Trade Liberalization and Investment: Firm-level Evidence from Mexico

Ivan T. Kandilov and Aslı Leblebicioğlu

Plant-level panel data from Mexico's Annual Industrial Survey is employed to evaluate the impact of reductions in tariffs and import license coverage on final goods, as well as intermediates, on firms' investment decisions. Using data from 1984 to 1990, a period during which a large scale trade liberalization occurred, a dynamic investment equation is estimated using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). Consistent with theory, the empirical analyses show that a reduction in import protection on final goods leads to lower plant-level investment, whereas reductions in tariffs and import license coverage on intermediate inputs result in higher investment. Also, firms with larger import costs experience a larger increase in investment following a reduction in import protection. On the other hand, higher markup firms lower investment more aggressively following reductions in tariffs and import license coverage on final goods. JEL codes: E22, F13, O16, O24, D92

Economic theory emphasizes the importance of free trade for increasing market efficiency and stimulating investment in new technologies. In the last 30 years, trade liberalization has been an important policy tool for many governments around the globe. A large number of developing countries and emerging economies have abandoned protectionist policies in an attempt to boost economic growth (e.g., Brazil, Chile, Colombia, and Mexico).[1] Wacziarg and Welch (2008) report that by 2000, more than 70 percent of the world's countries were open to trade, as defined by Sachs and Warner (1995). To date, however, only a few studies have investigated the impact of trade liberalization on investment, which is the focus of this article. In particular, the empirical analysis here estimates the effect of the Mexican trade liberalization on firm level investment in the manufacturing sector.

Ivan T. Kandilov is an associate professor of agricultural and resource economics at North Carolina State University; his e-mail address is ivan_kandilov@ncsu.edu. Aslı Leblebicioğlu is an assistant professor of economics at North Carolina State University; her e-mail address is alebleb@ncsu.edu. The authors thank the journal editor, Elisabeth Sadoulet, two anonymous referees, and the editorial board for useful comments.

1. As Goldberg and Pavcnik (2004) note, the large literature on trade and growth has not reached a consensus on the impact of trade on economic growth (see also Rodriguez and Rodrik 2000).

THE WORLD BANK ECONOMIC REVIEW, VOL. 26, NO. 2, pp. 320–349 doi:10.1093/wber/lhr048
Advance Access Publication November 13, 2011

In 1985, the Mexican government launched a large-scale trade liberalization program as the existing protectionist trade policies were deemed counter-productive after a foreign exchange crisis and meager growth. Prior to the liberalization, the most restrictive component of Mexico's import policy was not the extensive system of tariffs, but rather the high import license coverage (i.e., high ratio of industry output covered by import licenses). By the end of the liberalization, the incidence of (both input and output) import licenses decreased drastically from about 90 percent in early 1985 to below 20 percent in 1988 (see Figure 1 and Table 1). Over that relatively short period of three years, output tariffs were also aggressively cut from about 40 percent to less than 15 percent, while input tariffs were cut from about 20 percent to about 10 percent.

The empirical analysis here employs plant-level data from the Mexican manufacturing sector to estimate the effects of the wide-sweeping trade reforms that occurred in Mexico in the mid-1980s on firms investment decisions. Recent contributions that assess the impact of trade liberalization on productivity (Amiti and Konings 2007; Topalova and Khandelwal 2011) point out that both input and output tariffs have important, individual effects. Also, the theoretical framework suggests that access to cheaper inputs via lower input tariffs increases firm profitability, and therefore investment, while lower output tariffs bring about more intense import competition, which results in lower profits and investment. Hence, theoretically, a decrease in input tariffs has the opposite effect on firm investment from a decrease in output tariffs. To capture these differences, in our empirical investigation, we separate the impact of input tariffs from that of output tariffs.

Using data on manufacturing plants from Mexico's Annual Industrial Survey for the seven year period from 1984 to 1990, a reduced-form dynamic investment equation is estimated employing panel data techniques developed by Arellano and Bover (1995) and Blundell and Bond (1998).[2] One advantage of using plant-level panel data is that it allows us to control for unobservable plant effects that influence investment, sales, cash flow, and foreign exposure simultaneously. Consistent with the theoretical framework, the empirical analysis shows that the decrease in input tariffs, as well as import license coverage, resulted in higher investment in Mexican manufacturing establishments. Also, in line with the theory, the results reveal that the drop in output tariffs and license coverage led to a decrease in plant-level investment. The estimated effects are economically and statistically significant, and they suggest that the impacts of input tariffs and license coverage are larger than the impacts of output tariffs and license coverage, respectively. These results are consistent with recent findings in the trade liberalization and productivity literature discussed earlier, for example, Amiti and Konings (2007), as well as Topalova and Khandelwal (2011).

2. This is the same plant-level panel data from the Mexican manufacturing sector used by Tybout and Westbrook (1995) and Grether (1996), who analyzes the impact of the Mexican trade liberalization on price-cost margins.

This article's contribution to the literature is twofold. To the best of our knowledge, this is the first study to consider the effects of trade liberalization on establishment-level investment. While a few country-level and industry-level studies such as Ibarra (1995) and Wacziarg and Welch (2008) assess the impact of trade liberalization on investment, the use of plant-level panel data allows the empirical analysis here to control for plant-specific time-invariant unobservables that might affect investment and bias the estimated impacts. Moreover, country-level data and industry-level data can hide substantial heterogeneity in the effects of lower trade barriers for different firms—for example, those with large market power (high markups) versus those with little market power (low markups). Indeed, the results show that firm-specific factors, such as international trade positions and market power, determine the sensitivity of investment to changes in tariffs and import license coverage. Note that Wacziarg and Welch (2008), as well as Ibarra (1995), find that aggregate investment in Mexico was negatively affected in the years after the trade liberalization. The second contribution of this article to the literature is that it improves upon previous work, such as Wacziarg and Welch (2008), by considering the impact of both output and input tariffs (and import license coverage) on investment and by employing cross-industry variation in actual tariffs (both output and input tariffs, as well as license coverage), rather than indicator variables for years of pre- and post-liberalization.

This article is related to the broader literature on the economic impacts of trade liberalization, and especially the work investigating the effects of lower trade barriers on firm-level productivity. Some examples in this large and growing area of research include Tybout et al. (1991), Tybout and Westbrook (1995), Pavcnik (2002), Muendler (2004), Amiti and Konings (2007), Fernandes (2007), as well as Topalova and Khandelwal (2011). All of these studies suggest that lower trade protection has a positive impact on economic efficiency. Amiti and Konings (2007) and Topalova and Khandelwal (2011) find positive effects of both lower input and output tariffs on productivity in Indonesia and India, respectively. Pavcnik (2002), Muendler (2004), and Fernandes (2007) show that tariff liberalization leads to higher firm-level productivity in Chile, Brazil, and Colombia, respectively. The Tybout and Westbrook (1995) findings suggest that average costs fell in most industries following the Mexican trade liberalization. Similarly, Tybout et al. (1991) find evidence that Chilean industries that experienced relatively large reductions in protection also experienced relatively large improvements in average efficiency levels.[3]

3. There exists a small literature that relates exporting opportunities to investment. For example, using data from Mexico during 1994–2004, Iacovone and Javorcik (2008) show that future exporters increase product quality (unit value) and investment before they start servicing the foreign market. Similarly, Alvarez and Lopez (2005) use data from Chile and present evidence that exporters invest more, perhaps to upgrade product quality, even before they enter the foreign market compared to firms that supply to the domestic market alone.

Although different in nature, the empirical analysis here is also related to that of Bustos (2011), who incorporates a technology choice in a Melitz (2003)-type model of trade and heterogeneous firms. In her model, both trading partners are identical and trade costs (tariffs) are symmetric. Hence, when these costs decline, a firm in the home country faces increased competition from abroad due to the decrease in tariffs imposed by the home country, but it also sees its exports rise following the decrease in tariffs imposed by the foreign country.[4] For exporting firms, such trade integration results in an increase in total revenue and can lead to technology upgrading. The empirical example that Bustos (2011) considers is that of the regional trade agreement MERCOSUR and its effect on Argentinean firms. She shows that after the trade agreement took effect and Brazilian tariffs fell, Argentinean firms responded by increasing both exports to Brazil and their spending on technology upgrading.

The rest of the article is organized as follows. Section I describes the details of the Mexican trade liberalization that occurred in the mid-1980s. Section II discusses the theoretical framework which illustrates how lower input and output tariffs affect the firm's investment choice. Section III presents the empirical specification of the investment equation that is estimated, and it also discusses the econometric issues. Section IV describes the Mexican plant-level data employed in the empirical analysis and presents the summary statistics. Potential endogeneity issues of the trade policies with respect to investment are discussed in section V. The results are presented in section VI. The last section concludes.

I. TRADE LIBERALIZATION IN MEXICO

Through the 1970s, domestic producers in Mexico enjoyed fairly high rates of import protection. As a result of the oil boom in the late 1970s, Mexico's economy grew steadily during this period. Mexican real GDP per capita increased rapidly and topped \$5,400 (constant 2000 U.S. dollars) in 1981 according to the World Bank's World Development Indicators (WDI)—per capita income similar to that of low-income industrial countries such as Portugal, where per capita income in 1981 was \$6,300 (WDI). After a weakening of the oil market in the early 1980s, the Mexican economy faced a number of problems, including a foreign exchange crisis in 1982. While Mexico's foreign debt was successfully restructured and the high inflation rate declined by 1984, lack of growth was still considered a major issue. Considering that

4. Note that theoretically, this is not the relevant comparative static exercise for the case of the Mexican trade liberalization of the mid-1980s that we analyze here. The Mexican trade liberalization of the mid 1980s was a unilateral trade liberalization, so export revenues of Mexican producers would not be affected following the decline in Mexico's tariffs.

the protectionist trade policies were counterproductive, in 1985 the Mexican government initiated a large scale trade liberalization program.

Prior to the liberalization, the Mexican government had imposed a number of different import restrictions. The two most prominent were a system of quantity restrictions in the form of quotas or licensing and an ad valorem import tariff scheme.[5] The set of quotas and licenses is considered to have been the most restrictive component of Mexico's import policy (see Ten Kate, 1992).[6] The trade liberalization started in 1985 and proceeded in a number of rounds.[7] First, in 1985, a large number of import licenses were removed, which decreased the license coverage from about 90 percent to about 50 percent of domestic production.[8] The large majority of goods affected in this first round were intermediates and capital goods. Also, to compensate for the reduction in licensing requirements, the Mexican government slightly increased tariffs.

In 1986, the trade liberalization continued. In the second round, the focus was on tariffs. The highest tariff rate of 100 percent was eliminated leaving the highest rate at 50 percent. Further, a four-step across-the-board tariff reduction was initiated to decrease tariffs ranging from 0 to 50 percent down to 0 to 30 percent by the end of 1988.[9] Finally, in 1987, the government removed the official tariff surcharge of 5 percent, leaving tariff rates ranging from 0 to 20 percent. This completed the Mexican trade liberalization. For the rest of our sample years until 1990, no other major changes occurred. Figure 1 shows the evolution of the average (production-weighted) output and input tariffs, as well as the average (production-weighted) output and input import license coverage in the Mexican manufacturing sector from 1984, which is the first year in our sample, to 1990.[10] The figure shows that both tariffs and the license coverage were quite high at the beginning of the sample in 1984 and decline 50 to 80 percent by the end of the sample in 1990.

5. Official minimum prices for customs valuation of imports were also in place (see Ten Kate, 1992). When they were set in the domestic currency, their impact was sometimes greatly reduced because of large devaluations. On the other hand, when they were set much higher than transaction prices, they raised the effective level of the tariffs well above their nominal levels.

6. Established after WWII, its incidence had grown over the years, and in 1982, all imports were subject to licensing. Before the trade reform that was initiated in the second half of 1985, changes in import licensing were primarily driven by changes in the position of Mexico's balance of payments. For example, many of the license requirements initiated in 1982 were removed in 1984 as a result of improvements in the balance of payments. However, license requirements were removed only for goods that had no domestic competition.

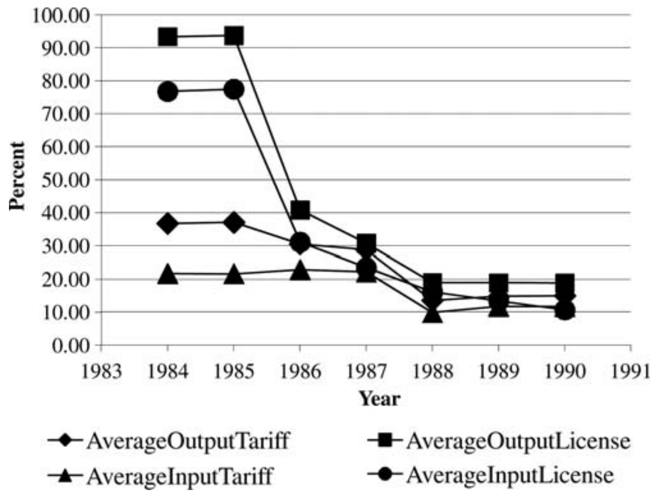
7. This was a unilateral trade liberalization that predated NAFTA, which started in 1994.

8. The remaining licenses covered about 40 percent of imports in 1984.

9. Mexico joined GATT in August of 1986 and agreed to eliminate all official minimum prices by the end of 1987, an agreement which was executed as scheduled. Other commitments upon the accession to GATT were already realized or even surpassed with the unilateral liberalization program at that time. The accession mostly served to bolster Mexico's credibility to fully implement the trade reforms.

10. See the Data section for details on the construction of the industry input tariffs and license coverage.

FIGURE 1. Average Tariffs and Licenses



Source: Unpublished data provided by Adrian Ten Kate, SECOFI.

Table 1 provides details of the tariff and license requirements changes across eight aggregate manufacturing industries.[11] For the majority of industries, output tariffs start off between 30 and 40 percent and decline to 10 to 20 percent by the end of the liberalization. Input tariffs start off somewhat lower, between 20 and 30 percent, and drop down to just over 10 percent by 1989. Both output and input license coverage are between 80 and 100 percent in the beginning of the sample and both precipitously drop to near 0 percent by 1989 for most of the manufacturing industries. The figures presented in Table 1 convincingly show that Mexico experienced a large-scale, across-the-board trade liberalization between 1985 and 1988.

II. INVESTMENT AND TARIFFS

In order to motivate the empirical specification, and to illustrate how input and output tariffs affect investment decisions differently, this section outlines a simple model of investment. Since the model considered yields a standard investment Euler equation augmented with tariffs, the discussion here focuses on the intuition behind the different effects of input and output tariffs on investment. The full set-up of the model and the derivation of the investment equation can be found in the Theoretical Appendix, which is available from the authors upon request. To keep the discussion tractable, we only consider the effects of lower tariffs. Theoretically, the impact of input import license is

11. The plant-level data are classified into 129 4-digit Mexican Census industries, which can be aggregated into 8 main industries roughly corresponding to 2-digit ISIC industries.

TABLE 1. Tariff and License Coverage Rates

Industry	Output Tariff			Output License			Input Tariff			Input License		
	1985	1987	1989	1985	1987	1989	1985	1987	1989	1985	1987	1989
Food, Beverages, Tobacco	41	30	16	100	45	22	19	19	11	55	59	39
Textile, Apparel and Leather Products	40	37	17	93	37	1	29	30	13	84	11	3
Wood and Paper Products	36	33	11	97	9	3	26	25	10	90	16	5
Chemicals and Plastics	30	29	14	87	10	0	21	20	11	81	16	10
Non-metallic Products	32	28	13	95	0	0	22	21	12	73	12	8
Basic Metals	8	15	10	95	0	0	15	16	11	75	2	2
Metal Products, Machinery and Equipment	45	28	16	93	55	45	22	26	13	91	13	4
Other Manufacturing	37	36	18	100	0	0	27	25	12	88	18	9
Total Manufacturing	37.09	28.86	14.79	93.78	30.78	18.92	21.64	22.18	11.78	77.50	23.47	13.46

Note: All figures are percentages. The output and input tariffs are exclusive of the 5 percent official tariff surcharges.

Source: Unpublished data provided by Adrian Ten Kate, SECOFI.

analogous to that of input tariffs and the effect of output import license is analogous to that of output tariffs, which are discussed here.

Consider the investment problem of a monopolistically competitive firm that imports some of its variable inputs of production and sells its output in the domestic market, where it faces foreign competition. The optimal investment decision implies that the firm will choose to invest up to the level where the marginal cost of investing in a new unit of capital is equal to the present discounted value of the marginal return to capital. The higher the marginal profitability of capital, the more incentives the firm will have to undertake investment. The marginal profitability of capital in turn depends on expected sales as well as expected costs of domestic and foreign variable inputs. Trade liberalization can affect investment through marginal profitability of capital by altering expected sales and costs of imported inputs.

While reductions in input tariffs can increase marginal profitability of capital through changes in the prices of imported inputs, reductions in output tariffs can decrease marginal profitability of capital through changes in foreign competitors' prices and hence through changes in firm sales. A reduction in input tariffs lowers the cost of using imported inputs, and thereby raises the marginal profitability of capital and investment. Hence, we expect trade liberalization to increase investment through lower input tariffs. Moreover, we expect the increase in investment to be stronger for firms with a higher volume of imported inputs, since lower input tariffs would lead to a larger increase in the marginal profitability of their capital.

Changes in output tariffs affect the marginal profitability of capital through changes in the foreign competition the firm faces. Assuming that the firm sells its product in the imperfectly competitive domestic market, the demand for its product will be affected by changes in domestic and foreign competitors' prices, as well as aggregate demand conditions. A reduction in output tariffs lowers the effective price individuals pay on foreign varieties, and thereby reduces the demand for the firm's product. As a result, a reduction in an output tariff can lower the marginal profitability of capital and investment. Hence, we expect trade liberalization to decrease investment through lower output tariffs that leads to intensified foreign competition.

An important factor that determines the sensitivity of investment to changes in output tariffs is the firm's markup, which is closely linked to the degree of competition the firm faces, as well as the industry structure. A firm with more monopoly power, hence a higher markup, may be affected more adversely by a reduction in output tariffs and the subsequent increase in import competition. On the other hand, the reduction in output tariffs may not affect a low markup firm as much, since it has already been exposed to ample competition. In the next section, we describe how the empirical investment equation we adopt incorporates the relationship between investment and input and output tariffs, as well as the sensitivity of this relationship to the firm's markup and the level of imported inputs.

III. EMPIRICAL INVESTMENT EQUATION AND ESTIMATION

The theoretical framework in section II motivates the relationship between investment and tariffs, illustrates how input and output tariffs can affect investment differently, and also suggests other firm-specific determinants of investment (such as sales and costs). One can further generalize this framework to accommodate a richer set of investment costs and additional constraints imposed on the firm. Each new assumption would give rise to a different structural relationship. Because the main goal of this study is to estimate the impact of trade liberalization on investment, instead of focusing on the structural process, we estimate a standard reduced form investment equation.[12] In their review of the empirical literature that uses firm- or plant-level data to estimate an investment equation, Bond and Van Reenen (2008) note that this type of reduced form model can be interpreted as representing an empirical approximation to the underlying investment process.

We start by estimating the following baseline specification, which focuses on the main effect of tariffs and import licenses on investment:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{ijt-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{C_{ijt}}{K_{ijt-1}} + \alpha_4 \tau_{jt}^{OT} + \alpha_5 \tau_{jt}^{OL} + \alpha_6 \tau_{jt}^{IT} + \alpha_7 \tau_{jt}^{IL} + \upsilon_i + \eta_t + \varepsilon_{ijt}, \tag{1}$$

where I_{ijt}/K_{ijt-1} is the investment rate for plant i in industry j in year t, and S_{ijt}/K_{ijt-1} and C_{ijt}/K_{ijt-1} are the plant's total sales and cash flow, respectively, normalized by its capital stock.[13] The terms τ_{jt}^{OT} and τ_{jt}^{OL} denote the output tariff and license measure for industry j, in year t, respectively.[14] Similarly, τ_{jt}^{IT} and τ_{jt}^{IL} denote the input tariff and license measure, respectively.

First, note that we include industry specific input and output tariffs and import license coverage as measures of protection in the baseline specification (1) simultaneously. It is important to include all of these four measures together in the model because they are positively correlated (see Panel B of Table 2). If we exclude one or more from the specification, for example, if we only include the tariffs or the license coverage ratios, omitted variable bias will

12. In the Theoretical Appendix (available from the authors upon request), we provide a model of investment with quadratic adjustment costs that can be used as the basis of the reduced form empirical investment equation.

13. The normalization by capital stock naturally arises in a model with quadratic adjustment costs, and it allows us to control for the size of the firm.

14. We have information on tariffs and import license coverage for the months of June and December of each year. In the baseline specification, we use the data on trade protection in June of year t as the relevant measure affecting investment in year t. Later, we check the robustness of our results to using an alternative timing of the protection measures, where we employ equally-weighted data on trade protection in December of year t-1, June of year t, and December of year t to explain investment in year t.

TABLE 2. Summary Statistics

Variable	Mean	St. Dev.	Min	Max
Panel A: Descriptive Statistics				
Investment Rate (I_{ijt}/K_{ijt-1})	0.15	0.38	−1.88	10.85
Total Sales (S_{ijt}/K_{ijt-1})	9.12	25.81	0.00	1,031.08
Cash Flow (C_{ijt}/K_{ijt-1})	−13.61	823.84	−80,041.88	267.85
Average Markup (Ψ_i)	2.25	5.68	−36.89	154.26
Imports (IM_{ijt}/K_{ijt-1})	1.06	21.18	0.00	1,892.37
Exports (EX_{ijt}/K_{ijt-1})	0.51	7.46	0.00	385.31
Foreign Share	0.19	0.36	0.00	1.00
Output Tariff $\left(\tau_{jt}^{OT}\right)$	21.68	10.64	0.20	45.00
Output License $\left(\tau_{jt}^{OL}\right)$	12.32	27.93	0.00	100.00
Input Tariff $\left(\tau_{jt}^{IT}\right)$	15.90	8.16	0.70	41.00
Input License $\left(\tau_{jt}^{IL}\right)$	16.16	23.75	0.20	99.50
Panel B: Correlations of the Trade Liberalization Measures				
Output Tariff	1.000			
Output License	0.362	1.000		
Input Tariff	0.770	0.456	1.000	
Input License	0.090	0.275	−0.135	1.000

Note: The total number of observations is N = 11,834. The output and input tariffs are exclusive of the 5 percnt official tariff surcharges.

Source: INEGI and SECOFI; see text for details.

likely be an issue.[15] Note that the positive correlations between the tariffs and the license coverage ratios are not high enough to raise multicollinearity concerns. Second, in order to control for marginal profitability of capital, we include the sales-to-capital ratio. Third, following Fazzari and others (1988), we include cash flow as a proxy for financing constraints, which arise due to capital market imperfections. Cash flow can be an important determinant of investment for Mexican firms, since it might be difficult for firms to smooth investment behavior via external capital markets.[16] Empirically, cash flow is constructed as the difference between sales and total costs, adjusted for taxes and depreciation.[17] Because costs and cash flow are highly correlated, we include only cash flow in the specification in order to minimize collinearity problems.[18]

15. For instance, the sample correlation between the input tariff and the output license ratio is 0.456. Given that we expect to find a positive coefficient on the output license (and tariff) and a negative coefficient on the input tariff (and license), if we do not include both measures in the same specification but only one of them, its estimated coefficient will likely be attenuated and may even have the wrong sign because of the omitted variable with which it is positively correlated.

16. Examples of previous work that have shown the importance of financing constraints for investment in developing countries include Jaramillo and others (1996), Harrison and McMillan (2004), and Love (2003).

17. Total costs include domestic and imported material costs, as well as labor costs, costs of industrial and non-industrial services.

18. The results including costs in addition to sales and cash flow are similar to those reported in the following sections, and they are available upon request.

We introduce the cost of imported inputs in a subsequent specification that augments equation (1). Fourth, we include the lagged investment rate to control for the autocorrelation that may arise due to adjustment costs.

The specification in equation (1) also includes plant specific fixed effects, υ_i, that capture time-invariant, plant-specific determinants of investment, as well as year effects, η_t, that capture aggregate, economy-wide fluctuations. Macroeconomic factors common to all firms, such as changes in interest rates and exchange rates, will be absorbed in these time effects. However, firms in different industries might face different economic conditions due to, for example, different working capital and borrowing needs. In order to allow for heterogeneous effects of the economy-wide fluctuations, in some specifications, we additionally include interaction terms between the year effects and a full set of eight aggregate industry dummies. Moreover, in some specifications, we include interaction terms between the year effects and a full set of six region dummies in order to control for temporal shocks that affect the various regions differently.[19] Finally, we assume that the error term, ε_{ijt} , is i.i.d. with $E(\varepsilon_{ijt})=0$.

Based on the implications of our theoretical framework, and following the empirical example of Amiti and Konings (2007), we augment the baseline specification (1) in two important ways. First, we recognize that reductions in import protection can increase investment by making imported inputs more readily available. In order to capture this channel, we include the cost of imported inputs (normalized by the size of capital stock, $K_{\mathrm{ijt}-1}$), as well as its interaction with the input tariff and the input import license measure. We expect a firm with larger imports to benefit more from the reductions in input tariffs and import licenses.

Secondly, to check how the impact of trade liberalization on investment depends on the firm's markup, we include an interaction term between the markup and all four protection measures. As discussed in section II, a reduction in the output tariff (similarly in the output license coverage) can reduce investment more in high markup firms, as they begin to face more stiff competition and a decrease in marginal profitability. Hence, we expect the interaction terms with the markup to reinforce the negative effects of the output tariff and the license coverage.

We estimate the dynamic investment equation (1) and the augmented specifications using the *system-GMM estimator* of Arellano and Bover (1995) and Blundell and Bond (1998). This estimator for panel data sets with short time dimension addresses the potential biases that arise from the correlation

19. We group the Mexican states into six regions. Region 1 (Northwest) includes the states of Baja California Northern and Baja California Southern; region 2 (Northeast) includes the states of Coahulia, Chihuahua, Durango, Nuevo Leon, Sinaloa, Sonora, and Tamaulipas; region 3 (Central) includes the states of Aguascalientes, Guanajuato, Queretaro, San Luis Potosi, and Zacatecas; region 4 (Southwest) includes the states of Colima, Chiapas, Guerrero, Jalisco, Michoacan, Nayarit, and Oaxaca; region 5 (Southeast) includes Dictrict Federal and the states of Hidalgo, Mexico, Morelos, Puebla, Tlaxcala, and Veracruz; finally, region 6 (East) includes Campeche, Quintana Roo, Tabasco, and Yucatan.

between the plant fixed effects, v_i and the lagged dependent variable, I_{ijt-1}/K_{ijt-2}, as well as the endogeneity of sales, S_{ijt}/K_{ijt-1}, and cash flow, C_{ijt}/K_{ijt-1}. The *system-GMM estimator* combines the first-difference equations, whose regressors are instrumented by their lagged levels, with equations in levels, whose regressors are instrumented by their first-differences.[20] All of the plant specific variables are treated as endogenous, and lagged values dated *t*-2 and *t*-3 are used as the GMM-type instruments.[21] To this instrument set, we add lagged advertisement costs as an outside instrument in order to help identification.[22] The full set of instruments can be found at the end of each table. We employ and report the Sargan-Hansen tests of overidentification to test for the validity of our instruments.[23]

IV. DATA

To identify the impact of trade liberalization on investment, we use Mexico's Annual Industrial Survey, which includes annual plant-level data from 1984 to 1990. The seven-year time span includes the period of the broad trade liberalization that took place starting from the second half of 1985 until 1988. As already mentioned, this balanced panel was originally used by Tybout and Westbrook (1995) to assess the impact of trade liberalization on productivity. The data represent all industries in the Mexican manufacturing sector and were collected by Mexico's National Institute of Statistics, Geography, and Information (INEGI). They were originally provided by Mexico's Secretariat of Commerce and Industrial Development (Secretara de Comercio y Fomento Industrial, SECOFI), which is currently Secretariat of Economy (Secretara de Economa, SE). On average, the sample plants represent about 80 percent of output in each industry; the smallest plants are excluded from the survey.[24] For each establishment, the survey collects data on sales, employment, inputs, investment, wages,

20. The *system-GMM estimator* builds on the *difference-GMM estimator* of Arellano and Bond (1991), which uses only the differenced equations, instrumented by the lagged levels of the regressors. If the regressors are persistent, then their lagged levels are shown to be weak instruments. See Arellano and Bover (1995) and Blundell and Bond (1998) for more details. To avoid this drawback of the *difference-GMM estimator*, we opted for the *system-GMM estimator*.

21. In some of the specifications lagged values dated *t*-2 were shown to be invalid instruments using the Sargan-Hansen tests of overidentification. In those cases, only the lagged values dated *t*-3 are used as instruments. The results look similar if we also include lagged values dated *t*-4 and *t*-5 in the instrument set.

22. We note that excluding the advertisement costs from the set of instruments does not change the results. We have verified the suitability of advertisement costs as an exogenous variable with the difference-in-Hansen test. In all of our specifications, we failed to reject the null hypothesis of exogeneity of advertisement costs.

23. All the estimations and tests were done using the *xtabond2* command in Stata 9.2.

24. Note that the *maquiladora* plants, which are considered producers of a service (processing of intermediates), are excluded from the analysis because they do not report values for gross output or intermediate inputs.

exports of output, imports of intermediate goods, inventories, and a small number of other plant characteristics. Information on industry affiliation is also available, and a unique plant identifier is assigned to each establishment, which makes it possible to track plants over time.[25] To construct plant-level capital stocks, we follow Tybout and Westbrook (1995). Each plant's capital stock is computed by adding the replacement cost (at the end of the year) of five different types of capital—machinery and equipment, buildings (construction and installation), land, transportation equipment, and other assets. Deflators (capital formation price indices) for the different types of capital at the two-digit industry level were provided by SECOFI.[26] Cash flow is calculated as the after tax operating profits plus depreciation.

All plants are classified into 129 four-digit Mexican Census Classification of manufacturing industries (Clase Censal 1975), a classification that roughly corresponds to the four-digit International Standard Industrial Classification (ISIC). The data on Mexico's commercial policy, including four-digit industry output and input tariffs as well as license coverage ratios, were originally constructed and provided by Adrian Ten Kate of SECOFI (see Ten Kate and de Mateo Venturini 1989, Tybout and Westbrook 1995) and are based on unpublished data from SECOFI. The tariff rates and license coverage ratios were aggregated according to a classification scheme compatible with that of Mexico's plant-level Annual Industrial Survey. In particular, each industry output tariff was computed by aggregating the relevant product-level tariffs, i.e. tariffs for products manufactured by that industry, using domestic production weights. The input tariff for each industry was constructed as a weighted average of the output tariffs for all inputs that the industry used, that is, $Input\ Tariff_{jt} = \sum_s \theta_{js} Output\ Tariff_{st}$, where θ_{js} is the share of input s in the value of output in industry j. The output license coverage ratio represents the share of goods subject to import licensing as a percentage of the value of the industry's production. The input license coverage ratio is computed similarly to the input tariffs.

As discussed in the previous section, a firm's market power is an important factor that determines the sensitivity of investment to changes in input and output import protection. On one hand, firms with high market power can be less sensitive to reductions in input tariffs and import licenses, as they can better absorb cost fluctuations in their markup. On the other hand, they can be more sensitive to reductions in output tariffs and licenses as they feel the pressures of competition brought about by increased imports. In order to check these predictions empirically, we construct plant-level markups, which proxy for an establishment's market power, using the information provided in the

25. Price indices at the industry level for output and intermediate inputs were provided by SECOFI.

26. Similarly, total investment is also the sum of investment in each of the five different types of capital.

panel. Following Campa and Goldberg (1999), the average markup, ψ_i, for plant i (average over the sample period from 1984 to 1990) is defined as[27]

$$\psi_i = \frac{\text{value of sales}_i + \Delta\text{inventories}_i}{\text{payroll}_i + \text{cost of materials}_i}. \tag{2}$$

Similarly, to test how a firm's foreign exposure affects investment, we use each establishment's exports of output (normalized by capital) and imports of intermediate goods (also normalized by capital) to expand the baseline specification (1). Table 2 presents the summary statistics for our dependent variable, the investment rate, and all of the right-hand side variables, including the output and input tariffs as well as import license coverage ratios.

V. ENDOGENEITY OF TRADE POLICY

It has been long recognized that trade policy may be endogenously determined by policy-makers—for example, governments may choose to offer more import protection for industries with low productivity levels or low investment rates in order to help firms grow their capital stock or protect jobs (see, for example, Hillman 1982). The political economy of trade literature has recognized that both domestic and foreign organized groups of firms or workers can influence local governments when import protection decisions are made (see, for example, Grossman and Helpman 1994; Grether and others 2001). For example, the fact that import license requirements in Mexico were eliminated starting in 1984 only for goods with no domestic competition may suggest that political economy forces were important in driving the trade liberalization. Therefore, there are two potential issues which may affect the reliability of the estimates of the effect of import protection measures on firm-level investment. The first is the possibility that policy-makers in Mexico chose import protection measures in response to industry-level investment rates. The second concern is that some of the factors that affect both import tariffs (as well as import license coverage) and investment rates, such as foreign direct investment (FDI), are omitted from the baseline specification, which can bias the estimates. Before the results from the baseline specification are presented, we show that the first issue is not relevant in the Mexican context, that is, we demonstrate that the Mexican government did not adjust any of the four trade protection measures—input and output tariffs, as well as input and output import licenses—in response to industries' investment rates. Then, in the robustness checks, it is also shown that additionally controlling for industry FDI, one of the potential determinants of import protection policy that can also affect a

27. This markup measure is a positive transformation of the markup measure of Domowitz and others (1986), *mk*, where the measure defined in (2) is equal to $1/1-mk$. We use the average markup rather than a contemporaneous measure in order to avoid endogeneity issues in the estimation.

firm's productivity and therefore investment, does not change the estimates at all.

If the Mexican government did adjust any of the four trade protection measures in response to industries' investment rates, one would expect either the cumulative changes in trade protection during the liberalization period (1985–1990) to depend on the initial industry investment rates, or current period industry investment rates to predict future period trade protection measures. To examine this, first industry investment rates are constructed as the sales-weighted average of firms' investment rates.[28] Then, two regression models are estimated. First, the changes in import protection over the period 1985–1990 are regressed on the initial level of the industry investment rate. Second, employing industry panel data from 1985 to 1990, industry output and input tariffs, as well as industry output and input import license coverage ratios, in period $t+1$ are regressed on the industry investment rate in period t. In this latter specification, industry and year fixed effects are included, and the regression is weighted by the number of firms in each industry-year cell.[29]

The results, which are presented in Table 3, convincingly show that none of the four import protection measures depends on the industry investment rates. Panel A of Table 3 shows the results from the four cross-sectional regressions of the 5-year (1990–1985) changes in import protection measures on initial (as of year 1985) industry investment. None of the four estimated coefficients are statistically significant with a mix of both positive and negative coefficients. Similarly, the industry-level panel regressions in Panel B demonstrate that future input and output import protection measures do not depend on current investment rates. Again, none of the estimated coefficients are statistically significant, with one positive and three negative estimates.

VI. RESULTS

The results from the baseline specification (1), which estimates the impact of input and output tariffs and import licenses on plant-level investment in the Mexican manufacturing sector, are reported in Table 4. This first set of results evaluates the average impact of the trade liberalization on investment in manufacturing establishments, and shows how changes in input and output protection measures affect investment differently, just as the theoretical framework in section II suggests. The estimates are shown to be robust to the inclusion of both industry-specific and region-specific controls. In section VI, the results from a number of robustness checks are reported. Also, section VI presents

28. Alternatively, we also constructed the industry investment rate as the ratio of aggregate industry investment over aggregate industry capital. The results with this alternative measure are very similar to the estimates reported using the sales-weighted measure in the text.

29. We also include aggregate (corresponding to 2-digit ISIC) industry dummies interacted with year dummies to capture aggregate, industry-specific, time-varying shocks (such as changing financing conditions).

TABLE 3. Trade Policy Endogeneity: Current Trade Policy and Past Investment

	(1)	(2)	(3)	(4)
Panel A: Cross-section Estimates				
Dependent Variable	Output Tariff	Output License	Input Tariff	Input License
Investment Rate	25.51 (19.91)	73.05 (71.79)	−8.17 (9.59)	−57.83 (35.32)
Number of Observations	126	126	126	126
R^2	0.0011	0.0086	0.0009	0.0015
Panel B: Panel Estimates				
Dependent Variable	Output Tariff	Output License	Input Tariff	Input License
Investment Rate	−10.41 (8.01)	−35.92 (40.21)	0.43 (4.57)	−21.68 (17.41)
Number of Observations	634	634	634	634
R^2	0.8934	0.6651	0.9273	0.9403

Note: Panel A presents the cross-section regressions of changes in the corresponding trade policy tool over the sample period (1984-1990) on initial (1984) investment. The regressions are weighted by the number of firms in each four-digit industry. Robust standard errors are reported. Panel B presents the panel regressions of current trade policy tool on lagged investment rate. Estimations include firm fixed effects, year effects and aggregate industry × year interaction dummies, and are weighted by the number of firms in each four-digit industry in each particular year. Standard errors are robust and they are clustered at the four-digit industry level.

Source: INEGI and SECOFI; see text for details.

TABLE 4. Baseline Results

Dependent variable : (I_{ijt}/K_{ijt-1})	(1)	(2)	(3)	(4)
Lagged investment rate (I_{ijt-1}/K_{ijt-2})	0.275** (0.104)	0.263** (0.105)	0.284** (0.104)	0.280** (0.103)
Sales/100 $(S_{ijt}/100 \times K_{ijt-1})$	0.087 (0.076)	0.073 (0.073)	0.078 (0.074)	0.071 (0.072)
Cash flow/100 $(C_{ijt}/100 \times K_{ijt-1})$	0.001 (0.004)	0.0001 (0.001)	0.001 (0.004)	0.0001 (0.004)
Output tariff/100 $\left(\tau_{jt}^{OT}/100\right)$	0.049 (0.065)	0.044 (0.063)	0.053 (0.065)	0.045 (0.062)
Output license/100 $\left(\tau_{jt}^{OL}/100\right)$	0.029** (0.015)	0.037** (0.016)	0.031** (0.015)	0.039** (0.016)
Input tariff/100 $\left(\tau_{jt}^{IT}/100\right)$	−0.201** (0.079)	−0.196** (0.086)	−0.233** (0.078)	−0.227** (0.086)
Input license/100 $\left(\tau_{jt}^{IL}/100\right)$	−0.063** (0.014)	−0.036** (0.017)	−0.063** (0.014)	−0.038** (0.017)
Industry× Year Effects	No	Yes	No	Yes
Region× Year Effects	No	No	Yes	Yes
Number of observations	11,834	11,834	11,706	11,706
Hansen test (p-value)	0.318	0.472	0.378	0.629
1st order serial correlation (p-value)	0.000	0.000	0.000	0.000
2nd order serial correlation (p-value)	0.393	0.445	0.378	0.406

Note: Two-step coefficients and robust standard errors with the Windmeijer (2005) small sample correction are reported. ** and * denote significance at 5% and 10%, respectively. A set of year dummies are included in all specifications. The instruments for the first-differenced equations are: (S_{ijt-2}/K_{ijt-3}), (S_{ijt-2}/K_{ijt-3}), (S_{ijt-3}/K_{ijt-4}), (C_{ijt-3}/K_{ijt-4}), $(\text{AdvertisementCosts}_{ijt-1}/K_{ijt-2})$.The instruments for the equations in levels are: $\Delta I_{ijt-2}/K_{ijt-3}$, $\Delta C_{ijt-2}/K_{ijt-3}$, $\Delta C_{ijt-2}/K_{ijt-3}$. The p-values for the Hansen test of overidentifying restrictions (where the null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term) are reported. The Arellano-Bond (1991) serial correlation tests are applied to the first-differenced residuals.

Source: INEGI and SECOFI; see text for details.

evidence of the heterogeneity in the impact of the trade liberalization across firms of different size. It further shows how trade liberalization is especially beneficial for investment in firms that import intermediate inputs. This section also documents the importance of the firm's market power, as proxied by the size of the firm's markup, in mediating the effects of trade liberalization on investment. Finally, the overall impact of Mexico's trade liberalization on investment is quantified at the end of section VI.

Main Effects of Trade Liberalization on Investment

Column (1) of Table 4 presents the results from our baseline specification (1), which includes both firm and year fixed effects. Confirming the theoretical predictions, the estimates show that the decrease in output and input protection measures during the Mexican trade liberalization affected plant-level investment differently. The estimated coefficients on the output tariffs and import licenses are respectively 0.049 (with a standard error of 0.065) and 0.029 (0.015), with the latter being significant at the conventional 5 percent level.[30] This is consistent with the theoretical framework discussed in section II: reductions in output tariffs and import licenses lower the marginal profitability of capital due to intensified foreign competition, which in turn leads to lower investment. The estimated coefficient on the output license coverage indicates that a 10 percentage point reduction in the output license coverage leads to a 0.29 percentage point decrease in investment, or 1.93 percent at the mean investment rate of 0.15.

The estimated coefficients of the input tariffs and the import license coverage, on the other hand, are both negative and statistically significant at the 5 percent level. The estimated coefficient of -0.201 (0.079) on the input tariffs implies that a 10 percentage point reduction in input tariffs raises investment by 2.01 percentage points. Similarly, the estimated coefficient of -0.063 (0.014) on the input import license coverage implies a 0.63 percentage point increase in investment given a 10 percentage point decline in input license coverage.[31] These results are consistent with the discussion in section II, which describes how a decrease in the protection measures imposed on inputs stimulates investment by lowering the cost of imported (intermediate) inputs, and thereby increases the marginal profitability of capital. These findings are also consistent with Amiti and Konings (2007) and Khandelwal and Topalova (2011), who, in a similar vein, show that reductions in input tariffs increase firm-level productivity in the Indonesian and Indian manufacturing sectors, respectively.

30. We compute robust standard errors using the Windmeijer (2005) small sample correction.

31. Note that when the size of the impacts of the output and input protection measures are compared, the investment-stimulating effect of lower input tariffs and license coverage (at 2.01 and 0.63 percentage points given equal reductions of 10 percentage points, respectively) dominates the adverse effects of lower output tariffs (at 0.29 percentage points given a reduction of 10 percentage points) and license coverage (insignificant effect).

In order to check if the main results are robust to aggregate industry-specific, time-varying shocks (such as changing financing conditions), as well as region-specific, time-varying shocks (capturing, for example, dynamic productivity differences across regions in Mexico), aggregate industry-specific year dummies, as well as region-specific year dummies are furthered included.[32] These specifications are presented in columns (2)-(4) of Table 4. The estimates of the impact of the four import protection measures on plant-level investment remain largely unchanged. In the most general specification with both aggregate industry- and region-specific year dummies (column (4)), the direction of the impact and the significance of the estimates of the four measures of protection are the same as in the baseline case in column (1). While the impact of the output import license coverage is estimated to be about 30 percent larger in column (4) than in column (1) (0.039 vs. 0.029), the impact of the input import license coverage is about 40 percent smaller (−0.038 vs. −0.063).[33]

In all four columns, lagged investment is positive and statistically significant, as expected. The other firm-specific determinants, sales and cash-flow, are positive as expected; however, they are small in magnitude and not precisely estimated. All specifications in Table 4 are supported by the tests of over-identifying restrictions, for which the Hansen test statistic fails to reject the validity of the instrument sets (the p-values are 0.393, 0.445, 0.378 and 0.406, respectively). Moreover, the tests for serial correlation, which are applied to the residuals in the first differenced equations ($\Delta\varepsilon_{ijt}$), show that the null hypothesis of no first-order serial correlation can be rejected, but the null hypothesis of no second order serial correlation cannot be rejected.[34] The fact that the errors only have first order autocorrelation conforms to the choice of instruments dated *t-2* and *t-3*.

Robustness Checks

The first robustness check demonstrates that the results and conclusions in the previous subsection do not change when the standard errors are clustered at the 4-digit industry level (still using the Windmeijer (2005) small sample correction), instead of being clustered at the firm level. Clustering at the industry level is of interest because the trade liberalization measures vary at the industry

32. Eight aggregate industry dummies (equivalent to two-digit ISIC manufacturing industry aggregates) and 6 region dummies (into which 32 Mexican states are geographically grouped) are used; see footnote 19.

33. We have also estimated the main model after trimming extreme observations by "winsorizing". We followed Angrist and Kruger (1999) and "winsorized" the data within each year for all of our main variables (including investment, sales, and cash flow) by setting all values below 0.5^{th} percentile to the value at the 0.5^{th} percentile and all values above the 99.5^{th} percentile to the value at the 99.5^{th} percentile. The estimates using the "winsorized" data, which are available upon request, are quite similar, both economically and in statistical significance, to those reported in Table 4.

34. Assuming that the residuals, ε_{ijt}, in equation (1) are i.i.d, we expect $\Delta\varepsilon_{ijt}$ in the first-differenced equations to have first order autocorrelation.

level. The first column of Table 5 shows that the results discussed in the previous section are robust to such clustering.[35]

As discussed in the previous section, it is possible that a variable which affects both import protection levels and firm-level investment is omitted from the baseline specification. Consequently, the estimates of the impact of trade protection on firm-level investment can be biased. The political economy of trade literature has identified a number of factors that may affect protection levels - industry share of foreign direct investment (FDI), industry concentration, industry labor intensity, etc. One that can feasibly affect both import protection levels and firm-level investment is industry FDI.[36] In the Mexican context, Grether, de Melo, and Olarreaga (2001) have shown that industry-level FDI did affect trade policy during the earlier liberalization years (1985–1988). While there is not much evidence, it is widely speculated that the industry share of FDI can bring about positive productivity spillover effects on domestic establishments, and hence increase investment (see, for example, Javorcik 2004). Therefore, omitting the industry-level share of FDI from the baseline specification may potentially lead to inconsistent estimates of the effect of trade policy on firm-level investment. In order to check if that is the case, the baseline specification is re-estimated additionally including the share of FDI (as a share of total industry output, or total industry capital) on the right-hand side of the regression.[37] Columns (2) and (3) of Table 5 show that additionally controlling for industry-level FDI does not change the estimated effects of import protection on firm-level investment.

For the next robustness check, the baseline specification is estimated using the alternative timing of the four import protection measures. As already discussed earlier, data on input and output tariffs as well as import licenses are available for June and December of each year in the sample. In the baseline specification, the data on trade protection in June of year t are used as the relevant measure affecting investment in year t, that is, the investment rate in 1985 was regressed on trade protection in June of 1985. In this robustness check, equally-weighted data on trade protection in December of year $t-1$, June of year t, and December of year t are used to explain investment in year t. The results with this alternative timing of the

35. Since the two-step coefficients from the system-GMM are presented, clustering the standard-errors at the industry level affects the coefficients as well as the standard errors. However, the coefficients obtained with industry level clustering are very similar to the baseline estimates.

36. To the best of our knowledge, there is no previous theoretical or empirical work that relates any of the other determinants of trade protection to firm-level investment.

37. On theoretical grounds, one would want to include FDI as share of industry imports, not as a share of industry output, on the right-hand side of the regression (see Grether, de Melo, and Olarreaga 2001). However, industry imports in the same (1975 Mexican Census) classification at the detailed four-digit industry level could not be located. Instead of aggregating the FDI data, FDI as a share of industry output at the original, detailed four-digit industry level was used.

TABLE 5. Robustness Checks

Dependent variable: (I_{ijt}/K_{ijt-1})	(1)	(2)	(3)	(4)
Lagged investment rate (I_{ijt-1}/K_{ijt-2})	0.270** (0.128)	0.274** (0.105)	0.275** (0.104)	0.276** (0.104)
Sales/100 $(S_{ijt}/100 \times K_{ijt-1})$	0.105 (0.095)	0.088 (0.076)	0.087 (0.076)	0.087 (0.075)
Cash flow/100 $(C_{ijt}/100 \times K_{ijt-1})$	−0.0005 (0.006)	0.0001 (0.004)	0.0001 (0.004)	0.0001 (0.004)
Output tariff/100 $\left(\tau_{jt}^{OT}/100\right)$	0.049 (0.067)	0.035 (0.067)	0.058 (0.064)	0.009 (0.051)
Output license/100 $\left(\tau_{jt}^{OL}/100\right)$	0.032** (0.016)	0.029* (0.015)	0.029* (0.015)	0.035** (0.015)
Input tariff/100 $\left(\tau_{jt}^{IT}/100\right)$	−0.183* (0.109)	−0.205** (0.079)	−0.205** (0.078)	−0.155** (0.071)
Input license/100 $\left(\tau_{jt}^{IL}/100\right)$	−0.061** (0.024)	−0.069** (0.015)	−0.062** (0.014)	−0.056** (0.015)
Foreign output (share of total industry output)		−0.022 (0.018)		
Foreign output (fraction of total industry capital)			0.003 (0.007)	
Number of observations	11,834	11,834	11,834	11,834
Hansen test (p-value)	0.469	0.317	0.321	0.320
1st order serial correlation (p-value)	0.000	0.000	0.000	0.000
2nd order serial correlation (p-value)	0.454	0.397	0.396	0.391

Note: The first column reports the baseline estimates with standard errors clustered by the four-digit industries. The last column reports the estimates with the tariff and license coverage measures that are averages over the previous year's December and corresponding year's June and December rates. See Table 4 for additional notes.

Source: INEGI and SECOFI; see text for details.

protection measures are presented in the last column of Table 5. These estimates are quite similar to their counterparts in the baseline specification in column (1) of Table 4. The only difference is in the coefficient on the output tariff, which is smaller than the baseline estimate, but still positive and not statistically significant.[38]

Heterogeneity in the Impact of the Trade Liberalization

The estimates presented in Table 6 shed light on the heterogeneity of the impact of Mexico's trade liberalization on firm-level investment. Building on the work of Melitz (2003), Bustos (2011) shows both theoretically and empirically that when a multilateral regional trade agreement, such as MERCOSUR, is implemented, firms in Argentina will have an incentive to upgrade technology given the expanded export opportunities as a result of lower tariffs in Brazil. In particular, Bustos (2011) emphasizes the fact that this incentive is not the same for all firms—it varies with productivity. Her model predicts that MERCOSUR will induce technology adoption for firms in the middle range of the productivity distribution. On the other hand, the trade agreement will not affect the least efficient producers, who do not export even after the agreement is in place, and the most productive firms, who already employed the upgraded technology even before the agreement took effect.

Similar effects of the unilateral trade liberalization in Mexico on firm-level investment are also likely to exist. For example, as input tariffs fall, firms in the middle of the productivity distribution are most likely to experience the largest investment incentive due to the lower input prices of imported intermediates. Such firms were previously likely on the margin and the lower input tariffs provided enough incentive for them to increase investment. On the other hand, the incentive was not enough for the least efficient firms, for which the marginal profitability of capital was quite low before and after the fall in tariffs. Moreover, the most productive establishments would also not increase their investment by much because they had likely already achieved a high investment rate based on the high expected level of sales before the trade liberalization.

To empirically test for heterogeneity in the impact of Mexico's trade liberalization on firm-level investment, following Bustos (2011) all firms were divided into 4 groups—the four quartiles of the initial firm size distribution, where initial size is a proxy for initial productivity.[39] Consequently, the following

38. In addition to the aforementioned robustness analyses, we also confirmed that the baseline results are robust to excluding observation with negative investment rates. Since there are only 372 negative observations (out of 11,834), not surprisingly, excluding them does not affect the estimates.

39. As in Bustos (2011), initial firm-level (log) employment relative to the four-digit-industry average was used as a measure of the firm's initial size.

TABLE 6. Heterogeneity of the Impacts across the Size Groups

	Output Tariff	Output License	Input Tariff	Input License
First Quartile	0.108 (0.152)	−0.042 (0.043)	−0.162 (0.171)	−0.052** (0.024)
Second Quartile	0.029 (0.156)	0.035 (0.035)	−0.030 (0.206)	−0.064** (0.028)
Third Quartile	0.045 (0.064)	0.041* (0.021)	−0.243** (0.104)	−0.087** (0.020)
Fourth Quartile	0.001 (0.007)	0.062** (0.020)	−0.282** (0.103)	−0.055** (0.021)

Note: The reported coefficients are the interaction terms between the corresponding liberalization measure and initial size dummy variables for the four quartiles. The initial size measure is constructed as the initial employment of the firm normalized by the employment in the corresponding four-digit industry.

Source: INEGI and SECOFI; see text for details.

expanded version of the baseline specification (1) was estimated:

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{ijt-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{C_{ijt}}{K_{ijt-1}} + \sum_{r=1}^{4} \gamma^r_{\tau^{OT}} (\tau^{OT}_{jt} \times Q^r_{ij}) + \sum_{r=1}^{4} \gamma^r_{\tau^{OL}} (\tau^{OL}_{jt} \times Q^r_{ij}) + \sum_{r=1}^{4} \gamma^r_{\tau^{IT}} (\tau^{IT}_{jt} \times Q^r_{ij}) + \sum_{r=1}^{4} \gamma^r_{\tau^{IL}} (\tau^{IL}_{jt} \times Q^r_{ij}) + \upsilon_i + \eta_t + \varepsilon_{ijt}, \quad (3)$$

where r indexes the four quartiles of the size distribution and Q_{ij} is the indicator variable equal to one when firm i belongs to quartile r.[40] The estimates are presented in Table 6. In general, the results are consistent with expectations and imply that the impact of lower tariffs and licenses increases with the size quartiles, and for both output tariffs and input licenses falls at the top of the distribution going from the third to the fourth quartile. Only for the input licenses are the estimates for each quartile statistically significant at the five percent level, and the coefficients follow the expected pattern. The impact of the reduction of input licenses is largest for firms in the third quartile and the point estimate of −0.087 (0.020) is about 40 percent larger than the average impact of −0.063 (0.014) that is estimated for all firms in the baseline specification (1) (see Table 4). The effects of lower output tariffs and licenses are less precisely estimated, and in the case of output licenses, the coefficients imply that the impact increases with the size quartiles.[41]

40. Note that the size indicator dummies are not included in the regression as they categorize firms based on their initial size, which is time-invariant.

41. This is broadly consistent with expectations and it may be due to the fact that firm size is not a perfect measure of productivity.

The Imported Inputs Channel

The discussion in section II illustrates how trade liberalization can increase investment by lowering the cost of imported inputs and making them more accessible. Hence, a firm that requires the use of imported inputs should benefit more from a reduction in input tariffs and import license coverage. To test this prediction explicitly, the baseline specification (1) is augmented with two interaction terms—one between the input tariff and the firm's import costs (normalized by the capital stock) and a second term between the input import license coverage and the firm's import costs.

The results are presented in column (1) of Table 7. The main effects of the input tariff and import licenses are again negative and statistically significant at −0.158 (0.076) and −0.048 (0.014), respectively. As expected, both interaction terms are negative with the input import license coverage interaction term statistically significant at the 5 percent level. The estimated coefficient of −0.008 (0.004) on this term implies that a firm facing the average amount of import costs (1.06) would increase investment by 0.56 percentage points given a 10 percent reduction in input import license coverage. At 2.26 percentage points, the effect is five times larger for a firm facing import costs that are one standard deviation above the mean import costs ($22.24 = 1.06 + 21.18$). This finding highlights the additional benefits of the reductions in input tariffs and import licenses for firms that import (intermediate) inputs, and it is consistent with previous work by Amiti and Konings (2007), who have shown that such firms enjoy larger productivity gains from a reduction in input tariffs. Moreover, similar to their results, in Table 7, the coefficient on imports itself is positive and highly significant, showing that a 10 percentage point increase in imports is associated with a 2.22 percentage point increase in investment.

The second column of Table 7 presents the results when, in addition to imports, two other (time-varying) firm-level characteristics that can potentially affect investment behavior—exports and foreign ownership—are included in the model. Either higher exports or foreign ownership can imply higher investment profiles, since such firms are typically more productive and are larger in size. Contrary to what one would expect, both higher foreign ownership and higher exports appear to be associated with a lower investment rate, although inferences are problematic since neither of the coefficients is statistically significant.[42]

The Markup Channel

Finally, this subsection considers the differential effects of input and output protection measures for firms with various levels of market power. The theoretical framework in section II illustrates how the effect of output tariffs and

42. Amiti and Konings (2007) also estimate a negative and insignificant effect of exports on firm-level productivity in Indonesian plants.

TABLE 7. Imported Inputs and Markup

Dependent variable: (I_{ijt}/K_{ijt-1})	(1)	(2)	(3)
Lagged investment rate (I_{ijt-1}/K_{ijt-2})	0.324** (0.103)	0.353** (0.110)	0.276** (0.105)
Sales/100 $(S_{ijt}/100 \times K_{ijt-1})$	0.087 (0.059)	0.084 (0.064)	0.089 (0.077)
Cash flow/100 $(C_{ijt}/100 \times K_{ijt-1})$	0.001 (0.003)	0.002 (0.002)	0.001 (0.004)
Output tariff/100 $\left(\tau_{jt}^{OT}/100\right)$	0.036 (0.066)	0.015 (0.070)	0.020 (0.068)
Output tariff × mark − up/100 $\left(\tau_{jt}^{OT} \times \Psi_i/100\right)$			0.016** (0.007)
Output license/100 $\left(\tau_{jt}^{OL}/100\right)$	0.025* (0.015)	0.024 (0.015)	0.018 (0.017)
Output license × mark − up/100 $\left(\tau_{jt}^{OL} \times \Psi_i/100\right)$			0.005 (0.003)
Input tariff/100 $\left(\tau_{jt}^{IT}/100\right)$	−0.158** (0.076)	−0.158** (0.080)	−0.126 (0.085)
Input tariff × imports/100 $\left(\tau_{jt}^{IT} \times IM_{ijt}/100 \times K_{ijt-1}\right)$	−0.003 (0.004)	−0.005 (0.005)	
Input tariff × mark − up/100 $\left(\tau_{jt}^{IT} \times \Psi_i/100\right)$			−0.036** (0.014)
Input license/100 $\left(\tau_{jt}^{IL}/100\right)$	−0.048** (0.014)	−0.051** (0.014)	−0.075** (0.017)
Input license × imports/100 $\left(\tau_{jt}^{IL} \times IM_{ijt}/100 \times K_{ijt-1}\right)$	−0.008** (0.004)	−0.009** (0.004)	
Input license × mark − up/100 $\left(\tau_{jt}^{IL} \times \Psi_i/100\right)$			0.005 (0.005)
Imports/100 $(IM_{ijt}/100 \times K_{ijt-1})$	0.222** (0.101)	0.268** (0.119)	
Exports/100 $(EX_{ijt}/100 \times K_{ijt-1})$		−0.112 (0.122)	
Foreign share		−0.021 (0.017)	
Number of observations	11,834	11,834	11,834
Hansen test (p-value)	0.559	0.546	0.327
1st order serial correlation (p-value)	0.000	0.000	0.000
2nd order serial correlation (p-value)	0.244	0.203	0.395

Note: In columns (1) and (2), we treat imports and the interaction terms as endogenous and use lags 2 and 3 of imports and the interaction terms as GMM-type instruments, in addition to the set of instruments listed in Table 4. In column (2), we further add lags 2 and 3 of exports and foreign share (both treated as endogeneous) to the instrument set used in the previous two columns. See Table 4 for additional notes.

Source: INEGI and SECOFI; see text for details.

licenses can be increasing in the size of the firm's markup. A firm with substantial market power, that is, with a high markup, can be affected more by lower output tariffs and import license coverage because of the heightened import competition that erodes its marginal profitability. At the opposite end of the spectrum, an already competitive firm with a low markup will not be affected considerably by the additional competition. While there is no direct theoretical prediction about the marginal impact of input tariffs and license coverage for high markup firms, one could expect the high markup firms would be affected less by changes in input tariffs and import licenses, as they can adjust their markups and absorb some of the cost fluctuations in their profit margins without any significant changes in their investment behavior.

To test these predictions, the baseline specification is augmented with markup interactions, where a time-invariant measure of the firm's markup, as described earlier, is employed. These results are presented in the last column of Table 7. As expected, the interaction terms between the markup and the output tariff and import license are both positive, implying that a reduction in output protection lowers investment more in high markup firms. While the main effect of the output tariff is not significant, as in the baseline specification, its interaction is statistically significant at the 5 percent level.[43] The estimated coefficients imply that a reduction in output tariffs of 10 percentage points lowers investment by 0.56 percentage points for a firm with the average markup (2.25), and it lowers investment by 1.47 percentage points for a firm with a markup that is one standard deviation above the mean ($7.93 = 2.25 + 5.68$). While both the coefficient on the main output import license coverage term and the interaction with the markup is positive, neither is statistically significant.

Finally, the interaction term between the markup and the input tariff measure and the interaction between the markup and the input import license measure have a negative and a positive sign, respectively. As expected, the interaction term between the input import license coverage and the markup is positive, albeit insignificant, implying a mitigating role for the markup when it comes to the effect of input licenses on investment. The coefficient on the input license coverage itself is negative and statistically significant as in the baseline results. While the main effect of input tariffs is negative and insignificant, the interaction term between the input tariff and the markup is negative and statistically significant. The negative interaction term implies that the higher markup firms increase investment more following a reduction in input tariffs. This could reflect the fact that high markup firms tend to be larger and import more intermediates, so their marginal profitability increases by more following a reduction in input tariffs.

Overall Impact of the Trade Liberalization on the Investment Rate in Mexico's Manufacturing Sector

Finally, this section analyzes the overall impact of Mexico's trade liberalization in the 1980s on the investment rate (I_{ijt}/K_{ijt-1}) in the manufacturing sector. Additionally, the respective contributions of the four major trade barriers—the output tariff and the output license coverage, as well as the input tariff and the input license coverage—which declined substantially as part of the trade liberalization process, are separated and compared. First, note that while both

43. The main effect and the interaction are jointly significant at the 10 percent level.

output and input tariffs fell significantly by about 22 percentage points and 10 percentage points respectively, the drop in both the output and input license coverage ratios was even more dramatic (see Figure 1). In 1984, the average output license coverage was 93 percent and the average input license coverage was 77 percent. By the end of our sample period in 1990, the average output license coverage had fallen 74 percentage points to 19 percent and the average input license coverage had dropped 66 percentage points to 11 percent.

Given the overall decrease in these trade barriers, the baseline estimates in column (1) of Table 4 imply that the 22 percentage point decline in the output tariffs led to a 1.08 percentage point decline in the investment rate and the 10 percentage point decrease in the input tariffs led to a 2.01 percentage point increase in the average investment rate. Hence, the overall change in the investment rate due to the drop in tariffs was an increase of 0.93 percentage points. Further, the estimation results in column 1 of Table 4 also imply that the 74 percentage point decline in the output license coverage resulted in a 2.15 percentage point drop in the investment rate, while the 66 percentage point decrease in the input license coverage led to a 4.16 percentage point increase in the investment rate. The net effect of the lower output and input import license coverage on the investment rate is therefore positive at 2.01 percentage points. Overall, the impact of the decrease in all four trade barriers is positive, implying that Mexico's trade liberalization led to a 2.94 percentage point increase in the investment rate in the Mexican manufacturing sector. It is also worth noting that the largest single (positive) impact on the investment rate came from the substantial decrease in the import license coverage on inputs.

Naturally, the net impact of the trade liberalization on the investment rate differs across four-digit manufacturing industries, driven by differences in the decline in the four import restriction measures. While the net impact is positive for the large majority of the industries, 14 (out of 129) actually experienced a decrease in the investment rate as a result of the trade liberalization, with the largest decrease being 8.88 percentage points ("Milling of Wheat"), and the largest increase being 7.94 percentage points ("Nonwoven Fabrics"). Among the industries that witnessed the largest decline in their investment rates is also "Milling of Corn." On the opposite end of the spectrum, some of the industries that experienced the largest increase in their investment rates as a consequence of the fall in tariffs and license coverage ratios include "Manufacturing of Fiberglass" and "Manufacturing of Paper."

Conclusion

Much research has been done on the impact of trade liberalization on firm productivity (e.g., Amiti and Konings 2007; Topalova and Khandelwal 2011). However, few studies have evaluated the effects of lower trade protection on investment. Apart from a few country- and industry-level studies (e.g., Ibarra 1995; Wacziarg and Welch 2008), to the best of our knowledge, this study is the first to have estimated the impact of trade liberalization on firm-level investment.

Employing plant-level data from the Mexican manufacturing sector, this study evaluates the impact of lower input and output tariffs as well as import license coverage on plants' investment decisions. It improves upon previous work with aggregate data as it controls for establishment-specific, time-invariant unobservables that may affect investment and bias the estimated impacts if not included in the empirical analysis. Also, it shows that employing aggregate country-level or industry-level data hides substantial heterogeneity in the effects of lower trade barriers on firms with different market power and international trade positions. Finally, as some of the recent studies on trade liberalization and productivity highlight the predominant importance of lower input tariffs (increased access to foreign inputs) compared to lower output tariffs (increased product market competition) for productivity, it evaluates the effect of both input and output protection measures on plant-level investment in the Mexican manufacturing sector.

In the case of investment, theory implies that access to cheaper inputs via lower input tariffs increases firm's profitability, and therefore investment, while lower output tariffs bring about more intense import competition, which results in lower profits and investment. This is exactly what the analysis finds. Using data that cover a period of broad trade liberalization in Mexico in the mid-1980s, it is shown that the decrease in input tariffs as well as import license coverage resulted in higher investment in Mexican manufacturing establishments. Also, in line with theory, the drop in output tariffs and import license coverage led to a decrease in plant-level investment. The estimated effects are economically and statistically significant and consistent with previous work on plant-level productivity (Amiti and Konings 2007; Topalova and Khandelwal 2011). Altogether, they suggest that the impacts of lower input tariffs and import license coverage (increased access to foreign inputs) on plant-level investment are larger than the impacts of output tariffs and import license coverage (increased product market competition). Consequently, the results show that Mexico's trade liberalization led to an increase in the average investment rate in the Mexican manufacturing sector.

REFERENCES

Alvarez, Roberto, and Ricardo A. Lopez 2005. "Exporting and Firm Performance: Evidence from Chilean Plants." *Canadian Journal of Economics* 38(4): 1384–1400.

Amiti, Mary, and Jozef Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review* 97(5): 1611–1638.

Angrist, Joshua D., and Alan B. Krueger. 1999. "Empirical Strategies in Labor Economics." In O. C. Ashenfelter, and D. Card, eds., *Handbook of Labor Economics* Vol. 3A. New York: Elsevier Science.

Arellano, Manuel, and Stephen Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58: 277–297.

Arellano, Manuel, and Olympia Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error-Components Models." *Journal of Econometrics* 68: 29–51.

Blundell, Richard, and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87: 115–143.

Bond, Stephen, and John Van Reenen. 2008. "Microeconometric Models of Investment and Employment." In James J. Heckman, and Edward E. Leamer, eds., *Handbook of Econometrics*. Basingstoke, U.K: Palgrave Macmillan.

Bustos, Paula. 2011. "Multilateral Trade Liberalization, Exports and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms." *American Economic Review* 101(1): 304–340.

Campa, Jose Manuel, and Linda S. Goldberg. 1999. "Investment, Pass-through, and Exchange Rates: A Cross-Country Comparison." *International Economic Review* 40(2): 287–314.

Domowitz, Ian, Robert G. Hubbard, and Bruce Petersen. 1986. "Business Cycles and the Relationship Between Concentration and Price-Cost Margins." *Rand Journal of Economics* 17: 1–17.

Fazzari, Steven M., Robert G. Hubbard, and Bruce C. Petersen. 1988. "Financing Constraints and Corporate Investment." *Brooking Papers on Economic Activity*: 141–195.

Fernandes, Ana. 2007. "Trade Policy, Trade Volumes and Plant-Level Productivity in Colombian Manufacturing Industries." *Journal of International Economics* 71(1): 52–71.

Goldberg, Pinelopi K., and Nina Pavcnik. 2004. "Trade, Inequality, and Poverty: What Do We Know? Evidence from Recent Trade Liberalization Episodes in Developing Countries." *Brookings Trade Forum*: 223–269.

Grether, Jean-Marie, Jaime de Melo, and Marcelo Olarreaga. 2001. "Who Determines Mexican Trade Policy?" *Journal of Development Economics* 64, 343–370.

Grossman, Gene M., and Elhanan Helpman. 1994. "Protection for Sale." *American Economic Review* 84: 833–850.

Hillman, Arye L. 1982. "Declining Industries and Political-support Protectionist Motives." *American Economic Review* 72: 1180–1187.

Iacovone, Leonardo, and Beata S. Javorcik. 2008. "Shipping Good Tequila Out: Investment, Domestic Unit Values and Entry into Exports." Technical Report.

Ibarra, Luis A. 1995. "Credibility of Trade Policy Reform and Investment: The Mexican Experience." *Journal of Development Economics* 47: 39–60.

Jaramillo, Fidel, Fabio Schiantarelli, and Andrew Weiss. 1996. "Capital Market Imperfections Before and After Financial Liberalization: An Euler Equation Approach to Panel Data for Ecuadorian Firms." *Journal of Development Economics* 51(2): 367–386.

Javorcik, Beata S. 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review* 94(3): 605–627.

Love, Inessa. 2003. "Financial Development and Financial Constraints: International Evidence from the Structural Investment Model." *Review of Financial Studies* 16(3): 135–161.

Love, Inessa, Ann E. Harrison, and Margaret S. McMillan. 2004. "Global Capital Flows and Financing Constraints." *Journal of Development Economics* 75: 269–301.

Melitz, Marc. 2003. "The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations." *Econometrica* 71(6): 1695–1725.

Muendler, Marc-Andreas. 2004. "Trade, Technology and Productivity: A Study of Brazilian Manufacturers." Policy Research Working Paper Series 1148, CESinfo.

Pavcnik, Nina. 2002. "Trade Liberalization, Exit and Productivity Improvements: Evidence from Chilean Plants." *Review of Economic Studies* 69(1): 245–276.

Rodriguez, Francisco, and Dani Rodrik. 2000. "Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence." In Ben Bernanke, and Kenneth Rogoff, eds., *NBER Macroeconomics Annual*. Cambridge, MA: MIT Press.

Sachs, Jeffrey D., and Andrew Warner. 1995. "Economic Reform and the Process of Global Integration." *Brookings Papers on Economic Activity* 1: 1–118.

Ten Kate, Adriaan, and Fernando de Mateo Venturini. 1989. "Apertura Comercial y Estructura de la Proteccion en Mexico." *Comercio Exterior* 39: 313–329.

Topalova, Petia, and Amit Khandelwal. 2011. "Trade Liberalization and Firm Productivity: The Case of India." *Review of Economics and Statistics* 93(3): 995–1009.

Tybout, James R., and M. Daniel Westbrook. 1995. "Trade Liberalization and the Dimensions of Efficiency Change in Mexican Manufacturing Industries." *Journal of International Economics* 39(1): 53–78.

Tybout, James R., M. Daniel Westbrook, Jaime De Melo, and Vittorio Corbo. 1991. "The Effects of Trade Reforms on Scale and Technical Efficiency: New Evidence from Chile." *Journal of International Economics* 31(3): 231–250.

Wacziarg, Romain, and Karen Horn Welch. 2008. "Trade Liberalization and Growth: New Evidence." *World Bank Economic Review* 22(2): 187–231.

Windmeijer, Frank. 2005. "A Finite Sample Correction for the Variance of Linear Efficient Two-step GMM Estimators." *Journal of Econometrics* 126: 25–51.