North-South Integration and the Location of Foreign Direct Investment[*]

Ayça Tekin-Koru[†] and Andreas Waldkirch[‡]

January 2008

Abstract

We investigate how North-South Integration affects the location of FDI between the two regions. The theoretical analysis suggests that integration affects the incentives of partner and non-partner Northern countries to locate in the South differently and may lead to investment diversion from the Northern partner. We test our propositions using data from the North American Free Trade Agreement (NAFTA), the first major North-South integration scheme. Using the largest possible control group, we use a difference-in-differences estimator to find that NAFTA partner FDI in Mexico has increased since the inception of NAFTA above what is implied by other determinants of FDI and the global upward trend during this time. Other countries have not increased their use of Mexico as an export platform. We also find no 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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[*] We would like to thank seminar participants at the University of Oregon, Bilkent University, the Midwest International Economics Conference, the Western Economic Association International Conference and the Empirical Investigations in International Trade Conference for useful comments on an earlier version.

[†] Department of Economics, Oregon State University, 303 Ballard Hall, Corvallis, OR 97331.
E-mail: a.tekin-koru@oregonstate.edu

[‡] Department of Economics, Colby College, 5244 Mayflower Hill, Waterville, ME 04901.
E-mail: andreas.waldkirch@colby.edu.

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 in one of the two advanced partners exists for all firms, these incentives differ for firms from partner versus firms from non-partner countries for a number of reasons. First, 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. Second, 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 North-South integration on the location of foreign direct investment (FDI) in both regions. The empirical analysis uses the case of NAFTA and pays special attention to partner versus non-partner country FDI. 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. Similarly, MacDermott (2007), using OECD data from 1980-1997, finds an increase in FDI following NAFTA in participating countries but no intra-NAFTA effect. Our contribution to the literature is to investigate the effect of NAFTA on FDI comprehensively by considering Mexican as well as U.S. inward FDI from various sources. Moreover, by employing a difference-in-differences estimator on the largest possible sample of global FDI, 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).[1] 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[2]. 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 (the North) with Mexico in NAFTA. Our model differs from Ekholm et al. (2007) in the following 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.[3]

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[1] 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.

Motta and Norman (1996) analyze integration in a three-country model. However, in their model there is no scope for vertical FDI since 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.

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

[3] By focusing on NAFTA's effect on the United States and Mexico, we do not imply that FDI in or from Canada would not be affected. However, NAFTA can largely be viewed as Mexico's addition to the existing U.S.-Canada Free Trade Agreement (CUSFTA), which we analyze in this paper. A detailed study of NAFTA's effect on the distribution of FDI between the U.S. and Canada is undertaken in Waldkirch and Tekin-Koru (2008).

There are a number of predictions that emerge from our model. Chief among them is that not only may North-South integration increase FDI in the South by partner firms, but it may also decrease investment in the North, ceteris paribus, which we term ‘FDI diversion’. The effect on non-partner investment in Mexico is potentially ambiguous, but is clearly different from the effect on partner investment for the reasons discussed above. Unlike in Ekholm et al. (2007), regional integration may not only lead non-partner FDI to be shifted from the North to the South 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.

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. In order to have the broadest possible sample of non-NAFTA countries for the difference-in-differences analysis, we also use bilateral OECD FDI data. Since we need to identify source countries of investment and use compatible data from all 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. We cannot add industry detail either, in large part because no industry-source country detail is available for Mexico prior to 1994.In order to estimate the effects of NAFTA, however, we need a reasonable amount of pre-NAFTA data.

Our results indicate that since NAFTA’s inception, FDI in Mexico from the U.S. and Canada has increased, but not from other countries. Indeed, there is some evidence of a slight fall from the latter. We also find no evidence of FDI diversion from the U.S. We caution, however, that we only include foreign investment data in our empirical analysis, while our 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. The potential investment diversion we account for is solely by non-U.S. firms.

We do emphasize that our results appear to be 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.

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 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 the 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.

Consider a one-period, two-stage static game in which there are three countries, denoted E, U

and M. Countries E and U are identical; they can be referred to simply as N (North). M is a small, low cost country in the south. 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. In essence, this confines the intermediate goods production sites to $i = \{E, U\}$ and the final goods assembly can be done anywhere, $j = \{E, U, M\}$. Finally, since M is a small country, 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 the consumer 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 in pure strategies for the second-stage quantity sub-game for any 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:

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

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[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 $\widehat{c} = z_U + c_M$.

[5] See Appendix for profit functions.

2.1 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.

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 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

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

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.

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

Proof. See Appendix. ■

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[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.

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. In other words, investment diversion from U is by non-partner countries. 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.

Proposition 2 *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. Another way of interpreting this result is that economic integration causes new entry into the southern country by firms in U. If the pre-integration equilibrium is not UU, there may be no change in M-production by firm u.

Proposition 3 *Integration between U and M increases third-country (E) investment in M only if and 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 the final assembly is shifted to M by firm e, and non-partner country investment in M will increase. This is due to the fact that 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. 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.

This proposition tells us that an increase in export platform FDI in M by non-partner countries is possible only under special conditions. In other words, if the dominant strategy for firm u before and after integration is $l^{u^*} = UM$, then firm e supplies the U market 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 possible.*

In summary, the model predicts that FDI in U may be diverted to M. Partner and 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. Moreover, there might be circumstances where there might be no increase or even a decrease in the investments of non-partner countries in M depending upon the pre-integration equilibrium. Thus, the question whether there is investment diversion from the U.S. and investment creation/diversion in Mexico, and by whom, is an empirical one.

3 Empirical Model

Our empirical strategy is to test the propositions from our model outlined above while including control variables drawn from the existing literature on the determinants of foreign direct investment.[8] These come from the seminal study by Brainard (1997) and the pioneering work of Markusen (1997)

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[8] 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.

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 our 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.[9]

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 other than Canada or Mexico. Let d_{h2} equal one if Mexico is the host and the U.S. or Canada are the source countries. Finally, let d_{h3} equal one if Mexico is the host country and the source is any country other than the U.S. and Canada. 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 NAFTA. 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

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[9] 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).

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 that we identify here are all relative to a control group, the identity of the control group matters. Initially, we used two different control groups. The first includes all FDI observations among non-NAFTA countries as well as U.S. and Canadian *outward* FDI. The latter is outside of our model and one could argue that most of that FDI is in other highly-developed countries which are quite dissimilar from Mexico and are thus unlikely to contain many competing hosts. However, increasingly other low-cost countries, in particular in South-East Asia, are attracting developed country FDI. Moreover, our hypothesis that U.S. FDI is more likely to go to Mexico due to its relative increase in attractiveness should affect its outward FDI to other countries, even though we do not model this explicitly. Hence, our second control group consists only of FDI between countries other than the three North American ones. We report results from using the latter in the text and tables and note any difference in the results using the wider control group in a footnote. The second issue pertains to econometric problems in the use of the difference-in-differences estimator as detailed in Bertrand et al. (2004). 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.[10]

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

$$FDI = f\left(\begin{array}{c} sumgdp, gdpdiffsq, d2skdgdpd, d2skdsumg, d1skdsumg, \\ invcosthost, topenhost, topensrc, distance \end{array}\right) \tag{12}$$

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

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

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 theoretically 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.[11] 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.

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[11] 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.

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 peso crisis in late 1994, early 1995 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 which does not have a role for exchange rates. Moreover, at least the real appreciation of the peso is likely to be endogenous as it may largely be caused by capital inflows.[12]

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. Bertrand et al. (2004) point out that ignoring serial correlation in difference-in-differences estimation can lead to biased standard errors. We implement several procedures to deal with this potential bias. First, 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), but of the first order in all cases. 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.[13]

We have an unbalanced panel because not all data are available for all years of the sample

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

[13] 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.

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 six must still be imposed in order to allow for the computation of the autocorrelation coefficients for all country pairs.

In addition to estimating a first-order autocorrelation coefficient, we also used several of the other techniques Bertrand et al. (2004) suggest. We report results from one which works well for samples of more than 20 observational units (we have at least 166 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. We report results from this procedure since it turns out to be the only one for which the results are qualitatively different.[14]

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.

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[14] Using their suggested bootstrapping method gave us qualitatively very similar results to our basic methodology of estimating pairwise autocorrelation coefficients.

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 in terms of stocks has been relatively stable over the sample period, fluctuating between about 69 and 74 percent. The vast majority of foreign investment originates in other high-income countries. The only sizable investment flows from other countries are from South Korea (now also considered high-income) 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 by source and the United States since 1980. OECD FDI data come from the OECD's International Direct Investment Statistics.

Control variable data also come from standard sources. We use PPP-adjusted GDP data from the Penn World Tables (6.2). 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 3 contains summary statistics for our basic sample with a minimum of 14 observations per country pair as well as for the larger sample where only a minimum of six observations are required.

5 Results

Tables 4-7 report the results. Tables 4 and 6 show the results from running a Prais-Winsten regression as outlined above as well as a number of 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 and directly test Propositions 1-3.

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

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 2,922 to 5,545 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]

Turning to Table 5, we first notice that there is no evidence whatsoever of a FDI diversion effect from the U.S. since there is no statistically significant negative sign. In fact, the only statistically significant coefficient in both the simple difference ($\beta+\delta_1$) and the difference-in-differences estimator (δ_1) is in column (6), when instead of computing the autocorrelation coefficients, we allow for an arbitrary variance-covariance matrix. In this case, a positive effect on non-NAFTA FDI into the U.S. is estimated. This result is quite different from that in all other specifications and even though this method worked well for Bertrand et al.'s (2004) data, we are not sure that it is the case here. For example, consider the average estimated autocorrelation in regressions (1) through (4). It is roughly between 0.74 and 0.79, much higher than in Bertrand et al.'s data, where the true autocorrelation is comparable to ours in magnitude. Moreover, they do not allow for individual (in our case: country-pair specific) autocorrelation coefficients, but impose a common one. Thus, we maintain that our Prais-Winsten methodology is appropriate and yields good results, but we do want to alert the reader that these can change when using one specific different methodology.

In order to get a sense of the estimated economic effect, we can calculate the predicted amount of FDI by the final year of the sample period with and without NAFTA. For the significantly positive coefficient here, we find that this stock is about five percent higher than it would have been without NAFTA. Thus, while the effect is positive, it is relatively small.[17]

The results are very similar when using the Barro/Lee skill data (Tables 6 and 7). Again,

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

[17] 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.

none of the computed effects using the difference-in-differences estimator are significantly negative, though allowing for the arbitrary variance-covariance matrix again yields a statistically significant, though economically small positive coefficient.[18] We thus conclude that there is no evidence of a FDI diversion effect from the U.S.

The next row of Tables 5 and 7 addresses FDI from NAFTA partners into Mexico. There is a statistically significant and economically large positive effect, suggesting that NAFTA has led to an increase in FDI in Mexico from partners. All coefficients, whether simple difference ($\beta+\delta_2$) or difference-in-differences (δ_2), are positive and significant regardless of specification, again with the exception of those making use of the arbitrary variance-covariance matrix. The economic magnitude is such that the inward FDI stock in 2000 is about 12 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 partner FDI in Mexico.[19]

The final row in Tables 5 and 7 shows the estimated NAFTA-effect on FDI from non-NAFTA sources into Mexico. All twelve difference-in-differences estimates are negative, half of them, including all those using the arbitrary variance-covariance matrix, significantly so. The estimated economic magnitude ranges from a 1.5 to a seven percent lower FDI stock. We can conclude that we find some evidence of a decrease of non-partner FDI in Mexico during the NAFTA period, though it is neither strong nor large. Coupled with the (weak) evidence of an increase in non-NAFTA FDI in the U.S., this finding seems to clearly indicate no export-platform FDI effect due to NAFTA. Instead, it suggests that, firstly, the access to the U.S. market from Mexico was not greatly affected by NAFTA, and secondly, that onerous rules of origin may indeed have had a significant investment preventing effect for investments from countries located outside of North America, which import a significant amount of their intermediates from their home countries. The findings underscore that it is misleading to ascribe the observed increase in the raw numbers of FDI following NAFTA to the

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[18] Expanding the control group to include Canadian and U.S. outward FDI results in unchanged statistical significance, although using the arbitrary variance-covariance matrix roughly doubles the economic magnitude of the NAFTA-induced change on FDI to just over ten percent.

[19] The estimated magnitude is smaller than what Waldkirch (2003) and Cuevas et al. (2005) find. Recall that the estimated effect is not the isolated increase observed in Mexico, but that which goes beyond the global rise and what can be explained by other determinants of FDI.

agreement as doing so fails to control for other important determinants, such as the economic boom in the U.S., and the global rise in FDI. The differential results with respect to NAFTA partner and non-NAFTA FDI into Mexico also show the importance of distinguishing between these two fundamentally different sources of FDI.

The coefficients on the determinants of FDI 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. Consistent with the predictions of that model, both source and host country openness have a positive effect on FDI, whereas our investment cost measure does not appear to perform well. This may be because of a lack of variation in the measure, especially over time.

In summary, we find that there is ample evidence that North-South economic integration in NAFTA has affected the distribution of FDI in the region, although not always in line with conventional wisdom. There is no evidence of an export-platform effect, although the South (Mexico) appears to have succeeded in attracting additional investment from the Northern partner countries. There is no evidence of an investment diversion effect 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, a large control group, 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.

6 Conclusion and Directions for Future Work

This paper has investigated the effect of North-South integration on the location of foreign direct investment (FDI) in both regions. 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 U.S., Mexican and bilateral OECD FDI data to test these hypotheses. Using a careful econometric analysis, we find that NAFTA partner FDI in Mexico was positively affected by NAFTA. At the same time, there is no evidence of FDI diversion from the U.S. Non-NAFTA 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. This finding begs a more thorough investigation of the role of discriminatory regulations in FTAs such as rules of origin, which is, however, beyond the scope of this paper.

The 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. We do add the caveat, however, that use of an arbitrary variance-covariance matrix, one of the methodologies proposed by Bertrand et al. (2004) to deal with the serial correlation problem in the use of the difference-in-differences estimator, does affect the results somewhat.

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. 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 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.

We also emphasize that we do not wish to imply that the addition of Mexico has had no effect on the distribution of FDI between Canada and the U.S. However, this raises a host of different questions, which deserve their separate treatment, which we undertake in Waldkirch and Tekin-Koru (2008).

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Appendix

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

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

Proof of Lemma 1

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

$$\Pi^u_{bi}(EM, UU) > \Pi^u_{bi}(EM, UM) \tag{13}$$
$$\Pi^e_{bi}(EM, UU) > \Pi^e_{bi}(EU, UU) \tag{14}$$
$$\Pi^e_{bi}(EM, UU) > \Pi^e_{bi}(EE, UU) \tag{15}$$

which yield respectively

$$\begin{gathered} (1-t)\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(t-1)^2 - (1-t)^{1/2}(1-3t)]}_{A_2} \\ -c_N\underbrace{[2(1-t)^{3/2}]}_{A_3} + c_M\underbrace{[(1-t)^{1/2} + (1-t)]}_{A_4} > 0 \end{gathered} \tag{16}$$

$$\begin{gathered} \phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+3t) - (1-t)^{1/2}(1+2t)]}_{A_5} \\ -c_N\underbrace{[(1-t)^{1/2} + (1-t)]}_{A_4} + 2c_M < 0 \end{gathered} \tag{17}$$

$$c_N - c_M > tz_N \tag{18}$$

Compare (16) and (17). 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 (16) holds, (17) 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 (14), one of the the necessary conditions for $l^* = \{EM, UU\}$.

Proof of 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

$$\Pi^e_{ai}(EU, UM) < \Pi^e_{ai}(EE, UM) \tag{19}$$

which yields

$$\frac{[\phi + z_N + c_M - 2(1+t)z_N - 2c_N]^2}{9\theta} < \frac{[\phi + z_N + c_M - 2(1+t)z_N - 2c_M]^2}{9\theta} \tag{20}$$

Taking the square root of both sides in expression (20) and simplifying yields $c_M < c_N$ which is always true given that M is the low cost country.

Proof of 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 $l^u = UM$.

$$\Pi^u_{ai}(EE, UU) < \Pi^u_{ai}(EE, UM) \tag{21}$$

which yields

$$\frac{[(1-t)\phi + z_N + c_N - 2(1-t)(z_N + c_N)]^2}{9(1-t)^2\theta} < \frac{[(1-t)\phi + z_N + c_N - 2(1-t)(z_N + c_M)]^2}{9(1-t)^2\theta} \tag{22}$$

Taking the square root of both sides in expression (22) and simplifying yields $c_N > c_M$ which is always true given that M is the low cost country.

Proof of Proposition 3

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

$$\Pi^u_{bi}(EU, UU) > \Pi^u_{bi}(EU, UM) \tag{23}$$

$$\Pi^e_{bi}(EU, UU) > \Pi^e_{bi}(EM, UU) \tag{24}$$

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

$$\Pi^e_{ai}(EM, UM) > \Pi^e_{ai}(EE, UM) \tag{25}$$

Suppose that (23) holds. Expression (24) yields

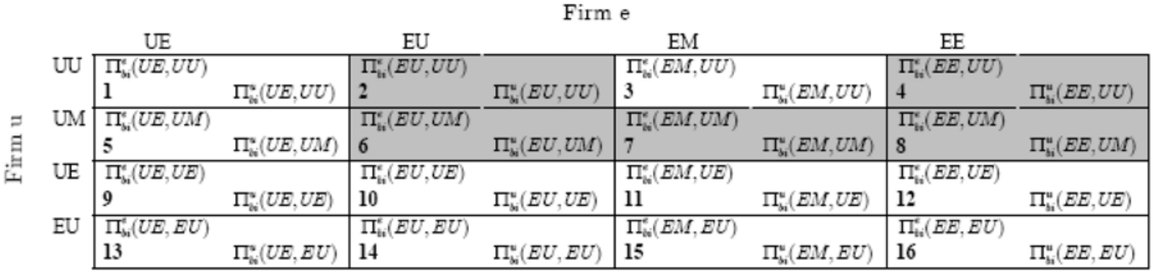
$$\begin{gathered}\phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+t) - (1-t)^{1/2}(1+2t)]}_{A_6} \\ +c_N\underbrace{[(1+t) - (1-t)^{1/2}]}_{A_7} > 0\end{gathered} \tag{26}$$

and expression (25) yields

$$\begin{gathered}\phi\underbrace{[(1-t)^{1/2} - (1-t)]}_{A_1} + z_N\underbrace{[(1+t) - (1-t)^{1/2}(1+2t)]}_{A_6} + 2c_N \\ -c_M\underbrace{[((1-t)^{1/2} + (1-t)]}_{A_4} > 0\end{gathered} \tag{27}$$

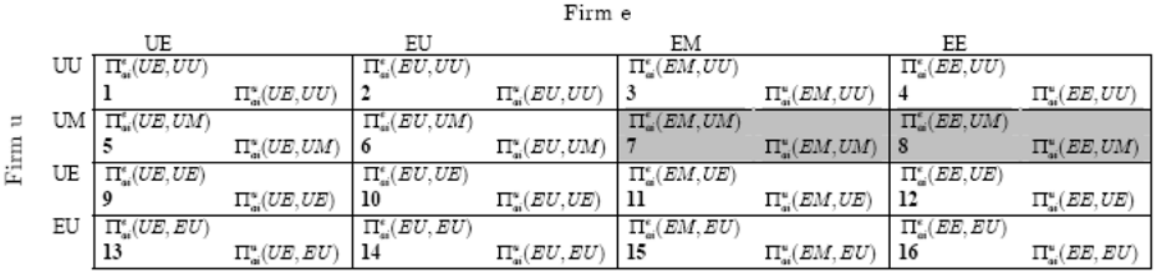
Provided that $t \in (0, 1)$, $A_4 + A_7 = 2$. Thus, since $c_N > c_M$ when expression (26) holds, so does expression (27).

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



		Firm e			
		UE	EU	EM	EE
Firm u	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 e			
		UE	EU	EM	EE
Firm u	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 3: Summary Statistics

	14+ Observations			6+ Observations		
Regressor	Mean	Median	S.D.	Mean	Median	S.D.
realfdi ('000s $)	5,035	699.7	15,365	2,864	195.8	11,421
sumgdp (mill. $)	2,912	1,830	2,736	2,105	1,213	2,448
gdpdiffsq	1.2E07	1.2E06	2.2E07	7.8E06	311,543	1.87E07
d2skdgdpd (ILO)	11.67	0	164.1	2.933	0	126.2
d2skdsumg (ILO)	95.85	0	198.8	74.96	1.415	158.1
d1skdsumg (ILO)	205.4	9.782	409.0	156.0	0	362.0
Skill source (ILO)	0.264	0.283	0.098	0.267	0.288	0.102
Skill host (ILO)	0.271	0.290	0.094	0.261	0.282	0.099
d2skdgdpd (Barro/Lee)	546.7	0	3,621	98.35	0	2,965
d2skdsumg (Barro/Lee)	2,112	0	5,085	1,548	0	4,046
d1skdsumg (Barro/Lee)	8,744	630.0	16,358	6,307	1,070	13,625
Skill source (Barro/Lee)	8.340	8.859	1.952	7.642	8.395	2.516
Skill host (Barro/Lee)	9.002	9.161	2.525	8.801	9.027	2.205
invcosthost (Index)	37.97	31.73	12.02	39.56	39.67	11.90
topenhost (%)	52.03	44.22	45.82	60.76	52.33	51.17
topensrc (%)	64.05	52.44	50.51	72.10	59.55	55.01
distance (km)	6,462	6,257	4,893	6,766	6,909	4,963
NAFTA dummy	0.40	0	0.49	0.56	1	0.50
US Host dummy	0.47	0	0.50	0.14	0	0.35
Mexico Host to NAFTA FDI dummy	0.01	0	0.12	0.01	0	0.09
Mexico Host to non-NAFTA FDI dummy	0.06	0	0.23	0.03	0	0.17

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

Regressor	(1) 14+ observation	(2) 6+ observations	(3) Announcement Effect
sumgdp	12.11***	7.347***	12.09***
	(1.433)	(0.743)	(1.450)
gdpdiffsq	-0.001***	-0.0004***	-0.001***
	(0.0001)	(0.0001)	(0.0001)
d2skdgdpd	-16.12***	-15.06***	-15.95***
	(2.696)	(2.262)	(2.735)
d2skdsumg	4.488*	5.034**	2.787
	(2.560)	(2.161)	(2.417)
d1skdsumg	-9.612***	-9.327***	-10.68***
	(1.529)	(1.157)	(1.498)
invcosthost	-7.063	-45.35***	24.75
	(40.59)	(16.82)	(40.24)
topenhost	30.36***	14.30***	34.27***
	(4.910)	(1.854)	(5.188)
topensrc	28.50***	9.911***	31.23***
	(6.507)	(1.662)	(7.161)
distance	-0.466***	-0.180***	-0.501***
	(0.112)	(0.045)	(0.117)
β	-578.1	-420.7	-938.8*
	(531.1)	(312.1)	(2,181)
γ_1	-24,213***	-12,693***	-22,206***
	(4,536)	(3,265)	(4,860)
γ_2	-7,347**	4,656	-6,729
	(3,735)	(4,270)	(4,117)
γ_3	480.7	-1,069*	309.5
	(774.4)	(567.2)	(782.5)
δ_1	-98.22	584.0	417.8
	(1,801)	(1,677)	(1,760)
δ_2	6,579**	6,806**	5,836**
	(2,742)	(3,035)	(2,780)
δ_3	-1,174	-677.6	-931.9
	(722.0)	(438.3)	(761.4)
Number of obs.	2,922	5,545	2,922
R^2	0.30	0.26	0.30
Wald χ^2	746.0	498.4	473.7
Prob > χ^2, p-value	0.00	0.00	0.00
Average autocorr.	0.772	0.789	0.772

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	10.90***	7.829***	7.786***
	(1.326)	(2.131)	(1.944)
gdpdiffsq	-0.001***	-0.001***	-0.001***
	(0.0001)	(0.0003)	(0.0003)
d2skdgdpd		-21.52***	
		(7.464)	
d2skdsumg		16.08***	
		(5.427)	
d1skdsumg		-5.762	
		(3.854)	
Skill source	46,887***		40,357***
	(8,406)		(11,470)
Skill host	1,423		3,898
	(2,885)		(7,140)
invcosthost	-11.70	-55.47	0.279
	(40.33)	(61.45)	(63.60)
topenhost	19.56***	18.36	15.81
	(4.464)	(12.20)	(13.34)
topensrc	16.56**	20.40	17.63
	(6.806)	(14.61)	(13.57)
distance	-0.518***	-0.309*	-0.237
	(0.100)	(0.160)	(0.161)
β	-958.9	-4,448*	-5,506**
	(598.6)	(2,370)	(2,425)
γ_1	-23,493***	-1,075	-215.3
	(4,824)	(5,994)	(6,101)
γ_2	-16,858***	2,248	-305.0
	(4,037)	(5,633)	(3,426)
γ_3	1,935***	-347.3	854.8
	(665.6)	(1,753)	(2,010)
δ_1	882.4	14,916	18,844**
	(1,833)	(9,109)	(8,786)
δ_2	7,474***	19,742	20,113
	(2,726)	(16,674)	(15,793)
δ_3	-1,284**	-3,746***	-2,491**
	(564.7)	(945.7)	(1,025)
Number of obs.	2,922	2,922	2,922
R^2	0.28	0.38	0.34
Wald χ^2	317.0	.	.
Prob > χ^2, p-value	0.00	.	.
Average autocorr.	0.741	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	6+ observations	Announcement Effect
Simple difference	-676.3	163.3	-521.0
U.S. FDI - $\beta + \delta_1$	(1,744)	(1,461)	(1,691)
Simple Difference	6,001**	6,385**	4,897*
NAFTA FDI in Mexico - $\beta + \delta_2$	(2,581)	(2,787)	(2,603)
Simple Difference	-1,752**	-1,098*	-1,871**
non-NAFTA FDI in Mexico - $\beta + \delta_3$	(804.1)	(575.8)	(855.1)
Difference-in-differences	-98.22	584.0	417.8
U.S. FDI - δ_1	(1,801)	(1,677)	(1,760)
Difference-in-differences	6,579**	6,806**	5,836**
NAFTA FDI in Mexico - δ_2	(2,742)	(3,035)	(2,780)
Difference-in-differences	-1,174	-677.6	-931.9
non-NAFTA FDI in Mexico - δ_3	(722.0)	(438.3)	(761.4)

	(4)	(5)	(6)
	Simple skill	Arbitrary VCE Base specif.	Arbitrary VCE Simple skill
Simple difference	-76.57	10,468	13,388**
U.S. FDI - $\beta + \delta_1$	(1,704)	(6,938)	(6,560)
Simple difference	6,515***	15,294	14,607
NAFTA FDI in Mexico - $\beta + \delta_2$	(2,484)	(16,280)	(15,490)
Simple difference	-2,243***	-8,194***	-7,997**
non-NAFTA FDI in Mexico - $\beta + \delta_3$	(757.6)	(3,026)	(3,158)
Difference-in-differences	882.4	14,916	18,844**
U.S. FDI - δ_1	(1,833)	(9,109)	(8,786)
Difference-in-differences	7,474***	19,742	20,113
NAFTA FDI in Mexico - δ_2	(2,726)	(16,674)	(15,793)
Difference-in-differences	-1,284**	-3,746***	-2,491**
non-NAFTA FDI in Mexico - δ_3	(564.7)	(945.7)	(1,025)

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.

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

	(7)	(8)	(9)
Regressor	14+ observation	6+ observations	Announcement Effect
sumgdp	10.37***	6.206***	9.967***
	(1.303)	(0.696)	(1.273)
gdpdiffsq	-0.0004***	-0.002**	-0.0003**
	(0.0001)	(0.0001)	(0.0001)
d2skdgdpd	0.797***	0.479***	0.738***
	(0.155)	(0.034)	(0.141)
d2skdsumg	-1.150***	-0.743***	-1.184***
	(0.191)	(0.108)	(0.194)
d1skdsumg	-0.661***	-0.658***	-0.757***
	(0.083)	(0.077)	(0.094)
invcosthost	111.8**	13.79	127.7**
	(49.20)	(14.71)	(49.62)
topenhost	17.01***	6.673***	16.79***
	(4.712)	(1.687)	(4.697)
topensrc	28.89***	6.666***	31.16***
	(7.017)	(1.268)	(7.194)
distance	-0.731***	-0.333***	-0.711***
	(0.172)	(0.067)	(0.171)
β	-406.4	-371.6	-1,056*
	(567.6)	(277.2)	(548.1)
γ_1	-6,995	5,331	-2,144
	(5,788)	(4,570)	(6,676)
γ_2	-3,202	6,438	-1,949
	(2,965)	(4,520)	(3,352)
γ_3	2,571***	-123.4	1,713**
	(873.0)	(548.8)	(844.1)
δ_1	727.9	1,324	1,297
	(1,758)	(1,661)	(1,783)
δ_2	5,954**	6,838**	4,472*
	(2,329)	(2,748)	(2,324)
δ_3	-990.6	-440.5	-520.9
	(700.8)	(409.9)	(735.9)
Number of obs.	3,453	7,730	3,453
R^2	0.33	0.25	0.35
Wald χ^2	772.7	4,173	1,300
Prob > χ^2, p-value	0.00	0.00	0.00
Average autocorr.	0.732	0.757	0.738

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	9.051***	7.001***	6.308***
	(1.130)	(1.772)	(1.629)
gdpdiffsq	-0.0004***	-0.001***	-0.001***
	(0.0001)	(0.0003)	(0.0003)
d2skdgdpd		0.785***	
		(0.245)	
d2skdsumg		-0.771***	
		(0.238)	
d1skdsumg		-0.404***	
		(0.124)	
Skill source	2,042***		1,653***
	(333.4)		(442.5)
Skill host	886.1***		1,090***
	(238.2)		(323.4)
invcosthost	58.45	95.85	111.2**
	(48.99)	(60.15)	(55.33)
topenhost	26.82***	11.38	23.97**
	(6.356)	(9.851)	(10.92)
topensrc	25.03***	26.75**	24.03**
	(6.688)	(13.19)	(12.14)
distance	-0.779***	-0.512***	-0.462***
	(0.175)	(0.180)	(0.165)
β	-632.0	4,034**	-4,098*
	(617.7)	(1,851)	(2,103)
γ_1	-19,905***	10,868*	-290.6
	(5,006)	(6,071)	(5,729)
γ_2	-16,461***	3,108	-937.0
	(3,855)	(5,102)	(3,334)
γ_3	5,829***	1,540	3,305*
	(992.4)	(1,622)	(1,767)
δ_1	1,087	18,174**	17,022**
	(1,763)	(7,153)	(8,095)
δ_2	6,412***	18,622	18,996
	(2,397)	(14,474)	(14,952)
δ_3	-1,038*	-2,398***	-2,304**
	(628.2)	(838.4)	(930.3)
Number of obs.	3,453	3,453	3,453
R^2	0.29	0.32	0.29
Wald χ^2	2,073	.	.
Prob > χ^2, p-value	0.00	.	.
Average autocorr.	0.737	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.

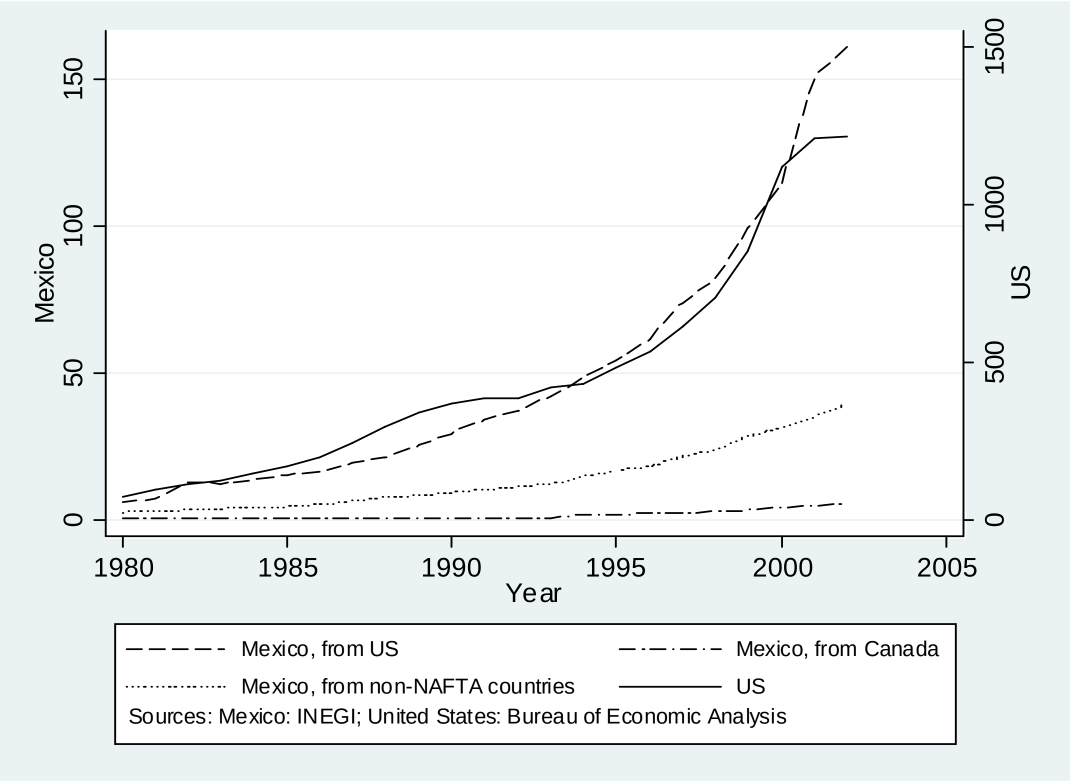
Table 7: The Effect of NAFTA on North American FDI, Barro/Lee Skill Data

	(7)	(8)	(9)
	14+ observations	6+ observations	Announcement Effect
Simple difference	321.5	952.4	240.7
U.S. FDI - $\beta + \delta_1$	(1,784)	(1,477)	(1,805)
Simple Difference	5,548**	6,467**	3,416
NAFTA FDI in Mexico - $\beta + \delta_2$	(2,205)	(2,532)	(2,163)
Simple Difference	-1,397*	-812.2*	-1,577*
non-NAFTA FDI in Mexico - $\beta + \delta_3$	(764.3)	(491.2)	(846.9)
Difference-in-differences	727.9	1,324	1,297
U.S. FDI - δ_1	(1,758)	(1,661)	(1,783)
Difference-in-differences	5,954**	6,838**	4,472*
NAFTA FDI in Mexico - δ_2	(2,329)	(2,748)	(2,324)
Difference-in-differences	-990.6	-440.5	-520.9
non-NAFTA FDI in Mexico - δ_3	(700.8)	(409.9)	(735.9)

	(10)	(11)	(12)
	Simple skill	Arbitrary VCE Base specif.	Arbitrary VCE Simple skill
Simple difference	455.4	14,140**	12,924**
U.S. FDI - $\beta + \delta_1$	(1,772)	(5,445)	(6,117)
Simple difference	5,780***	14,588	14,898
NAFTA FDI in Mexico - $\beta + \delta_2$	(2,216)	(14,246)	(14,699)
Simple difference	-1,670**	-6,432***	-6,402**
non-NAFTA FDI in Mexico - $\beta + \delta_3$	(764.8)	(2,420)	(2,734)
Difference-in-differences	1,087	18,174**	17,022**
U.S. FDI - δ_1	(1,763)	(7,153)	(8,095)
Difference-in-differences	6,412***	18,622	18,996
NAFTA FDI in Mexico - δ_2	(2,397)	(14,474)	(14,952)
Difference-in-differences	-1,038*	-2,398***	-2,304**
non-NAFTA FDI in Mexico - δ_3	(628.2)	(838.4)	(930.3)

Notes: Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Results derived from the regressions in Tables 6a and 6b.

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



Sources: Mexico: INEGI; United States: Bureau of Economic Analysis