North American Integration and the Location of Foreign Direct Investment

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Abstract

We investigate how the North American Free Trade Agreement (NAFTA) has altered the pattern of foreign direct investment (FDI) in North America. The theoretical analysis suggests that NAFTA affects the incentives of U.S. and non-U.S. firms locating in Mexico differently and may lead to investment diversion from the U.S. Combining U.S. and Mexican FDI data and using a difference-in-differences estimator, we find that U.S. FDI in Mexico has increased since the inception of NAFTA in a manner that cannot be explained entirely by the usual FDI determinants. Other countries have been using Mexico as an export platform since before NAFTA with no discernible positive effect from the agreement. We find little evidence that inward U.S. FDI has been diverted. The results are robust to a number of different model and econometric specifications as well as the skill data used.

Keywords: Foreign Direct Investment, Multinationals, Export Platform, NAFTA.

JEL Classification: F15, F21, F23.

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1 Introduction

A salient feature of international economic relations is the recent proliferation of regional integration schemes. The European Union (EU) has expanded its membership into Eastern Europe while at the same time continuing its move towards "deep" integration. Many developing countries in Asia and South America have pursued economic integration amongst themselves (ASEAN, Mercosur) or have sought free trade agreements with other developed countries or blocs, such as the EU or the United States. In North America, the 1989 U.S.-Canada free trade agreement was followed quickly by the inclusion of Mexico into a North American Free Trade Agreement (NAFTA). The latter had been unique at the time as it combined two advanced developed with a developing country, a phenomenon dubbed the 'new regionalism' by Ethier (1998).

The ever increasing web of integration schemes has important effects on international economic interactions. Traditionally, the analysis of such agreements has focused on their impact on trade flows as they potentially lead to both trade creation (between the partners in the agreement) and trade diversion (from countries now outside of the agreement). But economic integration and its coincident reduction in trade barriers also alters the incentives for firms when making their location decisions. With NAFTA, the conventional wisdom is that the reduced trade barriers facing exports from Mexico into the U.S. increase the incentive for firms to locate in comparatively low-cost Mexico and use it as an export platform.

Another important reason why one would expect NAFTA to change the location pattern of multinational firms is the commitment effect conveyed by the agreement. The commitment value arises as integration agreements bind future regimes to reforms undertaken and acts beyond any effects due to specific provisions of the agreement. Thus it alleviates the well-known time inconsistency problem whereby countries have an incentive to impose a higher tax rate ex post although they had committed to national treatment for foreign investors ex ante. This consideration is particularly relevant for Mexico with its history of political instability, default and expropriations. Fernandez-Arias and Spiegel (1998) show that a trade accord indeed allows a country to sustain a higher level of investment than without it. Waldkirch (2006) examines the case of two Northern and one Southern country and finds that following integration between the Southern and one of the Northern countries, the commitment effect more strongly affects partner than non-partner investment due to trade creation and trade diversion effects.

Hence, while the incentive to locate in Mexico rather than the U.S. (or Canada) exists for both U.S. and non-U.S. firms, these incentives differ for firms from partner versus firms from non-partner countries. Beyond the differential commitment effect, the Maquiladora program provided for reduced duties for Mexican exports into the U.S. even before NAFTA. Upon re-importation, Section 9802 of the U.S. Harmonized Tariff Schedule stipulates that only the value-added part of the imported good is subject to duties. Moreover, U.S. duties were relatively low even before NAFTA. Hence, NAFTA may not greatly increase the incentive for U.S. firms to locate more production in Mexico as compared to non-U.S. firms. Moreover, as a free trade area rather than a customs union, NAFTA has relatively strict rules of origin. For example, 62.5 percent of an automobile must have North American content in order to qualify for duty-free treatment. This may reduce or increase the incentive for non-US firms to locate in Mexico. On the one hand, the size of the investment may be bigger than optimal in the absence of rules of origin. On the other hand, trying to force locating a production process that may be optimally placed at home, e.g. skilled labor intensive production, may tilt the incentive towards not locating any production in the free trade area. Finally, NAFTA reduces the trade cost of shipping any intermediate inputs to Mexico from the U.S., but not from other countries.

This paper investigates the effect of NAFTA on the location of foreign direct investment (FDI) in North America. Despite the great importance of the effects of economic integration on firm location, there is a dearth of empirical work in that area. Waldkirch (2003) uses aggregate inward FDI data for Mexico to find that NAFTA appears to have raised FDI from the U.S., but not from other countries. Cuevas et al. (2005) use results from a cross-country study to estimate a NAFTA effect on FDI generally of about 70 percent, but do not distinguish the source of investment. Our contribution to the literature is to investigate the effect of NAFTA on FDI more comprehensively by considering not just Mexican, but U.S. inward FDI and its possible diversion. Moreover, by employing a difference-in-differences estimator, we are better able to disentangle the effects of NAFTA from other changes in the world economy, such as a worldwide rise in multinational activity in the 1990s, unlike the aforementioned studies.

To motivate the empirical analysis, which is the main contribution of the paper, we consider a three-country model (two Northern countries and one Southern country) based on Ekholm et al. (2007). The Southern country is the low-cost location and firms from either Northern country may locate the final goods assembly process in the Southern country. Initially, trade costs are the same among all countries.[1] Then, one of the Northern countries integrates with the Southern country. We can think of this scenario as depicting the integration of the United States and Canada with Mexico in NAFTA.

There are a number of predictions that emerge from the theory. Chief among them is that not only may NAFTA increase FDI in Mexico by U.S. firms, but it may also decrease investment in the U.S., ceteris paribus, which we term 'FDI diversion'. The effect on non-U.S. investment in Mexico is potentially ambiguous, but is clearly different from the effect on U.S. investment for the reasons discussed above. Unlike in Ekholm et al. (2007) regional integration may not only lead non-U.S. FDI to be shifted from the U.S. to Mexico but also back to its home country. We then test these propositions via a single difference as well as a difference-in-differences estimator. We include the standard determinants of FDI identified in the recent work of Markusen (2002), which reduces the likelihood of spurious correlations, thus increasing our confidence that we indeed isolate the effect of NAFTA.

[1] Note, however, that we do incorporate the features of the Maquiladora program discussed above.

We use the standard FDI data from the Bureau of Economic Analysis (BEA) that has been widely used in many studies of the determinants of multinational activity, e.g. by Brainard (1997), Carr et al. (2001), Markusen and Maskus (2002), Blonigen et al. (2003) and Yeaple (2003) and add data on inward Mexican FDI from INEGI, the Mexican National Statistical Institute. Since we need to identify source countries of investment and use compatible data from the two sources, our data are stock data at the aggregate level. While most studies using U.S. data use affiliate sales, such data are not available for Mexico. Only flows and stocks of FDI are available from both sources. We can also not add industry detail. While the problem of different industry classification systems in the two countries could be overcome, albeit at the cost of somewhat problematic concordances, there is no industry-source country detail available for Mexico prior to 1994.[2] In order to estimate the effects of NAFTA, however, we need a reasonable amount of pre-NAFTA data.

We find that NAFTA has resulted in an increase in FDI in Mexico from the U.S., but not from other countries. We also find only scant, if any, evidence of FDI diversion from the U.S. However, we only include foreign investment data in our empirical analysis, while the theoretical model allows for a strictly domestic location configuration as well. Thus, we are not able to identify U.S. investments that switch from being domestic before, but become foreign (Mexican) after NAFTA. Investment diversion is solely by non-U.S. firms.

We do emphasize that our results appear to be very robust. We carefully correct for both country-pair specific autocorrelation as well as heteroscedasticity in our econometric analysis. We use skill data drawn from the International Labor Organization (ILO) as, e.g., Carr et al. (2001), but also the updated schooling data from Barro and Lee as, e.g., Blonigen et al. (2003). The results are also robust to the consideration of an "announcement effect" since NAFTA was anticipated before its formal inception.

[2] The U.S. and Mexico will both use the new North American Industry Classification System (NAICS) in the future, but while the U.S. has switched in 1997, all Mexican industry-level FDI is still only reported using the Mexican classification system, CMAP.

The paper proceeds as follows. The next section lays out a three-country model of the location choice of firms. While it restricts the set of possible location configurations for tractability, it is sufficiently general to allow for a range of relevant cases. The following section presents the empirical model which is designed to allow testing of the main hypotheses generated by the theory. After a discussion of our econometric approach and the data, the empirical results are presented, followed by concluding remarks.

2 The Theoretical Model

In this section we present a simple model of location choice and economic integration. There are three countries, two (initially identical) high- and one low cost country. There exists one firm in each of the high-cost countries that is faced with the decision where to produce an intermediate good and where to assemble the final good. We first formulate the assumptions and the game played by the firms. We cannot find an analytical solution to this quantity-location game. While we could use numerical simulations as in Ekholm et al. (2007), we instead concentrate on the equilibrium candidates by dropping the strictly dominated strategies for all parameter values. The remaining nodes of the game represent the "feasible equilibria". Then, we consider two scenarios: one where there is no economic integration and one where one of the high cost and the low cost country integrate. Finally, we compare the results of these two games to arrive at testable hypotheses.

Other studies that consider economic integration and FDI are Motta and Norman (1996) and Ekholm et al. (2007).[3] The former analyzes the effect of economic integration on trade and foreign direct investment activities of oligopolists. They show that economic integration, by improving market accessibility, will induce outside firms to invest in the integrated regional

[3] Grossman et al. (2006) examine the integration strategies of heterogeneous multinational firms in a three-country setting. They do not consider economic integration effects, although their model could be extended to do that.

bloc. They find that it is not necessarily the case that economic integration results in a net increase in FDI in the regional bloc. If there is intra-regional FDI prior to integration, due to increased market accessibility after integration indigenous firms from the region may switch to intra-regional exports. In Motta and Norman (1996), final goods production takes place in a single stage. In our model, on the other hand, the location of intermediate goods production is in the strategy space we consider.

Ekholm et al. (2007) also use a three-region model in which there are two identical, high cost northern economies and a small, low cost, southern economy. They find that pure export-platform production arises in the symmetric case, when a firm in each of the high cost economies has a plant at home, and a plant in the low cost country to serve the other high cost country. In their model this occurs when trade costs for intermediates and plant fixed costs are moderate and the low cost country has a moderate cost advantage in assembly. After trade liberalization between one of the high cost countries and the low cost country, they find that the insider northern firm chooses to locate in the southern country to service both its home market and the third country market. The outsider northern firm builds a branch plant inside the free trade area to serve the insider northern market, but chooses the low cost country on the basis of cost.

Our model differs from Ekholm et al. (2007) in a number of respects. First, we do not confine the production of intermediate goods to a firm's home market; instead we assume that at least one of the production facilities -intermediate or final- must be located in the home market. Second, we assume that firms' fixed costs are invariant to location strategy. Having made this assumption, we focus on different location configurations for sales only in the large, high-cost economy integrating with the small, low-cost economy. Third, our results point out that regional integration not only leads the outsider northern firm to shift production from the insider northern economy to the low-cost, southern economy but also back to its home country. The next section describes the game in more detail.

2.1 Description of the Game

Consider a one-period, two-stage static game in which there are three countries, denoted E (Europe), U (Unites States) and M (Mexico). Countries E and U are identical; they can be referred to simply as N (North). M is a small, low cost country. There exist two final goods sectors; X (increasing returns, imperfect competition) and Y (constant returns, perfect competition) and one intermediate good (component) Z. Good Y is produced from a single factor L (Labor), where one unit of L produces one unit of Y. Good X, on the other hand, is produced using the intermediate good Z and factor L, both in fixed proportions. The linear demand functions are derived from the quasi-linear utility function maximized subject to a budget constraint. Income is derived from labor and profits.

$$\max U = \phi X - \left(\frac{\theta}{2}\right) X^2 + Y \qquad \text{subject to} \quad L + \Pi = Y + pX \tag{1}$$

where wages and the price of Y are numeraires. The demand function for good X is as follows:

$$p = \phi - \theta X \tag{2}$$

We assume that there are two firms producing X, one headquartered in E and one in U, and these can be referred to as firms e and u, respectively. Each firm aims to maximize profit in country U through its choice of production location configuration and the quantities supplied to the market. In the first stage of this location-quantity game, each firm chooses its location configuration and in the second stage makes its quantity choice in a usual Cournot setting by taking the market location configuration from the previous stage as given. A strategy for firm h has two elements:

(i) the firm's production location configuration for sales in country U which is a set of ordered pairs

$$l^h = \{ij\} \tag{3}$$

where $h = (e, u\}$.The first element i signifies the location choice for the intermediate goods production and the second one j for the final goods production. The configuration $l^u = \{UM\}$, for example, means that firm u supplies its own market from an assembly plant in M which uses components produced in U. We assume that at least one of the production facilities -intermediate or final- must be located in the home market. As a further simplification, we assume that any production in M consists of final assembly, which confines the intermediate goods production sites to $i = \{E, U\}$ while final goods assembly can be done anywhere, $j = \{E, U, M\}$. Finally, since M is small, we assume that it has no domestic demand, and so neither firm will build a plant in M simply to serve M. These assumptions still leave us with a wealth of possibilities to explore such that there are a total of 4 location configurations for each firm which generates 16 potential market supply strategies in country U. Define a market location configuration as:

$$l = \{l^e, l^u\} \in L \tag{4}$$

where L is the set of all possible production location configurations for sales in country U.

(ii) the firm's quantity choice which is

$$x^h(l) \tag{5}$$

where $x^h(l) > 0$ indicates that firm h is active in country U; $x^h(l) = 0$ indicates that firm h chooses not to sell in country U. Costs of production for the two firms are assumed identical. Unit costs for components production in country i, (z_i) and final goods production in country j, (c_j) need not be identical. These costs are identical across E and U, but lower in M, i.e. $z_M < z_N$ and $c_M < c_N$.

Establishment by firm h of a production facility in country i or j incurs a set-up cost F and we simplify the analysis by assuming that these set-up costs are neither country nor firm specific. Observe that a firm's quantity choice in two markets is independent and determined by the market location configuration l, and therefore the total set-up cost of establishing production facilities for sales in country U always adds up to $2F$.

Trade costs are assumed to be ad-valorem. The tariff rate is $t_{ij} \in (0,1)$, $i \neq j$ for components trade from country i to country j, and $t_{jk} \in (0,1)$, $j \neq k$ for final goods trade from country j to country k. We assume that $t_{ij} = t_{jk} = t$ for the sake of simplicity. This rate becomes zero between a country pair in the case of economic integration. On a given link we assume that the cost is the same in both directions for reciprocity reasons.

Aggregate supply to consumers in country U given the market location configuration l, is:

$$X(l) = \sum_h x^h(l) \tag{6}$$

and the aggregate profit to firm h from sales in country U with market location configuration l and market quantity choice $x^h(l)$ is:

$$\Pi^h(l, x^h(l)) = (1-t)[p(X(l)]x^h(l) - \widehat{c}^h(l^h)x^h(l) - 2F \tag{7}$$

where $\widehat{c}^h(l^h) = [1+t]z_i + c_j$ for $i = \{E, U\}$ and $j = \{E, U, M\}$. For example if firm e chooses to produce the intermediates in E and assembles them in U for sales in U, then $l^e = EU$. In this case, the production costs will be $\widehat{c}^e(l^e) = [1+t]z_E + c_U$.

The exception is the configuration, $l^u = \{UM\}$, where $\widehat{c}^u(UM) = z_U + c_M$. Before integration, tariffs for imports of final goods from M to U are only levied on the value-added portion.[4] This is consistent with the Maquiladora program that has been in existence for many years and has facilitated production in Mexico by U.S. firms. It is important to account for the special provisions since they affect the impact of North American integration on partner versus non-partner firms.

Denote by $X^h(l)$ the set of possible quantity choices in market U for firm h given the market location configuration l. The Nash equilibrium for the second-stage quantity sub-game for any

[4] If we drop the location indicators and firm superscripts, in the Maquiladora case the profits of firm u can be written as $\Pi = p(X)x - z_U x - c_M x - t_{UM} z_U x - t_{MU}(p(X) - z_U)x - 2F$ where $(p(X) - z_U)x$ is the value added from the assembly activities. If $t_{UM} = t_{MU} = t$, then $\Pi = (1-t)p(X)x - \widehat{c}x - 2F$ where $\widehat{c} = z_U + c_M$.

market location configuration l is the market quantity choice $x^*(l)$ such that[5]:

$$\Pi^h(l, x^*(l)) \geq \Pi^h(l, x^h(l), x^{*-h}(l)) \qquad \text{for all } x^h(l) \in X^h(l) \tag{8}$$

Denote by $\Pi^{*h}(l^*)$ the profit to firm h from the Nash equilibrium market quantity choice corresponding to the production location configuration l. An equilibrium for the first-stage location game is a market location configuration l^* such that:

$$\Pi^{*h}(l^*) \geq \Pi^{*h}(l^h, l^{*-h}) \qquad \text{for all } l \in L \tag{9}$$

2.2 Before Integration

Table 1 presents the market supply strategies and their associated payoffs before integration. Each cell is assigned a number which is stated at the lower left corner of the corresponding cell. The payoffs are the profits made by each firm in the equilibrium of the Cournot game. Each cell in this table represents a market location configuration, $l = \{l^e, l^u\} \in L$ where elements of l describe the respective supply strategies of firms e and u in country U. For example, cell number 6 in Table 1 is $l = \{EU, UM\}$ which translates as follows: Firm e supplies country U from an assembly plant in U which uses components produced in E, whereas firm u supplies country U from an assembly plant in M which uses components produced in U.

[5] Aggregate profit to firms e and u from sales in country U with production location configuration L and market quantity choice $x^h(l)$ can be expressed respectively as follows:

$$\Pi^e(l, x^e(l)) = (1-t)[\phi - \theta X(l)]x^e(l) - \widehat{c}^e(l^e)x^e(l) - 2F$$
$$\Pi^u(l, x^u(l)) = (1-t)[\phi - \theta X(l)]x^u(l) - \widehat{c}^u(l^u)x^u(l) - 2F$$

where $X_k(l) = x^e(l) + x^u(l)$.

Maximizing these two equations with respect to $x^e(l)$ and $x^u(l)$ in that order and solving for $x^e(l)$ and $x^u(l)$ in the first order conditions gives the equilibrium profit levels for each firm as

$$\Pi^e(l, x^e(l)) = (1-t)\theta[x^e(l)]^2 - 2F$$
$$\Pi^u(l, x^u(l)) = (1-t)\theta[x^u(l)]^2 - 2F$$

where

$$x^e(l) = \frac{(1-t)^2\phi + (1-t)\widehat{c}^u(l^u) - 2(1-t)\widehat{c}^e(l^e)}{3(1-t)^2\theta} \quad \text{and}$$
$$x^u(l) = \frac{(1-t)^2\phi + (1-t)\widehat{c}^e(l^e) - 2(1-t)\widehat{c}^u(l^u)}{3(1-t)^2\theta}$$

We cannot find an analytical solution to this quantity-location game. While we could use numerical simulations, we instead concentrate on the equilibrium candidates by dropping the strictly dominated strategies for all parameter values. Then we derive the changes in these candidates due to economic integration. The shaded cells in the tables are the candidates for equilibria in this quantity-location game, namely the *feasible equilibria*.[6] Any one or more than one of these cells can be the equilibrium/equilibria depending on the parameter values.

Before economic integration between U and M, UE and EU are strictly dominated strategies for firm u and UE is a strictly dominated strategy for firm e. The intuition is that if firm u outsources any part of its production process, it will always be to M since it has lower production cost than E, while trade cost are no higher.

Lemma 1 *Prior to economic integration between U and M, if u does not invest in M, neither does e.*

Proof. See Appendix. ■

If the dominant strategy for firm u is $l^{u^*} = UU$ for sales in U, then EM can never be the dominant strategy for firm e. Note that firm e always deviates from cell number 3 to cell number 2 since the condition for UU to be dominant for firm u also satisfies the condition for EU to dominate EM for firm e. If firm u chooses to remain national, then even though unit costs are lower in M, firm e will not prefer to produce intermediates in E, ship them to M for assembly and reship the finished product to U and thus pay tariffs twice. In other words, if firm u chooses UU over UM, then firm e will never choose EM over EU since the production cost differences between North (E and U) and South (M) are not large enough to cover trade costs for both the shipment of the intermediates and the final products for firm e to prefer EM.

[6] A sample of the calculations that generate these results can be obtained from the authors on request.

2.3 After Integration

Given that we are chiefly interested in the effects of North American economic integration on foreign direct investment, we concentrate on the case in which a regional bloc is established between countries U and M. In that case, the tariff barriers on both intermediate and final goods trade between U and M are completely lifted, making $t_{UM} = t_{MU} = 0$.

Table 2 shows the payoff matrix after such integration. Notice the reductions in the number of candidate equilibria compared to the situation before integration. For firm u, UU, UE and EU are strictly dominated strategies and UE and EU are strictly dominated strategies for firm e. Only cells number 7 and 8 remain as equilibrium candidates after integration.[7]

Changes in the feasible equilibria after economic integration yield a rich set of propositions about FDI creation/diversion in each of the production locations. We restrict our attention to the possibilities which can be derived analytically without numerical simulations. All of our propositions assume that demand in both markets remains unaffected by integration.

Proposition 1 *Economic integration between U and M has an FDI diversion effect in U if $l^{e^*} = EU$ before integration.*

Proof. See Appendix. ■

This proposition rests on the fact that for firm e, the strategy involving production in U, EU, is a dominated strategy after integration. Thus, if before integration the dominant strategy is $l_U^{e^*} = EU$, then final assembly is shifted either to E, in which case there is only investment diversion, or to M, in which case there is investment creation in M. Note that UU becomes a dominated strategy for firm u, but since we focus on foreign, not domestic investment, we do not test this prediction of the model.

[7] Intuitively, one expects EM to dominate EE for firm e after integration since it involves lower assembly costs and a tariff only on the intermediate goods as opposed to higher assembly costs and a tariff on the final good in case of EE. However, note that after integration cell number 8 involves a higher market price when compared to cell number 7. Therefore, it is possible to observe EE as the dominant strategy for firm e and thus no FDI after integration. The proof is available upon request.

Proposition 2 *Economic integration between U and M increases firm u's investment in M if $l^{u^*} = UU$ before integration.*

Proof. See Appendix. ■

This proposition stems from the fact that UU becomes a dominated strategy for firm u after integration. If that strategy was dominant before integration, some production is shifted from U to M which is the dominant strategy for firm u after integration. If the pre-integration equilibrium is not UU, there may be no change in M-production by firm u.

Proposition 3 *Economic integration between U and M increases third-country (E) investment in M only if $l^{e^*} = EU$ and $l^{u^*} = UU$ before integration.*

Proof. See Appendix. ■

If the dominant strategy for firm e before integration is $l^{e^*} = EU$ and $l^{u^*} = UU$ for firm u, then final assembly is shifted to M by firm e, and non-partner country investment in M will increase. This is because the conditions for EU to be dominant for firm e before integration also satisfy the condition for EM to dominate EE for firm e after integration. Note that a switch from EM before integration to EE after integration (and thus investment diversion from M) is not possible since the condition for EE to be dominated before integration by any other strategy is the same after integration and does not involve the tariff between integrating countries.[8]

Conversely, if the dominant strategy for firm u before and after integration is $l^{u^*} = UM$, then firm e supplies U with exports from E. This is formalized in the following corollary.

Corollary 1 *If firm u has investment in M before integration (the Maquiladora case) then an increase in third-country (E) investment in M is not guaranteed.*

[8] However, the condition does involve the unit cost of producing in M. One could model rules of origin as increasing this unit cost since they force a firm to locate additional parts of the production process along with the optimally located ones in M in order to achieve the required minimum local content, as discussed above. In that case, a switch from EM to EE (and thus investment diversion from M) is a distinct possibility.

In summary, the model predicts that FDI in U may be diverted to M, and that both partner as well as non-partner country investment in the low-cost country, M, may increase. However, the conditions under which investment from the partner versus the non-partner country increases differ for the two sets of countries, i.e. the identity of the source country matters. Thus, the question whether there is investment diversion from the U.S. and investment creation in Mexico, and by whom, is an empirical one.

3 The Empirical Model

Our empirical strategy is to test the propositions from the theoretical model outlined above while including control variables drawn from the existing literature on the determinants of foreign direct investment.[9] These come from the seminal study by Brainard (1997) and the pioneering work of Markusen (1997) and Markusen (2002), which were put to an empirical test in Carr et al. (2001) and Markusen and Maskus (2002).

We test the propositions generated by the theoretical model employing a difference-in-differences estimator. Specifically, let

$$FDI_{ijt} = \alpha + \beta d_r + \gamma D_h + \delta \left(d_r \cdot D_h\right) \tag{10}$$

where FDI_{ijt} is FDI in i from source j at time t; r denotes the regime (NAFTA or non-NAFTA) and h denotes host-type, to be explained below. d_r is a dichotomous variable that is equal to one if the regime is NAFTA (1994 and later), and equal to zero if it is not.[10]

D_h is a vector of dichotomous variables, one for each of three host types. Let d_{h1} equal one if the U.S. is the host country of FDI, for any source country. Let d_{h2} equal one if Mexico is the

[9] Ekholm et al. (2007) also conduct an empirical analysis, which, however, is very different from ours. Their dependent variable is the share of affiliate sales of US multinationals that go to third countries rather than foreign investment. They only use US data and do not have a breakdown of these shares by country.

[10] As a robustness check, we vary the starting point of NAFTA in consideration of a possible announcement effect. We also experimented with including separate dichotomous variables for 1994 onwards and 1999 onwards, recognizing that tariff cuts were phased in. This did not change the results (Available upon request).

host and the U.S. is the source country. Finally, let d_{h3} equal one if Mexico is the host country and the source is any country other than the U.S. The model thus can be written as

$$FDI_{ijt} = \alpha + \beta d_r + \sum_{k=1}^{3} \gamma_k d_{hk} + \sum_{k=1}^{3} \delta_k \left(d_r \cdot d_{hk} \right) \tag{11}$$

The estimated impact of NAFTA for a particular host-type is then given by the δ_k's, the difference-in-differences estimator. Proposition 1, which states the possibility of FDI diversion from the U.S., implies that δ_1 is negative. Propositions 2 and 3, which state the possibility of increased FDI in Mexico from the U.S. and other countries, respectively, imply significantly positive δ_2 and δ_3, respectively. To see this, note that α is the baseline effect for observations that are pre-NAFTA ($d_r = 0$) and are not of a (future) NAFTA host ($d_{hk} = 0 \; \forall \; k$). Then, $\alpha + \beta$ is the effect of NAFTA on non-NAFTA hosts. The difference, i.e. the "NAFTA-effect" is therefore given by β. For host type k, the pre- and post-NAFTA effects on FDI are given by $\alpha +\gamma_k$ and $\alpha + \beta + \gamma_k + \delta_k$, respectively, with the difference, the "NAFTA-effect", being $\beta + \delta_k$. Hence, the difference-in-differences estimate is given by δ_k. While the signs, magnitudes and significance levels of the δ_k's are going to be of central interest, we will also report the single difference results.

Two comments on the use of the difference-in-differences estimator are in order before we proceed to the other controls included in the empirical model. First, since the effects of NAFTA are all relative to a control group, the identity of the control group matters. Our control group consists of countries other than the NAFTA countries that are hosts to U.S. FDI (see Table 3b for a listing of countries and years included). We have chosen this control group largely because it allows us to limit ourselves to just two data sources, the U.S. Bureau of Economic Analysis (BEA) and the Mexican Statistical Institute (INEGI). The data section below will provide more details on the data. The inclusion of other OECD countries would have required the use of other data sources where comparability questions and thus mismeasurement loom large and may seriously contaminate the results. One could argue that U.S. outward FDI may also be affected by NAFTA. However, most U.S. outward FDI is in other highly-developed countries which are quite dissimilar from Mexico and thus unlikely to contain many competing hosts. Secondly, Bertrand et al. (2004) point out econometric problems in the use of the difference-in-differences estimator. We discuss how we address these in the next section.

For other control variables to include in the empirical model, we appeal to the standard FDI literature. We employ the most general specification from Markusen and Maskus (2002) as our base specification. We also use similar specifications to those suggested in Blonigen et al., 2003, Braconier et al., 2005, and Waldkirch, 2003.[11]

Thus, we augment the model by including the following controls:

$$FDI = f \begin{pmatrix} sumgdp, gdpdiffsq, d2skdgdpd, d2skdsumg, d1skdsumg, \\ invcosthost, topenhost, topensrc, distance \end{pmatrix} \tag{12}$$

The first term, *sumgdp*, is expected to be positive as larger combined market size will encourage foreign production. The second term, *gdpdiffsq*, squared differences in GDP between the host and the parent country of foreign investment, is expected to be negative as unequal-sized countries should encourage exporting rather than setting up a plant in the foreign market.

The next three terms are more complicated interaction terms. The third term, *d2skdgdpd*, interacts skill differences with GDP differences and a dummy equal to one if the skilled labor abundant country is the parent country. Multinationals are discouraged if skill and GDP differences are too large since the market of the small country is too small and the skilled labor abundant parent country has a comparative advantage in (skill-intensive) headquarter services. The other two terms are interactions of GDP sums and skill differences. The fourth term, *d2skdsumg*, is again nonzero if the parent country is skilled-labor intensive. Skill differences encourage vertical differentiation of the production process, but not horizontal multinationals, since skill differences make skilled labor too expensive in that case. Therefore, its sign is theoret-

[11] For a detailed discussion of the knowledge-capital model and its empirical implementation, see Markusen's (2002) book.

ically ambiguous. The next term, *d1skdsumg*, is nonzero if the skilled labor abundant country is the host country of investment. If this is the case, inward FDI is discouraged for all types of multinationals since the skilled labor abundant country would be expected to be the parent, but not the host country of investment. As a robustness check, we include simpler skill variables for both source and host countries.

Four additional controls are included. First is a measure of the cost of investing in the host country. It accounts for formal investment barriers as well as the overall economic climate that affects the decision where to invest. Higher investment costs deter FDI and hence a negative sign is expected for this regressor. Parent country and host country (Mexican) trade costs are measured by the ratio of exports plus imports to GDP, an often used measure for the trade openness of a country. It is used over others because it is available for the entire sample period. Since greater openness corresponds to lower trade costs, a positive sign is expected for parent country, but a negative sign for host country trade costs.[12] Finally, distance is measured as the distance between country capitals. Its sign is theoretically ambiguous since it can proxy for both trade and investment costs. It is included since it usually performs well in gravity-type models.

We should note that ascribing the effects that we find solely to NAFTA is clearly problematic as other events during the time period that we are looking at may affect the pattern of FDI as well and we have only limited ways to control for those. In addition to NAFTA, Mexico joined the OECD in 1994, but more importantly, the 1994 peso crisis led to a steep real depreciation of the peso, followed by a real appreciation in the years afterwards. We control for these effects by including Mexican GDP, which fell considerably in 1995. We could also include exchange rates in order to account more directly for the monetary effects of the crisis, but chose to follow real trade theory and omit them.[13]

[12]Endogeneity may be a concern with this openness measure. However, other measures such as an index from the Global Competitiveness Report are highly correlated with any measure of investment cost. In any case, omitting the openness variables does not change the qualitative results.

[13]We did include exchange rates as a robustness checks, which did not affect the results at all.

4 Econometric Considerations and Data

4.1 Econometric Considerations

The data are in panel form and preliminary tests indicated that both autocorrelation and heteroscedasticity were present. Therefore, we use a panel data model (Prais-Winsten regression) with panel corrected standard errors. We report results from regressions where the autocorrelation coefficient is assumed to be different for each observational unit (country pair). The variance-covariance matrix is computed under the assumption that the disturbances are heteroscedastic and contemporaneously correlated across units, where each pair of cross-sectional units has their own covariance. For each element in the covariance matrix, all available observations that are common to the two units contributing to the covariance are used to compute it, given that the panel is unbalanced.[14]

We have an unbalanced panel because not all data are available for all years of the sample period. We apply the following rules. Since we are primarily interested in the effects of NAFTA, we need sufficient data for both the pre- and the post-NAFTA time periods. We have at most seven years of post-NAFTA data (1994-2000) and only use country-pair observations for which we have at least seven years of pre-NAFTA information for all variables. In order to implement the correction for autocorrelation, no gaps in the data are allowed. Hence, when there is a gap, we limit ourselves to using post-gap information. In other words, if 1983 is available, 1984 is missing, and 1985 onwards is available, the data for this country-pair starts in 1985. One of the robustness checks uses a larger number of observations, although a minimum of five must still be imposed in order to allow for the computation of the autocorrelation coefficients for all country pairs.

Bertrand et al. (2004) point out that ignoring serial correlation in difference-in-differences

[14] We also ran the regressions under the assumption of a common AR coefficient, which resulted in no qualitative changes in the difference-in-differences results. These are available upon request.

estimation can lead to severely biased standard errors. While we account for the problem by estimating a first-order autocorrelation coefficient, we also use one of the techniques they suggest which works well for samples of more than 20 observational units (we have at least 70 country pairs). It requires estimating standard errors while allowing for an arbitrary covariance structure between time periods, using a generalized White-like formula. This estimator of the variance-covariance matrix is consistent as the number of country pairs tends to infinity.

4.2 Data

Mexican FDI data come from the Mexican National Statistical Institute (INEGI). These are FDI stocks in Mexico from 1980 on, published in U.S. dollars. In the empirical analysis, nominal values are converted to real dollars using the U.S. producer price index for capital equipment. The data distinguish ten source countries throughout the sample period. They account for about 90 percent of total FDI in Mexico. Since 1994, more source country and especially industry detail is available, but since we need sufficient pre-1994 data, we cannot use the additional detail in this study. No industry or additional source country detail is available retroactively for the time before NAFTA.

For most of the 1980s, investment flows exhibit large variation, for example around the time of Mexico's financial crisis in the early 1980s, but do not increase much over time. They do increase noticeably in the late 1980s and then a large and sustained increase occurs with the inception of NAFTA. The first substantial increase in FDI in the late 1980s and early 1990s coincided with a major overhaul of Mexico's investment laws in 1989. Many obstacles to foreign investors, such as licensing requirements and restrictions pertaining to majority ownership, were removed. This change reversed Mexico's long-standing policy of reserving ownership in many sectors to Mexican nationals or the Mexican state and encouraging foreign investment only in sectors that were deemed crucial to the pursuit of import substitution policies. At the same time, and earlier than in many other countries in the region, substantial privatizations occurred. By 1994, the number of state-owned enterprises had decreased to only 80, down from 1155. However, as Franko (1999: 158-61) points out, foreign investors participated in this sale only to a small degree. FDI from privatization constituted only 7.9 percent of total FDI between 1990 and 1995. Yet, during the first half of the 1990s, Mexico was the major recipient of FDI in Latin America. Brazil subsequently surpassed Mexico in that role, mainly because Brazil's major privatizations occurred in the second half of the 1990s. Lately, greenfield investment and acquisitions of local firms have dominated in Mexico. In 1997, 62 percent of FDI consisted of international investors acquiring local firms. According to CEPAL (1999), recent large acquisitions include several banks, beverage and tobacco companies.

The United States has been the most important source country both before and after 1994. Sizable flows have also originated in European Union countries and Japan. The share of North American investment in Mexico has decreased since 1994, even though Canada's share alone has increased. The U.S. share has fallen from over 80 percent in the early 1980s to about 60 percent since NAFTA took effect. The vast majority of foreign investment originates in other developed countries. The only sizable investment flows from other countries are from South Korea and India, the latter being largely a one-time large purchase of a Mexican steel company.

U.S. inward and outward FDI data come from the standard source used in most studies of U.S. FDI, the Bureau of Economic Analysis (BEA). These data are described in detail elsewhere. Figure 1 shows the evolution of FDI in Mexico and the United States since 1980.

Control variable data also come from standard sources. We use PPP-adjusted GDP data from the Penn World Tables (6.1). Trade data come from the same source. For investment costs, we use the comprehensive measure from Business Environment Risk Intelligence (BERI), which is a composite measure of operations risk, political risk, and a remittance and repatriation factor index. We adjust it such that a higher number corresponds to higher costs.

An important control variable in many studies is skill. The two most common sources of skill data are the International Labor Organization (ILO) and the Barro/Lee data on schooling. We use both in our analysis to ensure the robustness of our results. The ILO data measure the number of workers in a particular occupation and characterize some as skilled, some as unskilled, employing the skill definitions from Carr et al. (2001). A country's skill level then is represented by the share of skilled workers. We fill in missing data using a linear trend between non-missing years. For just a few countries, additional years are filled in using the growth rate of the skilled labor share between non-missing years. Alternatively, we use the Barro/Lee data on years of schooling. These are available only in five-year intervals and we fill in missing values using a linear trend as well.[15] Table 3a contains summary statistics; Table 1b lists the countries and years, separately for host and source observations.

5 Results

Tables 4-7 report the results. Tables 4a and 6a show the results from running a Prais-Winsten regression as outlined above and Tables 4b and 6b contain robustness checks. Table 4 uses the ILO skill data, while Table 6 uses the Barro/Lee skill data. Tables 5 and 7 present the simple difference and the difference-in-differences estimation results, which are of central interest here.

The results reported in the first three rows of Tables 5 and 7 test Propositions 1-3. Specification (1) is our base specification. The sample contains only source-host country pairs for which we have at least 14 observations, i.e. sufficient pre- and post-NAFTA information. Specification (2) includes country pairs with fewer observations, which increases the sample size from 1,387 to 1,595 observations. However, many of the newly included country pairs still have twelve or 13 observations. Specification (3) accounts for a possible announcement effect by starting the NAFTA regime dummy in 1992 rather than 1994.[16]

[15] Filling in missing values with repeated values from prior or future years does not change the results.

[16] Dating the announcement effect to 1991 or 1993 makes no difference to the results. These are available upon

Turning to Table 3, we first notice that there is only scant evidence of a FDI diversion effect from the U.S. since the effect, while negative, is statistically significant at only the ten percent level in one specification and then only when looking at the simple difference estimator ($\beta+\delta_1$). It is not significant in any of the difference-in-differences results (δ_1).[17]

This remains true for several robustness checks. Specification (4) uses simple skill variables instead of the complex interaction terms suggested by Markusen and Maskus (2002). We include the share of skilled workers in the total workforce separately for host and source countries of FDI. Specifications (5) and (6) use an alternative econometric technique, suggested by Bertrand et al.'s (2004) concern about serial correlation in difference-in-differences estimations. While the Prais-Winsten method corrects for serial correlation, Bertrand et al. (2004) show that the correction may not be appropriate since it does not take into account second- or third-order autocorrelation. Thus, we apply one of their suggested solutions, namely computing an arbitrary variance-covariance matrix, to both our base specification (1) and the specification with simpler skill terms. Results are shown in the bottom half of Table 5.

The difference-in-differences estimator for inward U.S. FDI is marginally negative in (5), but not in any other specification. When using the Barro/Lee skill data (Table 7), none of the computed effects on U.S. inward FDI are significant. We thus conclude that there is at best very weak evidence of a FDI diversion effect from the U.S.

The next row of Tables 5 and 7 addresses FDI from the U.S. into Mexico. Here, there is a statistically significant and economically large positive effect, suggesting that NAFTA has led to an increase in FDI in Mexico from the U.S. Almost all coefficients, whether simple difference ($\beta+\delta_2$) or difference-in-differences (δ_2), are significant at the one percent level, regardless of specification or skill data used. Thus, this is an extremely robust result. In order to get a sense of the estimated economic effect of NAFTA for U.S. investment in Mexico, we can calculate the

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request.

[17] Calculating the economic effect from the point estimates reveals that, if significant, NAFTA results in an eight percent drop in inward U.S. FDI.

predicted amount of FDI by the final year of the sample period with and without NAFTA. We find that this stock is about 24 percent higher than it would have been without NAFTA. We stress again that this effect includes events that we did not control for. Nonetheless, NAFTA appears to have had an important effect on U.S. FDI in Mexico.[18]

The final row in Tables 5 and 7 shows the estimated NAFTA-effect on FDI from non-U.S. sources into Mexico. Here, the results are somewhat mixed. All twelve simple difference estimates have a negative sign, four significantly so. Only two difference-in-differences estimates are significantly negative, the rest are not statistically significant. We can conclude that we cannot find any evidence of an increase of non-U.S. FDI in Mexico due to NAFTA, although there may have been a decrease. The reason appears to be that FDI from these sources was much higher than implied by the usual determinants even before NAFTA was implemented, as suggested by the uniformly large and significantly positive coefficient γ_3, which indicates that effect.

The differential results with respect to U.S. and non-U.S. FDI into Mexico underscore the importance of distinguishing between these two fundamentally different sources of FDI. They also confirm findings elsewhere using only Mexican data (Waldkirch, 2003, Cuevas et al., 2003). The novel result here is that this is confirmed when we add U.S. (inward and outward) data and that there is little, if any, evidence of a FDI diversion effect in the U.S.

The determinants of FDI shown in the first half of Tables 4a/4b and 6a/6b largely have the expected signs and are statistically significant, although the choice of skill data apparently matters. As shown in other work, total market size has a large positive effect on FDI, whereas market size differences deter it. The signs on the skill variables are mostly consistent with Markusen's knowledge-capital model, although more so when using the ILO skill data. Consis-

[18] Note that the model appears to be doing well in predicting FDI. The correlation between actual and predicted FDI stocks is 0.65, statistically significant at the one percent level. Blonigen and Davies (2004) find that in their data, the residuals are unreasonably large and differ systematically between rich and poor countries. Our residuals appear to be of reasonable size and do not differ in any systematic way.

tent with the predictions of that model, host country investment costs have a negative, source country trade openness has a positive effect, while the effect of host country openness is more ambiguous, though largely positive.

In summary, we find that NAFTA has affected the location of North American FDI largely by increasing U.S. FDI in Mexico. Other countries have been using Mexico as an export platform well before NAFTA. There is hardly any evidence of FDI diversion from the U.S. The inclusion of determinants of FDI that are well-established in the literature, a careful econometric specification that corrects for autocorrelation and heteroscedasticity, and the use of various measures of skill endowments make us confident that our results provide a good assessment of the effect of NAFTA on the pattern of FDI in the United States and Mexico.

6 Conclusion and Directions for Future Work

This paper has investigated the effect of the North American Free Trade Agreement on the distribution of FDI in North America. We built a simple three-country model of location choice. While the model is straightforward, it generates several interesting propositions. There is a possibility that NAFTA results in FDI diversion from the United States. While FDI in Mexico is likely to increase, the incentives for firms from NAFTA partners versus non-partner countries are affected differently. This is due to the existence of the Maquiladora program before NAFTA, but also to strict rules of origin and a possible commitment effect that affect partner countries more than non-partner ones.

To our knowledge, this is the first paper that combines both U.S. and Mexican FDI data to test these hypotheses. Using a careful econometric analysis, we find that U.S. FDI in Mexico was positively affected by NAFTA. At the same time, there is scant, if any, evidence of FDI diversion from the U.S. Non-U.S. firms have been using Mexico as an export platform to the U.S. well before NAFTA and we find no evidence that NAFTA has resulted in an increasing use of Mexico as a production location for these countries. If anything, FDI may have decreased. These results are robust to the nature of the skill endowment data chosen, the consideration of an "announcement" effect as well as to the inclusion of country-pair observations with a shorter time series. Moreover, we carefully take the serial correlation in the data into account and employ specifications that avoid biasing our standard errors.

In future work, we will consider several extensions, both to the theory and the empirics. The theory should incorporate plant-level scale economies through an integrated equilibrium approach. In order to draw distinct conclusions, however, this will require numerical solutions. We also envision a dynamic rather than a static game for economic integration, which will be capable of including announcement and commitment effects more formally.

On the empirical side, we note that even in its current form, our theoretical model also provides a rich set of results regarding the effect of NAFTA on trade within the region as well as with other countries. These conclusions can be tested using available trade data. We are especially interested in separating out the effects on intermediate versus final goods trade.

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Table 1: Payoff Matrix and Feasible Equilibria, Market U, Before Integration

Firm u \ Firm e	UE	EU	EM	EE
UU	$\Pi^e_{bi}(UE,UU)$ 1 $\Pi^u_{bi}(UE,UU)$	$\Pi^e_{bi}(EU,UU)$ 2 $\Pi^u_{bi}(EU,UU)$	$\Pi^e_{bi}(EM,UU)$ 3 $\Pi^u_{bi}(EM,UU)$	$\Pi^e_{bi}(EE,UU)$ 4 $\Pi^u_{bi}(EE,UU)$
UM	$\Pi^e_{bi}(UE,UM)$ 5 $\Pi^u_{bi}(UE,UM)$	$\Pi^e_{bi}(EU,UM)$ 6 $\Pi^u_{bi}(EU,UM)$	$\Pi^e_{bi}(EM,UM)$ 7 $\Pi^u_{bi}(EM,UM)$	$\Pi^e_{bi}(EE,UM)$ 8 $\Pi^u_{bi}(EE,UM)$
UE	$\Pi^e_{bi}(UE,UE)$ 9 $\Pi^u_{bi}(UE,UE)$	$\Pi^e_{bi}(EU,UE)$ 10 $\Pi^u_{bi}(EU,UE)$	$\Pi^e_{bi}(EM,UE)$ 11 $\Pi^u_{bi}(EM,UE)$	$\Pi^e_{bi}(EE,UE)$ 12 $\Pi^u_{bi}(EE,UE)$
EU	$\Pi^e_{bi}(UE,EU)$ 13 $\Pi^u_{bi}(UE,EU)$	$\Pi^e_{bi}(EU,EU)$ 14 $\Pi^u_{bi}(EU,EU)$	$\Pi^e_{bi}(EM,EU)$ 15 $\Pi^u_{bi}(EM,EU)$	$\Pi^e_{bi}(EE,EU)$ 16 $\Pi^u_{bi}(EE,EU)$

Table 2: Payoff Matrix and Feasible Equilibria, Market U, After Integration

Firm u \ Firm e	UE	EU	EM	EE
UU	$\Pi^e_{ai}(UE,UU)$ 1 $\Pi^u_{ai}(UE,UU)$	$\Pi^e_{ai}(EU,UU)$ 2 $\Pi^u_{ai}(EU,UU)$	$\Pi^e_{ai}(EM,UU)$ 3 $\Pi^u_{ai}(EM,UU)$	$\Pi^e_{ai}(EE,UU)$ 4 $\Pi^u_{ai}(EE,UU)$
UM	$\Pi^e_{ai}(UE,UM)$ 5 $\Pi^u_{ai}(UE,UM)$	$\Pi^e_{ai}(EU,UM)$ 6 $\Pi^u_{ai}(EU,UM)$	$\Pi^e_{ai}(EM,UM)$ 7 $\Pi^u_{ai}(EM,UM)$	$\Pi^e_{ai}(EE,UM)$ 8 $\Pi^u_{ai}(EE,UM)$
UE	$\Pi^e_{ai}(UE,UE)$ 9 $\Pi^u_{ai}(UE,UE)$	$\Pi^e_{ai}(EU,UE)$ 10 $\Pi^u_{ai}(EU,UE)$	$\Pi^e_{ai}(EM,UE)$ 11 $\Pi^u_{ai}(EM,UE)$	$\Pi^e_{ai}(EE,UE)$ 12 $\Pi^u_{ai}(EE,UE)$
EU	$\Pi^e_{ai}(UE,EU)$ 13 $\Pi^u_{ai}(UE,EU)$	$\Pi^e_{ai}(EU,EU)$ 14 $\Pi^u_{ai}(EU,EU)$	$\Pi^e_{ai}(EM,EU)$ 15 $\Pi^u_{ai}(EM,EU)$	$\Pi^e_{ai}(EE,EU)$ 16 $\Pi^u_{ai}(EE,EU)$

Table 3a: Summary Statistics for Basic Specification, Alternative Skill Measures

	ILO skill measure			Barro/Lee skill measure		
Regressor	Mean	Median	S.D.	Mean	Median	S.D.
realfdi	12,542	2,088	26,918	11,110	1,682	25,163
sumgdp	6,404	6,743	2,361	6,546	6,795	2,357
gdpdiffsq	3.6E07	3.6E07	2.1E07	3.6E07	3.6E07	2.1E07
d2skdgdpd	213.6	0	517.6	11,251	0	17,132
d2skdsumg	355.4	81.49	533.3	13,607	0	19,668
d1skdsumg	314.6	0	523.1	16,523	1,959	20.670
invcosthost	39.99	31.67	13.84	39.37	31.67	13.45
topenhost	37.49	25.97	28.35	35.55	25.66	26.59
topensrc	43.80	29.55	36.39	43.27	31.76	34.64
distance	8,020	7,130	3,547	8,278	7,222	3,693
dNAFTA	0.45	0	0.50	0.46	0	0.50
dUShost	0.47	0	0.50	0.50	1	0.50
dMexhostUS	0.02	0	0.12	0.01	0	0.11
dMexhostnonUS	0.14	0	0.34	0.12	0	0.33

Table 3b: Countries and Years Included

Country	Years Source	Years Host	Country	Years Source	Years Host
United States	1980-2000	1982-2000	Italy	1980-2000	1982-2000
Mexico	1980-2000	1980-2000	Japan	1980-2000	1982-2000
Argentina	1980-2000	1982-2000	Korea	-	1982-2000
Australia	1980-2000	1982-2000	Malaysia	1980-2000	1982-2000
Austria	1980-2000	1982-2000	Netherlands	1980-2000	1982-2000
Belgium	1980-2000	1982-2000	New Zealand	1980-2000	-
Brazil	1980-2000	1982-2000	Norway	1980-2000	1982-2000
Canada	1980-2000	1982-2000	Pakistan	-	1982-2000
Chile	1985-2000	1982-2000	Panama	1980-2000	-
Colombia	1980-2000	1982-2000	Peru	-	1982-2000
Czech Rep.	-	1993-2000*	Philippines	1980-2000	1982-2000
Denmark	1980-2000	1990-2000	Poland	1984-2000	1989-2000*
Ecuador	1982-2000	1982-2000	Portugal	-	1990-2000*
Egypt	-	1982-2000	Spain	1980-2000	1982-2000
Finland	1980-2000	1990-2000*	Sweden	1980-2000	1982-2000
Germany	1980-2000	1982-2000	Switzerland	1980-2000	1982-2000
Greece	1986-2000	-	Thailand	1980-2000	1982-2000
Hong Kong	1980-2000	-	Turkey	1984-2000	1989-2000*
Hungary	-	1990-2000*	United Kingdom	1980-2000	1982-2000
Ireland	1986-2000	1982-2000	Uruguay	1989-2000*	-
Israel	1980-2000	1982-2000	Venezuela	-	1982-2000

Notes: * indicates that this country is only included in the extended sample (5+ observations), not in the base sample.

Table 4a: Prais-Winsten Regression Results: ILO Skill Data

Regressor	(1) 14+ observation	(2) 5+ observations	(3) Announcement Effect
sumgdp	28.68***	28.76***	28.58***
	(2.981)	(3.023)	(3.074)
gdpdiffsq	-0.001***	-0.002***	-0.001***
	(0.0002)	(0.0002)	(0.0002)
d2skdgdpd	-16.21***	-14.57***	-16.33***
	(2.975)	(2.841)	(3.025)
d2skdsumg	1.563	3.244	1.848
	(2.338)	(2.265)	(2.364)
d1skdsumg	-3.149**	-2.136	-3.124**
	(1.556)	(1.483)	(1.484)
invcosthost	-147.8	-217.7**	-167.7*
	(108.5)	(106.7)	(108.7)
topenhost	193.4***	133.4***	180.4***
	(35.88)	(28.17)	(35.85)
topensrc	132.4***	132.5***	112.8***
	(18.99)	(19.84)	(17.97)
distance	-1.663***	-1.755***	-1.633***
	(0.296)	(0.304)	(0.287)
β	-1,758	-1,840	-508.2
	(2,175)	(1,787)	(2,181)
γ_1	-13,840***	-12,853***	-14,355***
	(4,879)	(4,778)	(5,058)
γ_2	-6,909***	-7,071***	-6,721***
	(2,317)	(2,375)	(2,331)
γ_3	69,153***	71,589***	67,242***
	(9,332)	(9,348)	(9,609)
δ_1	-1,242	-559.0	-1,615
	(1,194)	(725.9)	(1,219)
δ_2	13,421***	14,959***	9,873***
	(2,685)	(2,886)	(2,721)
δ_3	-532.0	319.9	-763.9
	(3,157)	(2,531)	(3,084)
Number of obs.	1,387	1,475	1,387
R^2	0.46	0.45	0.45
Wald χ^2	464.6	442.9	334.1
Prob > χ^2, p-value	0.00	0.00	0.00
Average autocorr.	0.847	0.852	0.848

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. All regressions include a constant and a time trend (not reported). Regressions correct for first-order autocorrelation where autocorrelation coefficients are estimated separately for each country pair. Covariances vary across country pairs. See the text for details.

Table 4b: Robustness Checks: ILO Skill Data

Regressor	(4) Simple Skill	(5) Arbitrary VCE Base specif.	(6) Arbitrary VCE Simple Skill
sumgdp	27.36***	16.22***	17.40***
	(2.839)	(3.705)	(3.310)
gdpdiffsq	-0.001***	-0.001***	-0.01***
	(0.0002)	(0.0003)	(0.0003)
d2skdgdpd		-30.10***	
		(6.482)	
d2skdsumg		12.24	
		(7.882)	
d1skdsumg		-1.560	
		(4.741)	
Skill source	86,419***		83,011***
	(18,209)		(27,893)
Skill host	93,888***		116,106***
	(18,855)		(42,328)
invcosthost	-124.8	357.8	398.5
	(114.0)	(327.0)	(292.5)
topenhost	102.0***	212.6**	172.5**
	(36.73)	(101.3)	(83.38)
topensrc	118.2***	99.27*	88.80
	(23.15)	(53.13)	(56.08)
distance	-1.567***	-1.116**	-0.775*
	(0.298)	(0.483)	(0.411)
β	-3,011	6,280*	142.9
	(2,100)	(3,518)	(2,950)
γ_1	-6,181	-1,135	4,235
	(5,333)	(10,637)	(9,652)
γ_2	-3,669	187.9	4,642
	(2,648)	(4,153)	(3,785)
γ_3	87,826***	25,998**	51,891***
	(11,427)	(11,903)	(11,418)
δ_1	492.6	-10,041*	-1,782
	(1,232)	(5,526)	(4,319)
δ_2	11,192***	16,811***	16,477***
	(2,524)	(4,032)	(4,022)
δ_3	-2,011	-15,877**	-12,956**
	(2,641)	(6,104)	(5,103)
Number of obs.	1,387	1,387	1,387
R^2	0.49	0.47	0.48
Wald χ^2	551.0	.	.
Prob > χ^2, p-value	0.00	.	.
Average autocorr.	0.842	N/A	N/A

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. All regressions include a constant and a time trend (not reported). Specification (4) corrects for first-order autocorrelation where autocorrelation coefficients are estimated separately for each country pair. Covariances vary across country pairs. Specifications (5) and (6) compute an arbitrary variance-covariance matrix. See the text for details.

Table 5: The Effect of NAFTA on North American FDI, ILO Skill Data

	(1)	(2)	(3)
	14+ observations	5+ observations	Announcement Effect
Simple difference U.S. FDI - $\beta + \delta_1$	-3,000* (1,780)	-2,399 (1,719)	-2,124 (1,773)
Simple Difference U.S. FDI in Mexico - $\beta + \delta_2$	11,663*** (3,300)	13,119*** (3,382)	9,365*** (3,480)
Simple Difference non-U.S. FDI in Mexico - $\beta + \delta_3$	-2,290 (1,750)	-1,520 (1,616)	-1,272 (1,763)
Difference-in-differences U.S. FDI - δ_1	-1,242 (1,194)	-559.0 (725.9)	-1,615 (1,219)
Difference-in-differences U.S. FDI in Mexico - δ_2	13,421*** (2,685)	14,959*** (2,886)	9,873*** (2,721)
Difference-in-differences non-U.S. FDI in Mexico - δ_3	-532.0 (3,157)	319.9 (2,531)	-763.9 (3,084)

	(4)	(5)	(6)
	Simple skill	Arbitrary VCE Base specif.	Arbitrary VCE Simple skill
Simple difference U.S. FDI - $\beta + \delta_1$	-2,518 (2,090)	-3,761 (3,143)	-1,639 (2,528)
Simple difference U.S. FDI in Mexico - $\beta + \delta_2$	8,181*** (2,965)	23,091*** (3,877)	16,620*** (3,997)
Simple difference non-U.S. FDI in Mexico - $\beta + \delta_3$	-5,022** (1,965)	-9,597** (4,706)	-12,813*** (4,429)
Difference-in-differences U.S. FDI - δ_1	492.6 (1,232)	-10,041* (5,526)	-1,782 (4,319)
Difference-in-differences U.S. FDI in Mexico - δ_2	11,192*** (2,524)	16,811*** (4,032)	16,477*** (4,022)
Difference-in-differences non-U.S. FDI in Mexico - δ_3	-2,011 (2,641)	-15,877** (6,104)	-12,956** (5,103)

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Results derived from the regressions in Tables 2a and 2b.

Table 6a: Prais-Winsten Regression Results: Barro/Lee Skill Data

Regressor	(7) 14+ observation	(8) 5+ observations	(9) Announcement Effect
sumgdp	24.25***	18.92***	24.10***
	(2.498)	(1.614)	(2.517)
gdpdiffsq	-0.001***	-0.001***	-0.001***
	(0.0002)	(0.0001)	(0.0002)
d2skdgdpd	2.376***	1.556***	2.387***
	(0.361)	(0.205)	(0.361)
d2skdsumg	-2.898***	-2.025***	-2.908***
	(0.367)	(0.213)	(0.368)
d1skdsumg	-0.760***	-0.853***	-0.765***
	(0.082)	(0.094)	(0.084)
invcosthost	-77.626	-113.9	-74.83
	(96.34)	(84.40)	(95.82)
topenhost	43.34	29.73	39.69
	(32.03)	(27.00)	32.22
topensrc	113.2***	91.65***	110.2***
	(24.02)	(21.73)	(24.25)
distance	-1.925***	-2.100***	-1.971***
	(0.373)	(0.429)	(0.377)
β	-2,134	-2,123	-1,645
	(1,849)	(1,482)	(1,810)
γ_1	-13,126**	-2,188	-13,308**
	(5,466)	(5,023)	(5,636)
γ_2	2,286	3,059	3,415
	(2,866)	(2,654)	(2,781)
γ_3	56,608***	45,306***	54,833***
	(10,114)	(7,682)	(9,771)
δ_1	1,040	1,441	1,110
	(1,295)	(1,307)	(1,290)
δ_2	12,662***	14,600***	8,005**
	(2,907)	(2,952)	(3,113)
δ_3	1,531	1,666	1,059
	(2,010)	(1,464)	(1,955)
Number of obs.	1,550	1,663	1,550
R^2	0.48	0.44	0.46
Wald χ^2	782.6	945.5	412.9
Prob > χ^2, p-value	0.00	0.00	0.00
Average autocorr.	0.859	0.863	0.860

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. All regressions include a constant and a time trend (not reported). Regressions correct for first-order autocorrelation where autocorrelation coefficients are estimated separately for each country pair. Covariances vary across country pairs. See the text for details.

Table 6b: Robustness Checks: Barro/Lee Skill Data

Regressor	(10) Simple Skill	(11) Arbitrary VCE Base specif.	(12) Arbitrary VCE Simple Skill
sumgdp	16.06***	17.51***	12.63***
	(1.693)	(3.316)	(3.484)
gdpdiffsq	-0.001***	-0.001***	-0.001**
	(0.0001)	(0.0002)	(0.0003)
d2skdgdpd		1.700***	
		(0.533)	
d2skdsumg		-1.989***	
		(0.482)	
d1skdsumg		-0.511***	
		(0.140)	
Skill source	4,308***		2,940***
	(811.1)		(865.6)
Skill host	2,986***		3,590*
	(993.0)		(1,923)
invcosthost	-152.8	79.64	210.4
	(106.2)	(261.9)	(292.0)
topenhost	101.1***	76.71	143.5*
	(33.32)	(70.69)	(81.25)
topensrc	50.73**	90.63	46.76
	(21.22)	(61.98)	(57.46)
distance	-2.255***	-1.386***	-1.422***
	(0.433)	(0.427)	(0.444)
β	-2,739	3,058	682.9
	(1,748)	(3,223)	(3,062)
γ_1	1,313	-1,744	844.6
	(6,117)	(10,039)	(12,032)
γ_2	-3,779	5,195	2,595
	(3,321)	(4,122)	(4,176)
γ_3	68,565***	36,302**	49,906***
	(10,289)	(14,109)	(12,951)
δ_1	1,984	-1,205	832.8
	(1,425)	(5,058)	(4,573)
δ_2	11,764***	17,823***	16,453***
	(2,649)	(3,723)	(4,778)
δ_3	921.5	-9,373	-9,137
	(1,904)	(5,735)	(5,599)
Number of obs.	1,550	1,550	1,550
R^2	0.42	0.44	0.37
Wald χ^2	704.2	.	.
Prob > χ^2, p-value	0.00	.	.
Average autocorr.	0.860	N/A	N/A

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. All regressions include a constant and a time trend (not reported). Specification (10) corrects for first-order autocorrelation where autocorrelation coefficients are estimated separately for each country pair. Covariances vary across country pairs. Specifications (11) and (12) compute an arbitrary variance-covariance matrix. See the text for details.

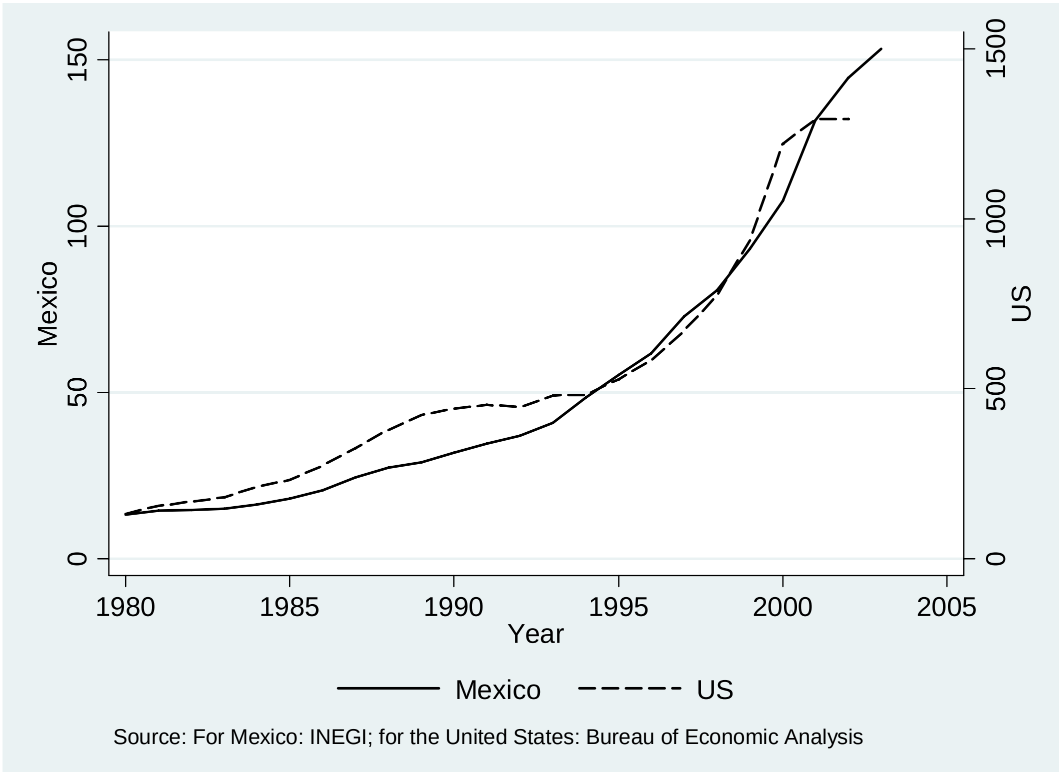
Table 7: The Effect of NAFTA on North American FDI, Barro/Lee Skill Data

	(7)	(8)	(9)
	14+ observations	5+ observations	Announcement Effect
Simple difference U.S. FDI - $\beta + \delta_1$	-1,093 (1,813)	-682.9 (1,516)	-534.3 (1,797)
Simple Difference U.S. FDI in Mexico - $\beta + \delta_2$	10,528*** (3,183)	12,477*** (3,012)	6,360* (3,444)
Simple Difference non-U.S. FDI in Mexico - $\beta + \delta_3$	-602.3 (1,129)	-457.2 (974.9)	-585.7 (1,253)
Difference-in-differences U.S. FDI - δ_1	1,040 (1,295)	1,441 (1,307)	1,110 (1,290)
Difference-in-differences U.S. FDI in Mexico - δ_2	12,662*** (2,907)	14,600*** (2,952)	8,005** (3,113)
Difference-in-differences non-U.S. FDI in Mexico - δ_3	1,531 (2,010)	1,666 (1,464)	1,059 (1,955)

	(10)	(11)	(12)
	Simple skill	Arbitrary VCE Base specif.	Arbitrary VCE Simple skill
Simple difference U.S. FDI - $\beta + \delta_1$	-754.7 (1,758)	1,853 (2,561)	1,516 (2,264)
Simple difference U.S. FDI in Mexico - $\beta + \delta_2$	9,024*** (2,760)	20,881*** (3,446)	17,136*** (4,417)
Simple difference non-U.S. FDI in Mexico - $\beta + \delta_3$	-1,818 (1,455)	-6,315 (4,302)	-8,454* (4,559)
Difference-in-differences U.S. FDI - δ_1	1,984 (1,425)	-1,205 (5,058)	832.8 (4,573)
Difference-in-differences U.S. FDI in Mexico - δ_2	11,764*** (2,649)	17,823*** (3,723)	16,453*** (4,778)
Difference-in-differences non-U.S. FDI in Mexico - δ_3	921.5 (1,904)	-9,372 (5,735)	-9,137 (5,599)

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Results derived from the regressions in Tables 4a and 4b.

Figure 1: FDI Stock in the United States and Mexico (billions of dollars)



Appendix - Proofs

Lemma 1. The necessary condition for $l^* = \{EM, UU\}$ before integration is given by the following inequalities:

$$\Pi^u_{bi}(EM, UU) > \Pi^u_{bi}(EM, UM) \tag{A.1}$$
$$\Pi^e_{bi}(EM, UU) > \Pi^e_{bi}(EU, UU) \tag{A.2}$$
$$\Pi^e_{bi}(EM, UU) > \Pi^e_{bi}(EE, UU) \tag{A.3}$$

which yield respectively

$$\begin{aligned}(1-t)\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(t-1)^2 - (1-t)^{1/2}(1-3t)]}_{A_2} \\ -c_N\underbrace{[2(1-t)^{3/2}]}_{A_3} + c_M\underbrace{[(1-t)^{1/2} + (1-t)]}_{A_4} > 0\end{aligned} \tag{A.4}$$

$$\begin{aligned}\phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+3t) - (1-t)^{1/2}(1+2t)]}_{A_5} \\ -c_N\underbrace{[(1-t)^{1/2} + (1-t)]}_{A_4} + 2c_M < 0\end{aligned} \tag{A.5}$$

$$c_N - c_M > tz_N \tag{A.6}$$

Compare (A.4) and (A.5). Assuming $t \in (0,1)$, the following will hold: (i) $0 < (1-t)A_1 < A_1$, (ii) $0 < A2 < A5$ and (iii) $0 < A_3 < A_4 < 2$. Moreover, since $c_N > c_M > 0$, $z_N > 0$ and $\phi > 0$, when (A.4) holds, (A.5) does not hold. In other words, if $\Pi^u_{bi}(EM, UU) > \Pi^u_{bi}(EM, UM)$, then $\Pi^e_{bi}(EM, UU) < \Pi^e_{bi}(EU, UU)$ for all parameter values, which violates condition (A.2), one of the the necessary conditions for $l^* = \{EM, UU\}$. ■

Proposition 1. Let firm u choose $l^u = UM$ as its optimum strategy after integration. FDI diversion in U requires $l^e = EU$ to be dominated by any other strategy for firm e. The necessary condition is

$$\Pi^e_{ai}(EU, UM) < \Pi^e_{ai}(EE, UM) \tag{A.7}$$

which yields

$$\frac{[\phi + z_N + c_M - 2(1+t)z_N - 2c_N]^2}{9\theta} < \frac{[\phi + z_N + c_M - 2(1+t)z_N - 2c_M]^2}{9\theta} \tag{A.8}$$

Taking the square root of both sides in expression (**??**) and simplifying yields $c_M < c_N$ which is always true given that M is the low cost country. ■

Proposition 2. Let firm e choose $l^e = EE$ as its optimum strategy. FDI creation in M by firm u requires $l^u = UU$ to be dominated by $l^u = UM$.

$$\Pi^u_{ai}(EE, UU) < \Pi^u_{ai}(EE, UM) \tag{A.9}$$

which yields

$$\frac{[(1-t)\phi + z_N + c_N - 2(1-t)(z_N + c_N)]^2}{9(1-t)^2\theta} < \frac{[(1-t)\phi + z_N + c_N - 2(1-t)(z_N + c_M)]^2}{9(1-t)^2\theta} \tag{A.10}$$

Taking the square root of both sides in expression (A.10) and simplifying yields $c_N > c_M$ which is always true given that M is the low cost country. ■

Proposition 3. For $l^* = \{EU, UU\}$ before integration, the necessary and sufficient conditions are

$$\Pi^u_{bi}(EU, UU) > \Pi^u_{bi}(EU, UM) \tag{A.11}$$

$$\Pi^e_{bi}(EU, UU) > \Pi^e_{bi}(EM, UU) \tag{A.12}$$

For $l^* = \{EM, UM\}$ after integration, the necessary condition is

$$\Pi^e_{ai}(EM, UM) > \Pi^e_{ai}(EE, UM) \tag{A.13}$$

Suppose that (A.11) holds. Expression (A.12) yields

$$\begin{aligned} \phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+t) - (1-t)^{1/2}(1+2t)]}_{A_6} \\ +c_N\underbrace{[(1+t) - (1-t)^{1/2}]}_{A_7} > 0 \end{aligned} \tag{A.14}$$

and expression (A.13) yields

$$\begin{aligned} \phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+t) - (1-t)^{1/2}(1+2t)]}_{A_6} + 2c_N \\ -c_M\underbrace{[((1-t)^{1/2} + (1-t)]}_{A_4} > 0 \end{aligned} \tag{A.15}$$

Provided that $t \in (0,1)$, $A_4 + A_7 = 2$. Thus, since $c_N > c_M$ when expression (A.14) holds, so does expression (A.15). ■