and shows that the principal driver of productivity changes across the entire period are the "within firm changes", however also the contribution of "external realllocation" and "exit" is, even if smaller, important and positively drives changes in aggregate productivity.

[10]In this preliminary version of the paper, for reason of space and time, we only present the results from the aggregate decomposition

Figure 8: Aggregate Productivity Decomposition



Concluding this section we showed that it is important to ask where the aggregate productivity changes come from a theoretic point of view. In the specific case of Mexico we showed that it would be incorrect just to focus on one of the determinants of productivity changes because, even if different in terms of size and trends, all the three determinants[11] of productivity appear to have been at work in this period.

4.2 Econometric Analysis

In this section we will try to evaluate more formally the impact of NAFTA reforms on firm level productivity, in order to identify this impact two strategies could be deployed. The first strategy consists in exploiting tariff variation across sectors and through time and analyse how this explains, conditional on some observable characteristics of the firm, the variations in plant-level productivity. This strategy has already been employed in two previous studies on Mexico by Tybout and Westbrook (1995) and López-Córdova (2003). Both these studies found a significant impact attributable to the "competition channel". In particular, the study by López-Córdova (2003) also finds that the "export channel" appears a significant source of productivity growth as the firms enjoying preferential access to the US market under NAFTA have higher productivity. Finally, intriguingly, López-Córdova (2003) does not find support for an impact of trade reforms through the "intermediate import channel", as firms using imported intermediates tend to have a *lower* productivity growth than non-users. This way of identifying the impact of the trade reforms has an important advantage but also two main drawbacks. The advantage is that it is able to isolate the impact of trade reforms components from other trade-related exogenous shocks (e.g. learning from integration). However, if we believe that trade reforms involve much more than just a reduction in tariff rates, then, using only the tariffs variations would lead to an *under-estimation* of trade reforms' impact. Indeed this appears to be a very important issue in the case of NAFTA, where the changes in tariff

[11] within-firm changes, reallocation and exit.

rates appear to have been relatively modest. The major changes introduced by NAFTA took the form of new rules and institutions to promote integration among the trade partners.[12] Further, a more subtle technical problem involves the identification of the impact of tariffs changes on intermediate inputs. Formally we would need to have information on the specific inputs used by each firm and calculate a firm-specific tariff rate for its intermediate inputs used. In the absence of detailed information on the specific intermediate inputs used at the 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. Further, because of data limitation, often the researcher need to assume that this input-ouptut shares remain constant over the time, an assumption that is especially implausible during a period of trade reforms (6).

In this paper, we will use an alternative strategy. The descriptive statistics presented in section 3 suggests that plants that differ in terms of their "integration status" show a different productivity evolution over time. Our crucial assumption is that the reforms introduced by NAFTA had a different effect across firms with different integration status. In particular, *integrated* firms will be positively affected by the reforms relatively to the *non-integrated* firms. Furthermore, the effect within the *integrated* firms differ across the different integration status, e.g. the effects of NAFTA can be different upon firms which are only exporting compared with those ones which are importing and exporting. Therefore NAFTA reforms will introduce an exogenous shock that which impact will differ across firms that have different integration status[13] and we can formally evaluate the impact of the reforms on plant productivity by using a difference in difference framework. Let us define a reduced form of productivity as function of time and integration status dummy variables, its interaction and some controls:

$$\varphi_{it} = \beta_0 + \beta_1 Time_t + \beta_2 DIntegration_{it} + \delta \cdot DIntegration_{it} \times Time_{it} + \beta_3 X_{ijs} + \varepsilon_{it} \quad (2)$$

Our outcome variable, φ_{it} is plant-level labour productivity defined as the value added divided by the total amount of hours worked. $Time_t$ is a year dummy capturing economy-wide macroeconomic shocks; $DIntegration_{it}$ is a binary indicator of the integration status of the firm which takes a value of one if the firms is integrated and zero otherwise. As we defined in section 3, firms can be integrated in three different ways:

1. Plant making use of imported intermediate inputs but not exporting

[12] One can argue that the reduction in trade barriers could serve as a proxy for the legal and institutional change, however, the nature of the exact relationship between changes in tariffs and changes in institutions is not clearly defined.

[13] A similar assumption is done by Pavcnik (2002) in her work on Chile.

2. Plant just exporting without importing intermediate inputs

3. Plant making use of imported intermediate inputs and exporting the final good

Therefore in equation 2 we will have three different integration status dummies, all off them interacted with the year time dummies. This specification allows the impact of NAFTA to be different across integration status and, given the interaction terms, these effects are allowed to vary over time. The coefficients of interests are the "treatment effects" δ which capture the change in productivity differential between integrated and non-integrated firms, where integration is here defined at plant-level. These treatments are capturing the effect of NAFTA on plant-level productivity—allowing for this impact to be heterogeneous through different channels. If correctly estimated, the coefficients of the "treatment" effects will capture the change over time in the difference between the "treated" (integrated) and the "control" (non-integrated) firms. Time changes are always with respect to our base year which is 1993, the year before NAFTA was enacted. Therefore, exploiting the heterogenous impact introduced by NAFTA (both across firms with different integrated status and over time), our coefficients, δ, are capturing the impact of the reforms upon productivity. Analytically these coefficients can be defined as follows:

$$\begin{aligned} \delta_{DID}^{Int} = \Delta\overline{\varphi}_{Int} - \Delta\overline{\varphi}_{NInt} &= \left(\overline{\varphi}_{Int}^{after} - \overline{\varphi}_{Int}^{before}\right) - \left(\overline{\varphi}_{NInt}^{after} - \overline{\varphi}_{NInt}^{before}\right) \\ &= \left(\overline{\varphi}_{Int}^{after} - \overline{\varphi}_{NInt}^{after}\right) - \left(\overline{\varphi}_{Int}^{before} - \overline{\varphi}_{NInt}^{before}\right) \end{aligned} \tag{3}$$

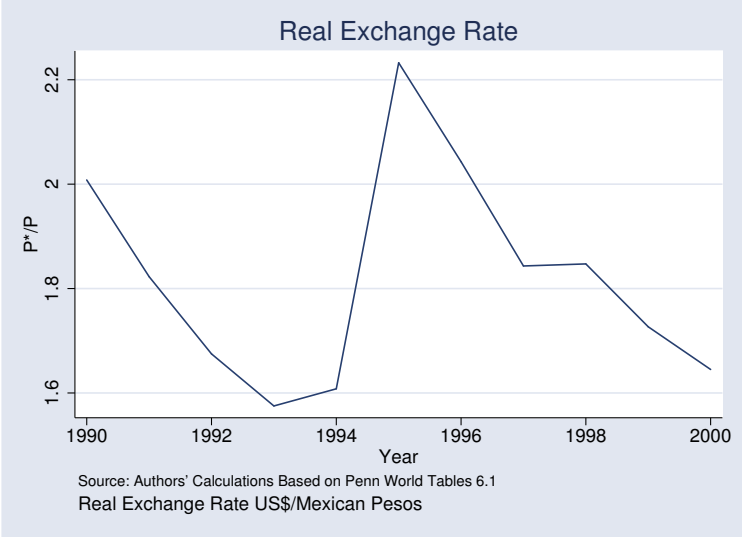
The model makes two important assumptions which need to hold in order to identify properly the treatment effect (Wooldridge 2002, Blundell and Costa Dias 2000). The first assumption is that the treatment is not correlated with time-varying unobservables. The second assumption is that the macroeconomic shocks are affecting all firms in a similarly fashion. The time dummies will capture macroeconomic changes, like the sharp real devaluation of December 1994 (see Figure 9).[14] Intuitively, it is quite plausible that exchange rate movements will have a different impact upon firms with different integration status, hence this could potentially introduce a bias into our treatment results. For example, non-exporting firms that import intermediate inputs will experience a negative impact from the devaluation and quite the opposite can be said about exporting firms. Addressing this problem is complex and we

[14] Formally, as explained by Blundell and Costa Dias (2000), our estimated difference-in-difference coefficients, $\delta_{Treatment}^{Int}$ recovers not only the effect of the integration-treatment but also the differential effect of the macro-trend across the two groups which is $\left(k^{\text{int}} - k^{\text{Nint}}\right)$

$$\hat{\delta}_{DID}^{Int} = \delta_{Treatment}^{Int} + \left(k^{\text{int}} - k^{\text{Nint}}\right)\left(Time_{after} - Time_{before}\right)$$

will discuss this further when presenting our results.

Figure 9: Real Exchange Rate (Source: Penn World Tables 6.1)



Bearing these caveats in mind, the detailed results of the regressions are presented in the Appendix Table 2. All three models are estimated via OLS and corrected for potential heteroscedasticity using the Huber-White robust standard errors. We do not estimate models with other panel data methods (e.g. fixed or random effects) because OLS is the model that captures the treatment effects as defined by equation 2.[15] The only difference between the three specifications lays in the controls used, in model (1) we have no controls, in model (2) we introduced firm-level controls[16] and finally in model (3) we also introduced industry (defined at 2 digits) and location (defined at state level) dummy variables. Although the results of the three models are consistent, we will focused on the estimates for model (3) which have much more controls and a higher R^2.[17]

Firstly, we need to underline that our treatment is not capturing the effects of the competition channel. The reason being that at a micro level we cannot identify if a firm is

[15]OLS explains the variations in firm-level productivity as variations both within firms (i.e. when a particular firm changes integration status) as well as between firms with different integration status. Differently, the fixed effects (FE) model would exploit only within-firm variation, i.e. firms changing their integration status. Clearly the two models are capturing different aspects of the reforms impact. The treatment effect within a FE framework, can be interpreted as the extra growth in productivity experienced by firms switching their integration status. This would leave out the differential in productivity growth between firms already integrated and non-integrated ones.

[16]The firm level controls are: total sales, total employment, R&D, level of capital stock, ownership distinguishing between domestic owned, foreign participation when foreign shares are less than 50 per cent and foreign owned when foreign shares are higher than 50 per cent.

[17]Notice that adding firm-level controls, increases the R^2 from a level of 0.078 in model (1) to a level of 0.655 in model (3).

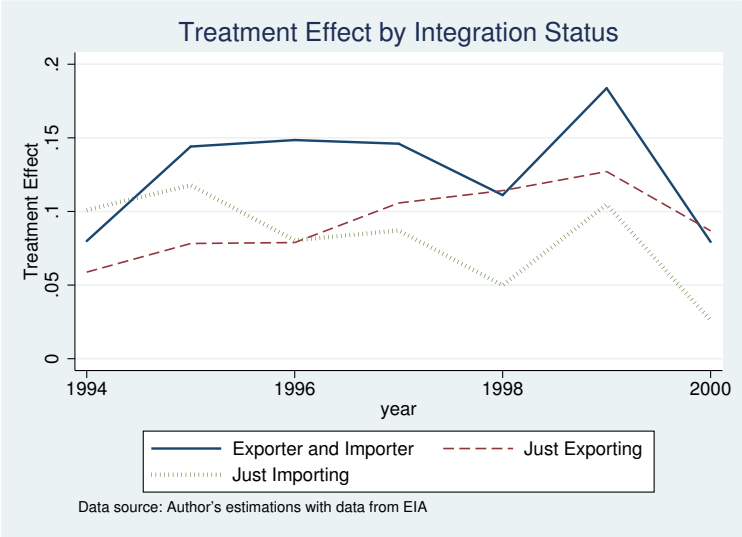
import-competing. Instead we use the Mexican tariff levels for US goods under NAFTA and, consistently with the findings of López-Córdova (2003), lower tariffs, proxy for an higher import-competition effect, increase productivity. Also, consistently with previous studies, we find that firms both with foreign ownership and with foreign participation have higher labour productivity than those ones without foreign presence.

Although further interesting results arose from the parameters linking productivity and other controls (X), given the scope of the study, we will focus on the treatment coefficients. In Figure 10 we show the coefficients capturing the treatment effect for the three integration status. The impact of the reforms upon "fully integrated" plants (those ones which export and import) is always positive and statistically significant. Furthermore this impact is sizeable because the reforms are increasing the productivity of these firms between 8 per cent and 13 per cent on average. As previously discussed the devaluation may be potentially biasing upward[18] these coefficients especially for the immediate years post-devaluation, namely 1995-1998, however the 1994 coefficient is not affected by the devaluation and the coefficients for 1999-2000 should be marginally affected because of the subsequent revaluation of the real exchange rate (Fig. 9). The impact of the reforms upon plants that "just export" is significant just for years 1997, 1998, 1999 suggesting that in those years the reforms made the difference in productivity between just-exporters and non-integrated increase around 11-12 per cent with the respect to the baseline difference between them in 1993. At this point we need to underline that some of the coefficients are likely to be upward biased, in particular for "just exporters" during the period 1995-1998, due to the exchange rate devaluation. If we take this into account, and given that the estimated coefficients for "just exporters" are smaller than those ones for "fully integrated" firms, we can conclude that the impact of NAFTA upon the former, does not appear as strong as its impact on firms that are fully-integrated.[19] What is remarkable is the impact of NAFTA on firms that don't export but make use of imported intermediate inputs, for these plants the impact of the trade reforms is always positive and significant, except for the years 1998 and 2000. Our results suggest that NAFTA increased the productivity gap between firms using imported intermediate inputs and non-integrated firms around 9 to 10 per cent. In this case our coefficients are likely to be downward biased due to the devaluation, especially for years 1995-1998. It is therefore interestingly to notice that despite this likely negative bias, the coefficients capturing the treatment effects are always positive and significant.

[18] However we must notice that apriori the sign of the bias for firms that both exports and imports is not clear

[19] We would expect a stronger exchange rate bias upon firms which are only exporting compared with the biased upon firms that are fully integrated, however, a formal test is needed to confirm this hypothesis.

Figure 10: Firm-Level Integration Treatments



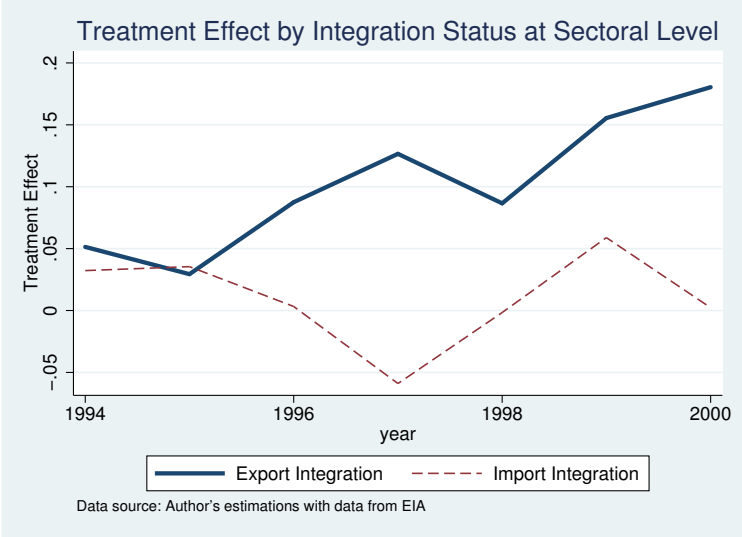
The fact that we estimated our original model defining the treatment at the firm-level may raise some concerns about the "endogeneity" of these treatments and on the possibility that self-selection into the treatment may be a consequence of unobservable firm-specific random shocks. In order to address this concern we estimate a similar model defining the treatment at the sectoral level. A 6-digit industrial sector is defined as integrated through "exports" when the ratio of the sum of sectoral exports over total sectoral sales is higher than 0.15. Analogously, a sector is defined integrated through "imports" when the ratio of the sum of sectoral imported intermediates over total sectoral intermediates is higher than 0.15. This approach is in line with the work of Pavcnik (2002) using Chilean data. The model we will estimate is defined by equation 4 and the results are presented in the Appendix Table 3. Following our previous discussion, all three models are estimated using OLS procedures with robust standard errors.

$$\varphi_{it} = \beta_0 + \beta_1 Time_t + \beta_2 DIntegration_{jt} + \beta_3 \cdot DIntegration_{jt} \times Time_{it} + \beta_4 X_{ij} + \varepsilon_{it} \quad (4)$$

The time trend of the coefficients capturing the treatment effects are presented in Figure 11. Most of the results from this second model are consistent with the previous results. This is evidence suggesting that defining "integration" at the firm level, does not introduces a self-selection biased. Moreover we observed that the other firm-level controls appear to have the same coefficient and magnitude as in the previous model, which suggest that the results of our estimation are pretty robust. Consistently with our expectations plants that have

more sales, performing R&D and with higher capital intensity tend to have higher labour productivity. Interestingly, plants larger in terms of employees number, conditioning on all other observables, tend to be markedly less productive, which could be related to the low degree of flexibility imposed by the Mexican labour law.

Figure 11: 6-Digits Sectoral-Level Integration Treatments



The impact of NAFTA on plants belonging to sectors integrated through exports appear to be significant and positive for all years after 1996. NAFTA appears to have increased the difference in productivity of export-oriented firms with respect non-integrated firms between 8 per cent and 18 per cent. As before, the exchange rate devaluation may be introducing a an upward bias in the results, especially during the period 1995-1998. Interestingly, these coefficients appear to be larger towards the end of the period, in 1999-2000, than in the aftermath of the devaluation when the positive bias was stronger. It is likely that the effects of the trade reforms introduced by NAFTA are not immediate because firms may have to adjust to the new scenario.

Regarding the impact of NAFTA on firms belonging to sectors "integrated" via the use of imported intermediate inputs, the treatment is not significant except for 1997 when it is negative and significant. This is different with respect to our previous estimation defining integration at the firm-level, however two important caveats need to be considered. First, the coefficients may be downward bias because of the devaluation. Second, when we used the integration-status defined at sectoral level our identification power is being reduced in the sense that we are pooling together and assigning the same status to firm that belong to the same 6-digits sector but that are different in terms of their particular firm-level integration status.

5 Conclusions

In this paper we have analysed the evolution of Mexican firm level productivity during a period of trade reforms. In this paper we aimed to disentangle the trade-productivity linkages. In the first part of our empirical analysis we decomposed aggregate changes in labour productivity into changes in the *external* and *internal* components. In the second part of the paper we undertake a difference-in-difference approach to isolate the productivity effects of the reforms introduced by NAFTA.

Our decomposition exercise shows that while in the short-run the within-firm productivity changes appear to be the most important driver of aggregate productivity change, this component is also highly volatile. Overall the principal component of aggregate change is within-firm changes. However, also external restructuring and exiting jointly accounts for approximatively one third of the aggregate changes in productivity.

Our difference-in-difference approach allows for the reforms to have heterogenous impact across years and between firms with different integration status. Our results show that the impact on NAFTA on productivity is consistently positive for most of the years and across different integration status. However the magnitude of this impact differs across firms with different integration status. We also found that by lowering Mexican tariffs NAFTA had a positive impact upon firm productivity, most likely due to an increase in competition.

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A Appendix 1: Regression Tables

Table 2: Diff-in-Diff OLS with Firm Level "Integration Treatment"

	Variables	**(1)**	**(2)**	**(3)**
Integration Status	Exporter and Importer (DMX)	0.395***	-0.060**	-0.127***
		(0.029)	(0.023)	(0.023)
	Only Exporting (DnMX)	0.018	-0.022	-0.008
		(0.040)	(0.034)	(0.032)
	Only Importing (DmnX)	0.249***	-0.109***	-0.143***
		(0.026)	(0.021)	(0.020)
Year	1994	0.039	0.055**	0.054**
		(0.024)	(0.021)	(0.021)
	1995	-0.096***	0.035	0.049*
		(0.026)	(0.024)	(0.023)
	1996	-0.092***	-0.021	0.001
		(0.028)	(0.026)	(0.025)
	1997	-0.102***	-0.122***	-0.082**
		(0.030)	(0.029)	(0.028)
	1998	-0.169***	-0.172***	-0.130***
		(0.030)	(0.030)	(0.029)
	1999	-0.232***	-0.299***	-0.237***
		(0.036)	(0.039)	(0.038)
	2000	-0.128***	-0.241***	-0.164***
		(0.035)	(0.037)	(0.036)
Exporter and Importer	1994*DMX	0.201***	0.093**	0.080**
		(0.041)	(0.032)	(0.031)
	1995*DMX	0.338***	0.166***	0.144***
		(0.042)	(0.032)	(0.031)
	1996*DMX	0.320***	0.165***	0.149***
		(0.042)	(0.033)	(0.032)
	1997*DMX	0.215***	0.173***	0.146***
		(0.043)	(0.038)	(0.037)

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... table 2 continued

	Variables	(1)	(2)	(3)
	1998*DMX	0.260***	0.140***	0.111**
		(0.044)	(0.038)	(0.037)
	1999*DMX	0.296***	0.223***	0.184***
		(0.047)	(0.045)	(0.044)
	2000*DMX	0.139**	0.112*	0.079
		(0.046)	(0.045)	(0.043)
Only Exports	1994*DnMX	0.033	0.057	0.059
		(0.056)	(0.045)	(0.043)
	1995*DnMX	0.146**	0.090*	0.078
		(0.055)	(0.045)	(0.043)
	1996*DnMX	0.096	0.102*	0.079
		(0.056)	(0.048)	(0.046)
	1997*DnMX	0.086	0.140**	0.106*
		(0.056)	(0.048)	(0.046)
	1998*DnMX	0.107	0.151**	0.114*
		(0.058)	(0.052)	(0.050)
	1999*DnMX	0.163**	0.162**	0.127*
		(0.060)	(0.058)	(0.056)
	2000*DnMX	0.071	0.141*	0.087
		(0.064)	(0.062)	(0.060)
Only Imports	1994*DMnX	0.118**	0.103***	0.101***
		(0.036)	(0.028)	(0.027)
	1995*DMnX	0.204***	0.134***	0.118***
		(0.041)	(0.032)	(0.031)
	1996*DMnX	0.183***	0.098**	0.080*
		(0.043)	(0.037)	(0.035)
	1997*DMnX	0.126**	0.108**	0.087*
		(0.044)	(0.041)	(0.039)
	1998*DMnX	0.228***	0.057	0.050
		(0.046)	(0.042)	(0.040)
	1999*DMnX	0.223***	0.118*	0.105*
		(0.051)	(0.049)	(0.048)
	2000*DMnX	0.124*	0.039	0.026
		(0.051)	(0.048)	(0.047)

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... table 2 continued

	Variables	**(1)**	**(2)**	**(3)**
Competition Effect	Tariffs	0.011	-0.084***	-0.048***
		(0.006)	(0.006)	(0.007)
Firm Controls	Real Sales		0.689***	0.722***
			(0.007)	(0.008)
	Employment		-0.608***	-0.629***
			(0.008)	(0.009)
	R&D		0.083***	0.060***
			(0.012)	(0.012)
	Total Assets		-0.003	0.004*
			(0.002)	(0.002)
	FDI Participation		0.327***	0.253***
			(0.018)	(0.018)
	FDI Ownership		0.344***	0.274***
			(0.014)	(0.014)
Other Controls	Industry	No	No	Yes
	State	No	No	Yes
	Constant	Yes	Yes	Yes
	Robust SE	Yes	Yes	Yes
	R^2	0.078	0.628	0.655
	N	42014	22010	22010
Legend	* $p < 0.05$	** $p < 0.01$	*** $p < 0.001$	

Table 3: Diff-in-Diff OLS with Sectoral Level "Integration Treatment"

	Variables	**(1)**	**(2)**	**(3)**
Integration Status	Exporting Sector (DXIND6)	-0.071*	-0.094***	-0.086***
		(0.031)	(0.026)	(0.026)
	Importing Sector (DMIND6)	0.124***	-0.041*	-0.122***
		(0.024)	(0.018)	(0.018)
Year	1994	0.027	0.066**	0.064**
		(0.028)	(0.023)	(0.022)
	1995	0.031	0.074**	0.086***
		(0.030)	(0.025)	(0.024)
	1996	0.031	0.005	0.033
		(0.032)	(0.027)	(0.026)
	1997	0.024	-0.057*	-0.012
		(0.033)	(0.028)	(0.028)
	1998	-0.091*	-0.139***	-0.100***
		(0.036)	(0.030)	(0.030)
	1999	-0.137***	-0.295***	-0.235***
		(0.041)	(0.039)	(0.039)
	2000	-0.121**	-0.260***	-0.186***
		(0.041)	(0.039)	(0.039)
Exports Treatment	1994*DXIND6	0.106*	0.086*	0.051
		(0.041)	(0.035)	(0.034)
	1995*DXIND6	-0.024	0.049	0.029
		(0.040)	(0.033)	(0.032)
	1996*DXIND6	-0.056	0.114***	0.088**
		(0.040)	(0.034)	(0.033)
	1997*DXIND6	-0.066	0.139***	0.127***
		(0.040)	(0.035)	(0.034)
	1998*DXIND6	-0.130**	0.080*	0.087*
		(0.042)	(0.037)	(0.037)
	1999*DXIND6	-0.092*	0.149***	0.155***
		(0.043)	(0.040)	(0.039)

Continued on next page...

... table 3 continued

	Variables	**(1)**	**(2)**	**(3)**
	2000*DXIND6	-0.014	0.205***	0.180***
		(0.043)	(0.042)	(0.041)
Imports	1994*DMIND6	0.124***	0.055*	0.032
Treatment		(0.034)	(0.024)	(0.023)
	1995*DMIND6	0.099**	0.080**	0.035
		(0.035)	(0.026)	(0.025)
	1996*DMIND6	0.134***	0.059*	0.003
		(0.036)	(0.028)	(0.027)
	1997*DMIND6	0.108**	0.007	-0.059*
		(0.036)	(0.029)	(0.028)
	1998*DMIND6	0.217***	0.052	-0.002
		(0.039)	(0.031)	(0.031)
	1999*DMIND6	0.215***	0.121**	0.059
		(0.043)	(0.038)	(0.037)
	2000*DMIND6	0.186***	0.044	0.002
		(0.043)	(0.039)	(0.039)
Competition	Tariffs	-0.003	-0.083***	-0.051***
Effect		(0.006)	(0.007)	(0.007)
Firm Controls	Real Sales		0.688***	0.723***
			(0.007)	(0.008)
	Employment		-0.602***	-0.636***
			(0.008)	(0.009)
	R&D		0.094***	0.061***
			(0.012)	(0.012)
	Total Assets		-0.002	0.006**
			(0.002)	(0.002)
	FDI Participation		0.340***	0.254***
			(0.018)	(0.018)
	FDI Ownership		0.356***	0.277***
			(0.014)	(0.014)
Other Controls	Industry	No	No	Yes
	State	No	No	Yes
	Constant	Yes	Yes	Yes
	Robust SE	Yes	Yes	Yes

Continued on next page...

... table 3 continued

	Variables	**(1)**	**(2)**	**(3)**
	R-squared	0.021	0.626	0.656
	N	42014	22010	22010
Legend	* $p < 0.05$	** $p < 0.01$	*** $p < 0.001$	

B Appendix 2: Detailed Description of the Data Used

The EIA[20] is a yearly industrial survey that covers the manufacturing sector[21] and was originally started in 1963, when it only included 622 plants spread among 29 classes of activity. The original coverage was expanded in 1976, 1987 and 1994 when the classes of activities covered were respectively expanded to 57, 129 and 205, and the number of plants surveyed expanded to 1338, 3218 and 6867 respectively (see Table 4. Normally the expansion of the coverage coincided with a new industrial census, in this cases a new "picture" of the manufacturing sector allowed to establish which "new" activities and firms had emerged and had to be included and which ones where not any more important and could be excluded. The diversification and development of Mexican economy has therefore naturally lead to an expansion of the "manufacturing activities" in Mexico and therefore to an expansion of the coverage of the EIA. For this reason, it is likely that after the latest industrial census carried out in 2003 the EIA will see another an expansion of the classes of activity covered.

	N. of manufacturing activities covered	**N. of firms covered**
1963	29	622
1976	57	1,338
1987	129	3,218
1994	205	6,867

Table 4: EIA's Historical Evolution (Source: INEGI)

The unit of observation is the plant described as the manufacturing establishment where the production take place and the plant is classified in its respective class of activity based on its principal product. Whenever the plant is producing more than one product and the importance of the "secondary" product is not insignificant, in this case different questionnaire are applied and the plant is registered in different classes of activities.

Unfortunately, because of its design the EIA does not allow to identify plants that are part of a multi-plant complex because there is not any question about ownership [22]

B.1 The "new EIA"

The "new EIA", which is the survey used in this paper, started in 1993 (in correspondence with a new economic census) and implied a very important improvement over the "old

[20]Encuesta Industrial Anual

[21]It is important to notice that the "maquiladoras" are not included in the EIA"

[22]In the early years of the EIA with 205 classes, 1993 and 1994, there were various questions about ownerships, unfortunately since 1997 INEGI settled on a questionnaire which excluded these questions.

EIA" both in quantitative and qualitative terms. However, the changes implied by this improvements also make it more complex to link the two series.

The system of classification used is the CMAP94[23] (Clasificación Méxicana de Actividades y Productos) for the "new EIA" . The first digit indicates the sector (the EIA only includes firms which fall in the sector "3" corresponding to manufacturing sector). The second digit indicates the "división" (sub-sector or division), e.g. "31" indicates "food products, beverages and tobacco". At four digit the CMAP indicates the "rama" (sub-division branch) of activity. Finally, CMAP at six digit indicates the "clase" (class or type) of activity (e.g. "311203" indicates "preparation of condensed milk, evaporated milk and in powder"). The classification level that is used for the EIA is the CMAP at 6 digits which allow to identify the respective activity with a very high degree of detail.

B.1.1 Coverage and sampling structure

As previously mentioned the *new EIA* spans over the period 1993-2002[24] and it is very similar to the *old EIA* in terms of the sampling methodology. Here the sampling method is described in detail.

First INEGI select the class to be included in the following way:

1. Based on the industrial census of 1993 the classes are ranked in decreasing order based on their total value of production measured as the total output valued at the "factory gate" price for all the plants included in the class.
2. The most important classes, that jointly compose 85% percent of the total manufacturing output, are selected

Secondly, the selection of the plants within each of the already selected classes:

1. Plants are ranked in decreasing order based on their total value of production, measured as the total output valued at the "factory gate" price
2. Plants are selected until the set of the selected plants covers 85% of the respective class' output value
3. Each plant with 100 or more employees is included automatically, regardless if the 85% threshold has been reachead (this means that the survey is in reality a census for plants

[23]This system of classification can be harmonised with international systems as the SITC, regional systems as SCIAN, and other Mexican systems adopted in the past as the SCNM. For this purpose INEGI has developed appropriate tables of concordance

[24]In this study we just focus on the period 1993-2000 because of lack of data on tariffs for the years 2001 and 20002

with more than 100 employees)

4. For the highly dispersed classes (e.g. textile, footwear, etc.), whenever the normal sampling procedure implies that more than 120 plants need to be surveyed to reach the 85% treshold the number of plants surveyed is kept to a maximum of 120 (however all the plants with more than 100 employees are surveyed no matter how many plants have already been included. It is the case that for "highly disaggregated" sectors the actual coverage is at about 40% of the total manufacturing output of the respective class

5. For the highly concentrated classes, where the 85% threshold is reached by covering less than fifteen plants, then all the plants are included (for these classes of activities the survey is indeed a census)

The 1994 industrial census is the sampling frame on which the *new EIA* is based. Given the new "picture" of the manufacturing sector given by this census presented a more diversified economy, consequently in order to capture a representative sample of the most important classes and plants the sample was expanded to cover 205 of the 309 6-digits classes of the CMAP-1994. The "ramas" covered are all 50 included in the CMAP 1994, and the number of divisions covered are all the 9 divisions included in the CMAP 1994 . The number of firms covered in 1993 is 6861, this has been changing through time because the *new EIA* is an unbalanced panel that accounts for both entry and exit. Due to attrition the sample gets smaller through the time as the number of exiting firms is larger than that of entering ones.

Unfortunately the entering firms are captured non systematically and therefore are excluded from our analysis.

A very unique and useful feature of the *new EIA* is the way to capture exit. The plants are not eliminated from the sample at the precise moment when they become inactive, in fact they are kept as "suspended" for two years in a sort of of stand-by in case the cause of the suspension are temporaries. After the two years the plant exit the sample and the causes of this exit are recorded in details and can range among 9 different causes [25]. It is important to notice that a pure change of ownership is not recorded as a change whilst a change in the "type" implies the firm to exit and re-enter as a new firm [26].

Each firm is classified on the basis of its principal product, whenever it is the case that there

[25] Fusion, switching of class of activity, change of activity, change of trade name, disappeared, information reported by another plant, duplicated, administrative fusion, strike, liquidation, export maquila, domestic maquila, bankruptcy, unwilling to provide information, accident, suspension of operations

[26] Only since 1997 INEGI started to record systematically switcher when these plants were appearing in the new class of activity

are more than one principal products the firm is asked to complete different questionnaires. Using the EIM we can detect the plants that use different questionnaire, also since 1997 INEGI started to identify systematically the plants for which information provided in the EIA is by production line. Analogously, since 1997 INEGI started to identify systematically the plants that concentrate information also for other plants and the ones for which information is provided by other establishments.

B.2 Data Management