Gravity Estimation for Multinational Enterprises: An application to the GATT/WTO Puzzle

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Abstract

We derive a gravity equation for firm-level research on foreign direct investment (FDI), where particular attention rests on the endogeneity of economic policy. We apply this methodology to examine the effect of GATT/WTO accession on FDI using micro-level panel data on the investment decisions by Swedish multinational firms in twenty-one countries which join the GATT/WTO between 1965 and 1998. We find that GATT/WTO accession has no significant effect on the probability that a new affiliate is established. However, accession significantly increases the export intensity of foreign affiliates. These results are consistent with a three-country heterogeneous-firm model, where GATT/WTO membership turns the accession country into a better platform for affiliate exports to incumbent countries, while at the same time facilitating imports from these countries. Since these two effects have opposing impact on affiliate profits, the net effect on a firms’ investment decision is ambiguous.

Keywords: Multinational Firms, GATT accession, heterogeneous firms, IV estimation

JEL classifications: F13, F23

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1 Introduction

Economic science seems like a simple task: it is about formulating theories and testing them. Unfortunately, data analysis is often detached from the existing theories which causes omitted variable bias and misinterpretation of estimates. In empirical trade research, this danger was recognized early. Right after a well-fitting empirical specification to explain bilateral trade patterns - the so-called gravity equation - came up (Tinbergen, 1962), attempts were made to underpin it with a proper theoretical foundation.\(^1\) The importance of such an endeavor was most notably demonstrated in Anderson and van Wincoop (2003) which resolved the border puzzle by including multilateral resistance terms derived from a multi-region model into the analysis.\(^2\) According to Blonigen (2005), "there is no similar paper to Anderson and van Wincoop (2003) that lays out a tractable model that specifically identifies gravity variables as the sole determinants of FDI patterns." (p. 21)

In this paper, we propose a gravity-equation analysis for firm-level data on Foreign Direct Investments (FDI) that derives from a heterogeneous-firm model, where particular attention is paid to the endogeneity of economic policy both in theory and empirical analysis. We derive from a heterogeneous-firm model two gravity estimation equations - one that explains the probability of a new foreign investment of a firm in a host country; and a second that explains the export intensity of foreign affiliates. The first equation explores the extensive margin of FDI, i.e. the emergence of new investment projects, and the second the intensive margin of FDI, i.e. the change in the intensity of activity of existing projects. The underlying model comprises three countries and allows discussion of horizontal FDI, where a firm serves each market by local production, and export platform FDI, where a foreign affiliate from some home country serves not only the host but also some third-country markets.\(^3\)

We pay particular attention to causality issues. Causality is important if research interest rests on policy impacts of FDI because those policies are often endogenous when countries self-select into whether to undertake certain policy measures.\(^4\) Moreover, endogeneity bias arises also, because governments

\(^1\) See Anderson (1979), Bergstrand (1985,1989), Helpman and Krugman (1985), Feenstra et al. (2001), and Anderson and van Wincoop (2003), among others.
\(^2\) The "border puzzle" associates with the finding of McCallum (1995) that borders diminish trade between Canadian and U.S. regions to an implausibly large extent (22-fold).
\(^3\) According to Braconier et al. (2005), these are the two by far most important types of FDI of Sweden to which we apply our analysis.
\(^4\) The importance of causality in gravity estimation has been noted recently in the related but still distinct issue of the impact of regional trade agreements on trade policy, volume, and structure. See Baier and Bergstrand (2007) and Egger et al. (2006). A difference emerges to our study, because the theory of regional trade agreements suggests that the same covariates are contained both in selection and outcome equation. Since there is no excluded instrument, IV estimation is impossible. Therefore, Egger et al. (2006) resort to matching techniques. Our theory of GATT/WTO accession contains different variables explaining selection and outcome equation which renders IV estimation feasible. Moreover, we identify as a major estimation problem omitted variables, in which case matching techniques are not appropriate, because they assume that there is no selection into treatment based on unobservable characteristics which are at the same time correlated with the error of the outcome equation.
implement simultaneously whole packages of policies besides the one of research interest and those others may not all be observable in available data. We incorporate several endogenous policy choices into our model and derive the probability limits of the estimated coefficients in the two gravity equations under the null hypothesis that the theoretical model is true. Since we have two simultaneous causal effects through our policy variable of interest, and the export-intensity estimation identifies unambiguously one of them, the other is also identified as a remainder through the estimation of the probability of new investments by instrumental variable (IV) methods. In addition, we can also identify two self-selection effects by comparing estimates with instrumenting with those without.

Instrumental variable methods are a simple and elegant tool to explore causality issues. However, this method is known to depend entirely on the assumption that the instrument is not correlated with the error term in the outcome equation. Unfortunately, this assumption has so far not been testable. However, taking the data generating process of our theoretical model as a null hypothesis, we can device a simple test for the validity of the instrument and the model jointly. Since we cannot jointly reject model and instrument validity, we gain confidence in both. The appendix provides a simple Monte Carlo study that investigates size and power of the test and demonstrates its usefulness in our context. Similar procedures will be applicable to many economic issues where causal impact of policy is investigated with a theoretical foundation.

We then apply this methodology to investigate what average causal impact has accession to the General Agreement of Trade and Tariffs (GATT) or its successor - the World Trade Organization (WTO) - on FDI using micro-level panel data on the investment decisions by Swedish multinational firms in twenty-one countries which join the GATT/WTO between 1965 and 1998. Our methodology provides strong evidence that GATT/WTO affects trade policy in accession- as well as incumbent countries, and therefore contributes to a resolution of the "GATT/WTO puzzle", where Rose (2004a,b, 2005) in seminal work argues that there is no statistically robust evidence that membership in these organizations promotes trade, or affects trade policy.

We first show that accession increases the probability that a Swedish MNE will invest into a new affiliate in the host country. However, our analysis does show that accession to the GATT/WTO increases foreign affiliate trade by having a strong, positive and highly significant effect on the export-intensity of the affiliates. In short, accession to GATT/WTO affects trade through multinationals. To see why accession may have no impact on firms discrete investment decisions, while at the same time increasing foreign affiliate trade, we note the principle of most-favored-nation (MFN) status in the GATT/WTO treaties entitles a new member economy to all the favorable policies on international trade that the incumbent member economies have granted each other. Therefore, a country with low labor costs and proximity to large markets may be a favorable location for export production to third markets (export platform

\footnote{If there are several instruments for one endogenous variable, then a test on overidentifying restrictions can assess the validity of the remaining instruments given the assumption that the first instrument is valid.}
FDI\(^6\) after trade barriers to incumbent countries have been reduced which stimulates trade. Due to the accession, however, import barriers to the host country are likely to be lowered, too. Because of the principle of national treatment\(^7\), the acceding country has also limited possibilities to discriminate against imported foreign products.

Thus, accession to GATT/WTO, will *increase foreign affiliate trade* by increasing affiliate exports from the host country as well as substituting exports for FDI directed at serving local markets (reverse tariff jumping effect). From reciprocal tariff reductions through accession, affiliate export platform FDI faces increased profitability (export platform effect), whereas horizontal FDI activities face lower profitability relative to exports from the home country (reverse tariff jumping effect). Since total foreign investment is made up of the combination of these two counteracting effects, the overall effect of accession on FDI is ambiguous, and possibly zero. In addition to these causal effects of GATT/WTO, we find also indirect evidence for that GATT/WTO accession is possibly accompanied by other reforms which in turn attract FDI (domestic economic policy effect). This omitted policy variable bias overcompensates the self-selection bias which results if countries join GATT/WTO because they want to reduce trade barriers rather than the other way around (self-selection effect).

Although recent research has come to stronger evidence in favor of GATT/WTO by either separating de jure from de facto membership (Tomz et al., 2005), or taking into account several asymmetries in the GATT/WTO system (Subramanian and Wei, 2007), or when taking into account zero trade links and aggregate impact of new exporting firms (Felbermayr and Kohler, 2006, and Helpman et al., 2007), we contribute to this literature by (i) using firm-level data as the unity of observation, (ii) by explicitly addressing the endogeneity of the accession decision,\(^8\) and (iii) by examining the impact of GATT/WTO on multinational firms.\(^9\)

All these three aspects are important in understanding the role of GATT/WTO. The first one - firm level analysis - has the advantage that the unit of observation is the decision maker himself, i.e. the firm, because changes in valuation or composition do not obscure direct behavioral changes in firm-level-contrary to aggregate-data analysis. The second feature of our analysis - endogeneity of the GATT/WTO accession decision - can also be expected to be relevant at first sight, since countries are not randomly assigned GATT/WTO membership. For example, countries may join GATT/WTO, because they want to liberalize trade anyhow. Moreover, countries that change their attitude towards more liberal trade

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\(^{6}\)Recent models of export platform FDI include Neary (2002), Yeaple (2003), Grossman et al. (2006), and Ekholm et al. (2007).

\(^{7}\)A theoretical foundation of the principle of national treatment in the GATT/WTO rules is given by Horn (2006).

\(^{8}\)An exemption is Rose (2004a) which uses one specification with an instrumental variable. Contrary to our approach, there is no test of the validity of the instrument, although the estimation result is known to rest entirely on this assumption.

\(^{9}\)Gravity-equation-like reduced forms were also derived for foreign direct investment (FDI) research (Carr et al., 2001, Helpman et al., 2004, and Kleinert and Toubal, 2005). However, all these reduced forms were designed for bilateral aggregate data. Firm-level empirical research on FDI with a theoretical microfoundation is also executed in Feinberg and Keane (2007). However, their approach is not related to gravity estimation.
policy are also likely to be inclined to liberalize other policies which may be hard to control for in an empirical analysis yielding omitted variable bias. The third aspect of analysis - exploring the impact of GATT/WTO on FDI - is itself important for two reasons. A large part of world trade is facilitated through multinational enterprises (MNEs). Moreover, most accession countries are LDCs or emerging market economies which may lack technology to participate in the world markets for industrial products with their own firms but do it instead through MNEs. Then, the benefits of GATT/WTO materialize more strongly through FDI than through international trade.

The rest of the paper is organized as follows. Section 2 gives a first informal overview of the paper and provides some first descriptive evidence of the main hypotheses. Section 3 provides a model that guides the empirical analysis which is conducted in section 4. Section 5 concludes.

2 GATT/WTO and FDI - a first look

In its origins, GATT was shaped as a multilateral agreement aimed at fostering international trade through facilitating reciprocal reductions in trade barriers. Even though there were major changes from the GATT to the WTO, extending its coverage to more sectors and activities, the fundamental principles are still the same. Countries that apply for accession go through several rounds of negotiations with the major trading partners and agree to a reduction in its own tariffs to maximum binding rates (bound rates) and to other trade liberalization measures. By the principles of reciprocity and non-discrimination, the new member is entitled to the MFN-tariff of all other member countries in exchange. Moreover, the dispute settlement procedure ensures enforcement of the trade barrier reduction.

What impact should one expect on the activities of multinational firms when a host country accedes the GATT/WTO? An immediate prediction should be that since the accession event increases market

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10 According to estimates from UNCTAD (1995, p. 193) for the year 1993, about a third of world trade consists of intra-firm exports, and another third of other parent and foreign affiliate exports.

11 Most liberalization of international trade that was facilitated through GATT was confined to industrial products according to Subramanian and Wei (2007).

12 The principle of reciprocity enables international cooperation by promoting multilateral negotiations via a legal framework in which a member country agrees to lower its protection in return for a reciprocal concession. The principle of nondiscrimination involves two components, the MFN-principle and the National Treatment principle. In line with the MFN-principle, member countries cannot discriminate between their trading partners. The National Treatment principle implies that products from any other member country must be treated no less favorable than the equivalent domestically produced products, at least after the foreign goods have crossed the border.

13 In contradiction to reciprocal concession, there is also a concept of non-reciprocity between the North and the South. One of the non-reciprocity components is the “Enabling Clause”, which stipulates that developing countries are not obliged to make commitments which are in volition to their economical development. An outcome of the “Enabling Clause” is the possibility by a member country to grant a developing country “special and deferential” treatment under the “Generalized System of Preferences” (Langhammer and Lücke, 1999). Hence, we will consider as an alternative hypothesis in our empirical analysis that accession countries may invoke “special and deferential” treatment to be granted exemption from trade barrier reductions.
access to all member countries this should foster trade activities within the MNEs’ foreign affiliates (export platform effect). In Figure 1(i), we examine this prediction in our sample of affiliates to Swedish multinational firms. Figure 1(i) thus shows the average share of affiliate sales exported by year in the period 1965 until 1998. These export intensities are then compared between countries which entered GATT/WTO before 1965 (marked out as X) and the group of countries which joined during our sample period. The mean export intensity in these switching countries are indicated before (marked out as ◦) and after accession (marked out as ·).

Several noteworthy features arise: Affiliates in the group of countries that were already members before 1965, mostly developed countries, show a steady increase in affiliate export intensity, as expected from the globalization process. In countries that acceded between 1965 and 1998, before accession, the average share of exports of affiliates is low and even somewhat declining. After GATT/WTO accession, instead, the export share of affiliate production rises dramatically over time. The rise in the export share after accession is even steeper than the one of countries that entered GATT before 1965, going from roughly 5% pre-accession to roughly 30% post-accession - a six-fold increase.

Accession to GATT/WTO thus seems to have a very strong effect on foreign affiliate trade. Does this also imply that MNEs are more likely to invest into new affiliates when countries obtain membership? Since Figure 1(i) shows that affiliate exports are promoted so much through accession, affiliate production for third markets (export platform FDI) must have become very attractive. In contrast, since the market access to the accession country improves also, host country imports become cheaper and local affiliate sales may be substituted for exports from the home country thereby reducing FDI (reverse tariff jumping effect). Figure 1(ii) gives a hint that these two opposing effects tend to balance each other. This figure gives the frequency of new investments per number of investment choices by the Swedish MNEs for each sample year. Note that the pre- to post accession comparison shows a much weaker pattern, where the small difference in average frequency pre- and post accession arises mainly because the investments decrease over time in the countries still outside GATT/WTO. As a larger share of the acceding countries has switched to membership over time, this may hint at a self-selection rather than a causal effect.

Another effect that could blur the causal effects of GATT/WTO becomes obvious from the sequence of accession in panel (iii). Former socialist countries such as Slovak Republic and Slovenia entered GATT/WTO after the fall of the iron curtain. Those countries switched from highly distorted centrally planned- to free market economies, and WTO accession was only one out of many policy changes. Introduction of private property rights, liberal labor markets, and privatization of the economy all affect quite clearly the attraction of those countries to FDI. In Mexico, Morocco, or Thailand, the economy was

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14 As will be clear from the empirical analysis, we use the countries which joined the GATT/WTO during 1965-1998 and where at least one Swedish MNE invested during this time period.
in a deep crisis. To overcome it, the government liberalized the trade regime by GATT/WTO accession which was intended to steer up competition and stimulate growth. However, liberal FDI policy, domestic economic deregulation, anti-corruption measures, and removal of other government distortions were also initiated for the same purpose and made those countries more attractive to FDI leaving the question open which of the coinciding policy measures actually caused FDI.\footnote{Yet, some countries in our sample also joined GATT without other policy changes such as socialist Romania and Hungary in 1971 and 1973, respectively.}

Next, we will develop a theoretical model to examine how accession of a host country to GATT/WTO will affect foreign affiliate trade and FDI decisions. From this model, which takes into account that the accession decision may be correlated with other policy choices, we derive gravity estimation equations which allows us to estimate the causal effect of GATT/WTO. In particular, it will be shown that the effect of accession on the export intensity in Figure 1(i) reveals the causal effect of GATT/WTO accession, whereas the effect of accession on the investment decision, illustrated in Figure 1(ii), is biased and needs a correction.

3 The model

Consider a three-country model where two countries are members of GATT/WTO and the remaining country has a simultaneous choice on GATT/WTO accession, trade barriers, and other economic policies. We will examine how GATT/WTO accession affects FDI into the potentially acceding country.

3.1 Multinational firms in partial equilibrium

We assume a world with three countries denoted by $H$ (mnemonic for home country), $S$ (mnemonic for South), and $R$ (mnemonic for rest of the world). Since we only have data on multinational firms from Sweden, we assume, without loss of generality, that only country $H$ headquarters multinational firms. Country $S$ is a potential host country to these multinationals from country $H$. Country $R$ is a potential export destination country for affiliate sales from $S$. Countries $H$ and $R$ are already members in the GATT/WTO. Thus, we will examine how an accession of Country $S$ to the GATT/WTO affects (i) the incentives of firms with headquarter in country $H$ to invest in country $S$ and (ii) how accession affects foreign affiliate trade in such country-$H$ firms.

In section 3.1.1, we examine the investment decisions by the MNEs in a partial equilibrium. In section 3.2, MNEs will be embedded into a general equilibrium setting where the accession choice of country $S$ is examined. Furthermore, we take as given that multinational firms have existing production facilities in country $H$ from which the home market will be served. This is true for virtually all Swedish MNEs. In addition, affiliate exports back to Sweden is the smallest component in Swedish MNEs’ affiliate sales (Braconier et al., 2005). To simplify the analysis, we therefore abstract from this type of vertical FDI.
3.1.1 Product market interaction

Let us consider a sector with monopolistic competition and differentiated goods. Then, each firm in this sector produces a different variety indexed by \( z \). Assuming a Dixit-Stiglitz CES utility function with a substitution elasticity between any two varieties denoted \( \sigma, \sigma > 1 \), the demand for a variety \( z \), produced in country \( i \) and sold in country \( j \) is \( x_{ij}(z) = \frac{P_i(z)^{-\sigma}}{P_j(z)^{-\sigma}}I_j \), where \( p_{ij}(z) \) is the price of a variety \( z \), produced in country \( i \) and sold in country \( j \). \( P_j = \left[ \int_0^1 p_{ij}(z)^{1-\sigma}dz \right]^{\frac{1}{1-\sigma}} \) is the price index in country \( j \) on differentiated goods and \( I_j \) is total expenditure attributed to the differentiated goods sector in country \( j \).

Focusing now on differentiated country-\( H \) firms, each firm is characterized by a total factor productivity \( \theta \in [0, \infty] \) with a frequency distribution \( g_H(\theta) \). There is a total exogenous unity mass of differentiated country-\( H \) firm varieties accessible to consumers both in countries \( S \) and \( R \). Thus, \( \int g_H(\theta)d\theta = 1 \). The productivity parameter \( \theta \) is firm-specific and does not differ across locations, i.e. \( \theta(z) \) can be thought of as an intangible asset services of which are fully available within all parts of the firm. The operating profit from producing a variety \( z \) in country \( i \) selling it in country \( j \) is:

\[
\pi_{ij}(z) = \left[ \frac{p_{ij}(z)}{(1 + t_{ij})(1 + T_i)} \cdot \frac{w_i}{\theta(z)} \right] x_{ij}(z) \tag{1}
\]

Here, \( t_{ij} \) is an ad valorem tariff on imports from country \( i \) to country \( j \) and \( t_{ii} \equiv 0 \); Moreover, we have introduced the domestic economic policy instrument \( T_i \). This could be a tax, but also corruption payments, or any other policy instrument that shifts rents from foreign investors to the host-country government. Henceforth, we will refer to \( T_i \) as the business cost rate to indicate that it is much broader than just a tax rate. To focus on the potential accession country \( S \), we set \( T_H = T_R = 0 \).

As usual profit maximization implies \( p_{ij}^*(z) = \frac{\theta(z)^{\sigma}}{w_i} \), where it is convenient to define \( c_{ij} \) as the marginal cost adjusted for tariffs and business cost (but unadjusted for productivity):

\[
c_{ij} = (1 + t_{ij})(1 + T_i) w_i \tag{2}
\]

Note that optimal sales are \( x^*_{ij}(z) = \frac{c_{ij}^*(z)^{-\sigma}}{p_{ij}^*}I_j = \theta(z)^\sigma \frac{(1 + t_{ij})(1 + T_i)}{p_{ij}^*}I_j \). Conveniently, it then follows that the reduced-form operating profit \( \pi^*_{ij}(z) \) is linear in productivity index \( \Theta(z) \):

\[
\pi^*_{ij}(z) = \Theta(z) B^*_{ij}, \tag{3}
\]

where \( \Theta(z) \equiv \theta(z)^{\sigma-1} \), \( B^*_{ij} \equiv \phi \frac{I_j}{(p_{ij}^*)^\sigma} c_{ij}^{-(\sigma-1)} \), and \( \phi \equiv (\sigma - 1)^{\sigma-1} \sigma^{-\sigma} \). Note that \( B^*_{ij} \) is the operating profit unadjusted for productivity, whereas \( \Theta(z) \) indicates the firm level heterogeneity in productivity.

3.1.2 Location Choice

We are now ready to solve for the equilibrium location choices. Altogether, multinationals (headquartered in country \( H \)) have six location strategies to choose from.\(^{\text{16}}\) For a full solution with all investment choices

\(^{\text{16}}\)All firms will serve all markets in equilibrium, since we assume the absence of fixed trade costs contrary to Melitz (2003) and Helpman et al. (2004) and since we assume that the fixed cost of home production are sunk. The reason is that we
we refer to the Appendix A. In order to highlight the main mechanisms in the model we focus on three strategies - namely exporting firms, export platform FDI and horizontal FDI. Exporting firms produce in country H only and serve the markets in S and R by exports. In what follows, we assume that individual firms take real income in each country as given.

**Pure exporting firms.** In the exporting strategy, firms serve the markets in S and R with exports from H. Thus, the total profits are:

$$\Pi^{Export}(z) = \Theta(z)[B_{HR}^* + B_{HS}^*]$$

(4)

where the operating export profit to country R is $B_{HR}^* = \varphi \frac{I_H}{(P_H^*)^\sigma} [(1 + \bar{t})w_H]^{-(\sigma - 1)}$, where $\bar{t}$ is the GATT/WTO bounded tariff rate which we assume is binding. Operating export profit to country S is $B_{HS}^* = \varphi \frac{I_S}{(P_S^*)^\sigma} [(1 + t_{HS})w_H]^{-(\sigma - 1)}$.

**Export platform FDI.** Export platform firms produce both in country H and S but serve the R market from production in S. Thus, the total profit becomes:

$$\Pi^{PFDI}(z) = \Theta(z)[B_{SR}^* + B_{SS}^*] - f,$$

(5)

where $f$ is the fixed cost of operating a foreign affiliate which we, for simplicity, assume to be expressed in terms of a freely-tradable numeraire good. $B_{SR}^* = \varphi \frac{I_{SR}}{(P_H^*)^\sigma} [(1 + t_{SR})(1 + T_S)w_S]^{-(\sigma - 1)}$ is the operating profit from affiliate exports from country S to country R, whereas $B_{SS}^* = \varphi \frac{I_S}{(P_S^*)^\sigma} [w_S (1 + T_S)]^{-(\sigma - 1)}$ is the profit from affiliate local sales in country S.

**Horizontal FDI.** In horizontal FDI, an MNEs affiliate serves each market by local production. Hence, total profits are:

$$\Pi^{HFDI}(z) = \Theta(z)[B_{RR}^* + B_{SS}^*] - 2f$$

(6)

where $2f$ is the fixed cost of operating two affiliates. $B_{RR}^* = \varphi \frac{I_{RR}}{(P_H^*)^\sigma} [w_R]^{\sigma - 1}$ and $B_{SS}^* = \varphi \frac{I_S}{(P_S^*)^\sigma} [w_S (1 + T_S)]^{\sigma - 1}$ are the operating profits from affiliate local sales in countries R and S, respectively.

In order to proceed, it is convenient to define the following productivity cut-off levels. Let $\Theta_{PFDI}$ be the productivity level at which total profits are equalized between exporting firms and export platform FDI, $\Pi^{Export}(z) = \Pi^{PFDI}(z)$. Using (4) and (5), we have:

$$\Theta_{PFDI} = \frac{f}{B_{SR}^* + B_{SS}^*}$$

(7)

Then let $\Theta_{HFDI}$ be the productivity level at which total profits are equalized between horizontal- and export platform FDI, $\Pi^{HFDI}(z) = \Pi^{PFDI}(z)$. Using (5) and (6), we have:

$$\Theta_{PFDI} = \frac{f}{B_{RR}^* + B_{SS}^*}$$

(8)

observe only MNEs in our data. Hence, we cannot test any theory that explains firms that serve only the Swedish market. However then, it would be an unnecessary complication without testable implication to introduce fixed trade cost.
In line with our Swedish data, we now make the following assumption:

**Assumption A1:** There exists at least one firm choosing export platform FDI (PFDI) and at least another one choosing horizontal FDI (HFDI).

From Assumption A1, the following proposition holds:

**Proposition 1** Under Assumption A1, there are productivity thresholds $\Theta_{PFDI}$ and $\Theta_{HFDI}$ such that there are only: (i) exporting firms for $\Theta(z) < \Theta_{PFDI}$, (ii) only export platform FDI (PFDI) for $\Theta_{PFDI} < \Theta(z) < \Theta_{HFDI}$ and (iii) horizontal FDI (HFDI) for $\Theta(z) > \Theta_{HFDI}$.

**Proof.** See Appendix A.

Proposition 1 is illustrated in Figure 2. Panel (i) solves for the equilibrium firm type as a function of firm productivity $\Theta(z)$, the cut-offs and associated firm types are depicted in panel (ii), while panel (iii) shows the proportion of firms choosing each firm-type.

In Figure 2 (i), the total profit of each firm type is increasing in productivity $\Theta(z)$. Note that the slope of each locus is directly measured by operating profits, i.e. $\frac{d\Pi_{HFDI}(z)}{d\Theta} = B_{SR} + B_{SS}$ and $\frac{d\Pi_{PFDI}(z)}{d\Theta} = B_{SR}^* + B_{SS}^*$ and $\frac{d\Pi_{Export}(z)}{d\Theta} = B_{HR}^* + B_{HS}^*$. Note that the horizontal FDI-locus $\Pi_{HFDI}(z)$ has the steepest slope, followed by the platform FDI-locus $\Pi_{PFDI}(z)$ while the export-locus $\Pi_{Export}(z)$ has the smallest slope, i.e. $\frac{d\Pi_{HFDI}(z)}{d\Theta} > \frac{d\Pi_{PFDI}(z)}{d\Theta} > \frac{d\Pi_{Export}(z)}{d\Theta} > 0$. This ranking mirrors that horizontal investments completely avoid trade costs, platform FDI only incurs trade costs from exports from country $S$ to country $R$ ($t_{SR}$), while exporting from country $H$ incurs trade costs both in sales to countries $S$ and $R$ ($t_{HS}$ and $\bar{t}$). That the HFDI-locus has the largest slope is then intuitively explained by the fact that unit costs of horizontal FDI are lowest and sales volume largest unless unit cost components other than trade barriers are much larger for local production than for Swedish production which is excluded by Assumption A1. A given increase in productivity $\Theta(z)$ results in the largest savings in variable costs for horizontal FDI and hence largest increase in total profits.

Note that horizontal FDI incurs the largest fixed costs operating two affiliates ($2f$), followed by platform FDI with fixed costs for one affiliate ($f$), whereas export production does not entail fixed costs. Inspecting Figure 2 (i), we see that low-productivity firms will not find it profitable to take on the increased fix costs of operating foreign affiliates. Thus, in the region $\Theta \in (0, \Theta_{PFDI})$ country-$H$ firms export to consumers in countries $S$ and $R$ as shown in Figure 2 (ii). At higher productivity, the larger sales from trade cost savings enable firms to open an affiliate in country $S$ at the fixed cost $f$. Thus, in the region $\Theta \in (0, \Theta_{PFDI})$, H-firms choose platform FDI. Finally, at even higher productivity, H-firms operate affiliates in both country $S$ and $R$. Thus, horizontal FDI takes place in the region $\Theta \in (\Theta_{HFDI}, \infty)$, where
we note that $\Theta_{HFDI} > \Theta_{PFDI} > 0$ holds from Assumption A1. In Figure 2 (iii), given the cut-off levels and the frequency distribution $g_H(\Theta)$, we trace out the proportion of firms belonging to each category.\(^{17}\)

### 3.2 Accession to GATT/WTO

In this section, we examine the $S$-country decision of whether to join the GATT/WTO together with the decision on other policies. This information will be used to predict the causal effect of accession on the MNEs investment decisions. For this purpose, it will be sufficient to analyze the accession decision in a reduced-form model, which can be interpreted as a general equilibrium extension of the model in Section 3.1.1. In a technical annex to this paper, we give such a microfoundation which is sufficiently simple to be solved analytically and at the same time sufficiently plausible in its assumptions.

**GATT/WTO definition** In section 2, we described GATT/WTO as an organization with the objective to facilitate reciprocal trade barrier reductions. Let $t^m_S = (t_{HS}, t_{RS})$ be the vector of import tariffs to country $S$, $t^e_S = (t_{SR}, t_{SH})$ be the vector of tariffs faced by exports from country $S$ and let $\bar{t} = (\bar{t}, \bar{t})$ be the vector of bound rates on $t^m_S$ and $t^e_S$. We have the following assumption:

**Assumption A2:** (i) Membership to the GATT/WTO is granted to country $S$ if it agrees on a bound rate $\bar{t}$ for its import tariff, $t^m_S \leq \bar{t}$. (ii) Granted accession, country $S$ obtains MFN-status which implies that exports from country $S$ to country $j$ face the tariffs $\bar{t} < t^e_S$.

Incumbent countries will thus demand from the entrant a tariff cut on the import tariffs within GATT/WTO to the bound rate $\bar{t}$, i.e. $t^m_S \leq \bar{t}$. In exchange, the accession country $S$ enjoys MFN-status, which implies a concession from incumbent countries on imports from country $S$, i.e. $\bar{t} < t^e_S$.\(^{18}\)

The latter inequality explains why a country has not entered GATT/WTO already\(^{19,20}\).

### 3.2.1 A reduced-form model of economic policy

As noted in section 2, accession to GATT/WTO is often associated with a change in the preference of governments towards free markets, and/or an economic crisis which triggers a change in trade and other

\(^{17}\)Explicit functional forms of the cut-off levels and some comparative-static results on them are given for future reference in Appendix B.

\(^{18}\)See Bagwell and Staiger (1999) for such an interpretation of the effects of GATT on international trade. Bagwell and Staiger (1999) provide also a theoretical justification for the reciprocity in tariff reductions and the non-discrimination principle within a multilateral trade agreement.

\(^{19}\)A description of what accession to WTO involves is given in Langhammer and Lücke (1999). For example, they point out that increased market access to incumbent countries can be expected by LDC accession countries in particular through the Agreement on Textiles and Clothing, which is part of WTO, and through a reduction in anti-dumping measures. Vice versa, a key demand of incumbent countries is the reduction in the import-weighted average bound rate.

\(^{20}\)As an alternative hypothesis, we will also consider in the empirical section the case that "special and deferential" treatment of LDCs may have allowed LDCs to accede without a binding constraint on $t^m_S$. We will come back to this issue in section 5.4 and provide an indirect test on this hypothesis.
policies to sustain political stability. To capture the idea that there are concomitant domestic policy reforms\textsuperscript{21}, suppose that there are also domestically-owned differentiated goods firms with behavioral assumptions similar to MNEs, but which are assumed not to undertake FDI themselves. These firms may also export to other countries. However, suppose that FDI is undertaken only by firms from country H, for simplicity. To model economic policy, we introduce a business cost rate $T_S$ which applies to all differentiated-goods producers in country S.\textsuperscript{22} Moreover, we assume that the number of domestically-owned firms is very large relative to foreign affiliates.

To illustrate how preferences of governments may influence the accession choice, let consumer rents in country S be a function $U_S(t^m_S, T_S, t^e_S)$ which decreases in both distortionary tariff vectors $t^m_S$ and $t^e_S$ and the general business cost rate $T_S$. Let local firm profits be denoted $\Pi_S(t^m_S, T_S, t^e_S)$ with negative partial derivatives on $T_S$ and $t^e_S$ and a positive one on $t^m_S$, and government revenues $R_S(t^m_S, T_S, t^e_S)$ with a global interior maximum assumed in its arguments. Then, the accession-country government’s objective function $W_S(t^m_S, T_S, t^e_S, \chi_S)$ is a preference-weighted sum of these three components:

$$W_S(t^m_S, T_S, t^e_S, \chi_S) = U_S(t^m_S, T_S, t^e_S) + \Pi_S(t^m_S, T_S, t^e_S) + \chi_S R_S(t^m_S, T_S, t^e_S), \quad \chi_S \geq 1. \quad (9)$$

In (9) the parameter $\chi_S$ suggests that governments place an additional value on government revenue above social welfare. This may occur for several reasons. First, in socialist countries, a government has a strong incentive to redistribute income to workers from firms in general and foreign businesses in particular. Second, the government may want to draw resources from the public into its own or its clientes’ pockets, acting like a "grabbing hand" (Acemoglu et al., 2004).\textsuperscript{23} Third, additional votes could be won with revenues used for campaigns which causes an incentive for the government to value revenue above social welfare in a democracy (Baldwin, 1987). Finally, applying the parameter $\chi_S$ to the profits of domestically-owned firms in the differentiated goods sector $\Pi_S(t^m_S, T_S, t^e_S)$ instead of to the revenue term, $\chi_S$ can be understood as the reduced form parameter of the lobbying distortion from domestic firms in the political decision process.\textsuperscript{24}

We make the following general assumption on (9).

\textsuperscript{21}For example, a WTO economist writes: "Historically, unilateral liberalization, which is usually linked to a broader programme of domestic reform, has accounted for most of the reductions in border protection. Most comprehensive trade reforms among large countries (Argentina, Brazil, China and India in the early 1990s) were primarily unilateral reforms that were undertaken to increase competition, and thus productivity, in their domestic economies." Daly (2006), p. 530.

\textsuperscript{22}We assume that the business cost rate $T_S$ is generally not regulated by GATT/WTO. The GATT intervenes into national direct and indirect taxation only to the extent that such taxation discriminates foreign goods. See Daly (2006) for a discussion of how WTO rules affect taxation. See Horn et al. (2006) for a GATT/WTO theory, where contracting cost determine endogenously why it is optimal to regulate in an international agreement trade policy instruments but not other domestic economic policy measures.

\textsuperscript{23}In what follows, it is qualitatively unimportant whether government revenue is redistributed equally lump sum across the electorate or unequally lump sum favoring few rich or many poor. However, we do not make explicit the resulting distortion of the labor supply decisions other than through the term $U_S(t^m_S, T_S, t^e_S)$.

Assumption A3: (i) $W_S(t_S^m, t_S, t_S^f, \chi_S)$ is concave in $t_S^m$ and $T_S$ with $\partial W_S/\partial t_S^m < 0$, $\partial^2 W_S/\partial t_S^m \partial T_S = 0$, and $\partial^2 W_S/\partial t_S \partial T_S \geq 0$; (ii) Larger tariffs reduce private welfare (Formally: $\partial^2 / \partial T_S^2 + \partial^2 / \partial t_S^2 < 0$); (iii) The tariff concession at GATT/WTO accession by third countries is sufficiently small (Formally: $(t_S^S - \bar{t}) \to 0$.)

The concavity property in Assumption 3(i) captures the idea that tariffs and taxes are distortionary; the inequality $\partial W_S/\partial t_S^m < 0$ implies that third-country import tariff reductions benefit the host country, e.g. because this attracts export platform FDI which provides not only cheaper access to products in third markets but also to the host-country consumer. To highlight how domestic policies will bias the estimate of the effect of accession to GATT/WTO on FDI, we apply the major simplification $\partial^2 W_S/\partial t_S^m \partial T_S = 0$. This assumption, which holds approximately when the number of domestically-owned firms is very large relative to foreign affiliates, captures our hypothesis from section 2 that there are policy reforms independently from trade policy considerations but concomitant to them. $\partial^2 W_S/\partial t_S \partial T_S \geq 0$ describes a strategic complementarity of tariffs. Since imports from country R are substituted for imports from country H at higher tariffs for imports from country R, the tariff revenue base for imports from country H increases which in turn magnifies the revenue from an additional increase in tariffs for imports from country H.\(^{25}\)

Assumption 3(ii) captures our hypothesis that tariffs are distortionary. Assumption A3 (iii) serves as analytical simplification.

Optimal policy choices. From Assumption A3, the S-country government will choose to join GATT/WTO if the value of the objective function $W_S(t_S^m, T_S, t_S^f, \chi_S)$ in (9) under the membership constraint, $W_S^{WTO}(\chi_S, \bar{t})$, is larger than its unconstraint value, $W_{S}^{NWTO}(\chi_S, t_S^f)$ at less access to third markets, where:

$$W_{S}^{WTO}(\chi_S, \bar{t}) \equiv \max_{\{t_S^m, T_S\}} W_S(t_S^m, T_S, t_S^f, \chi_S), \text{s.t: } t_S^m \leq \bar{t}, \ t_S^f = \bar{t}, \quad (10)$$

$$W_{S}^{NWTO}(\chi_S, t_S^f) \equiv \max_{\{t_S^m, T_S\}} W_S(t_S^m, T_S, t_S^f, \chi_S) \quad (11)$$

To examine this choice, let $\chi_S$ be the level of policy preferences at which a country is indifferent of joining GATT/WTO, i.e. $W_{S}^{WTO}(\chi_S, \bar{t}) = W_{S}^{NWTO}(\chi_S, t_S^f)$. Denote $t_S^{m,WTO}, t_S^{m,NWTO}, T_S^{WTO}$ and $T_S^{NWTO}$ the optimal tariffs and business costs within and outside GATT/WTO in dependence of policy preference $\chi_S$, respectively. Moreover, let $\tilde{\chi}_S$ be the policy preference values such that this government is just not constraint in its import tariff choices by the respective bound rates, i.e. $t_S^{m,WTO}(\tilde{\chi}_S) = \bar{t}$. Then, we can state the following proposition:

\(^{25}\)The Assumption A3 does not hold generally if our FDI model is the microfoundation to the objective function (9). We show in a technical annex to this paper that some mild alternative assumptions are sufficient to ensure that the results of the following proposition will hold when embedding the FDI model of sections 3.1 and 3.2 into general equilibrium. We argue there also that these assumptions correspond to stylized facts of LDCs which make up almost all accession countries contained in our sample.
Proposition 3: Assume that assumptions A1, A2, and A3 hold. Then, (i) inside and outside GATT/WTO tariffs $t_{W^{WTO}}^S$ and $t_{W^{NWTO}}^S$, and business costs $T_{W^{NWTO}}^S$ are non-decreasing in government preferences for rents $\chi_S$, (ii) countries where the government has low preferences for rents join the GATT/WTO, i.e. accession occurs for $\chi_S \in [0, \bar{\chi}_S)$, and (iii) accession to GATT/WTO causes a reduction in host-country import tariffs as compared to unilaterally set tariffs at least for some countries, i.e. $t_{W^{NWTO}}^S > t_{W^{WTO}}^S = \bar{t}$ for each $\chi_S \in [\bar{\chi}_S, \tilde{\chi}_S)$.

Proof. See Appendix C.

The core insights of Proposition 3 are demonstrated graphically in Figure 3.

Figure 3(i) depicts accession choice in country S, Figure (ii) depicts the tariff chosen in country S against imports from country H, $t_{HS}$. Figure (iii) depicts the optimal tax or business costs. All three choices are given as functions of the government preference for income redistribution, $\chi_S$.

Starting with the accession choice in Figure 3(i), note that welfare is maximized by accession to GATT/WTO when $\chi_S$ is low. Intuitively, when the government places little value on income distribution, the government avoids distortionary taxes. Accession avoids additional trade taxes levied by incumbent countries and improves market access from country S.

Figures 3(ii) and (iii) show that the government will raise import tariffs and domestic taxes at increasing taste for redistribution. Intuitively, this will imply that the S country is less willing to join when it values redistribution highly. To see this, note that $\frac{\partial W_{WTO}^S}{\partial \chi_S} = R_S(t_{W^{WTO}}^S, t_{W^{NWTO}}^S, \bar{t})$ and $\frac{\partial W_{NWTO}^S}{\partial \chi_S} = R_S(t_{W^{NWTO}}^S, t_{W^{NWTO}}^S, t_{S})$ hold by the envelope theorem. Thus, the slope of the welfare loci associated with accession and non-accession to GATT/WTO reflect the level of government revenues. At $\tilde{\chi}$ the government hits the bound rate $\bar{t}$ on the import tariff $t_{HS}$. This constraint will make the loci associated with accession $W_{WTO}^S$ less steeply sloped than the loci associated with not acceding GATT/WTO $W_{NWTO}^S$, since the constraint on import tariffs makes government revenues smaller under accession. At some point $\bar{\chi}$, welfare from not acceding GATT/WTO is higher than from accession. Relieved by its concession on import barriers, the government will adjust its import barriers upwards. As shown in the Appendix, this necessarily implies a jump upward in the import tariffs, in Figure 3(ii) shown by the jump from $t_{HS}^{WTO}$ to $t_{HS}^{NWTO}$ at $\bar{\chi}$. However, due to our assumption of the number of foreign varieties being small as compared to the number of domestic varieties, there is only a smooth adjustment by the government-influenced business costs $T_S$.

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26 We omit the corresponding tariff in country H against imports from country S, $t_{RS}$, in Figure 3, since our primary interest is to infer how the investment choice by MNEs from country H are affected by accession in country S. Note that MNEs by assumption always serve their home market by home production. Hence, the investment decision is not affected by $t_{RS}$. Relaxing this assumption does not qualitatively change results.

27 According to Bagwell and Staiger (1999), GATT has the purpose to alleviate a terms-of-trade externality in the government objective function. Such an externality could easily be integrated into a general equilibrium version of our MNE-model if the unit cost depend on two factors and the differentiated goods sector is augmented by another sector into which country S is specialized. Moreover, an additional externality arises in models with imperfect competition, because foreign firm profits are not included in the national social welfare function.
In sum, Proposition 3 shows that liberal trade policy is positively correlated with liberal domestic economic policy; governments of countries which choose low business cost $T_S$ and tariffs $t^m_S$ will at the same time join the GATT/WTO. In addition, the Proposition 3 claims a reduction of import protection through GATT/WTO. We will return to these effects when discussion what causal effects accession has on FDI in the next section.

On a final note, Proposition 3 will extend into other settings. It will apply if government policy affects entry barriers through fixed cost $f$. Typical examples are government inflicted market entry barriers, red tape, or regulatory business set-up cost. Proposition 3 will also apply for a country in crisis.28

4 Econometric framework

In this section, we will use the information of the theoretical model to derive estimates of the impact of accession to GATT/WTO on FDI. In section 2, we illustrated this in Figure 1, where the effect of accession on the export share in affiliate sales was shown in panel (i), and the one on the probability of new investment in panel (ii). Let us now derive the reduced form of these measures from our theoretical model.

Note that all firms with productivity $\Theta(z) \in (\Theta_{FFDI}, \Theta_{HFDI})$ will invest in country $S$ and export part of their production to country $R$. The export share of an affiliate $z$ in country $S$ can then be written

$$Share_{SR} = \frac{P^a_Z x^a_Z}{P^a_Z x^a_Z + P^a_S x^a_S} = \left[1 + \left(\frac{1}{1 + t^m_S} \right)^{\sigma - 1} \left(\frac{t^m_S}{P^a_S} \right)^{1 - \sigma}\right]^{-1}.$$ Log-linearizing $Share_{SR}$ in a first-order Taylor expansion around the population means and augmenting the resulting expression by a white noise error term $u_z$, we obtain:29

$$\ln Share_{SR} = \alpha_0 + \alpha t^m_z \ln(1 + t^m_S) + \alpha t^m_z \ln \left(\frac{t^m_S}{P^a_S}\right) + \alpha t^m_z \ln \left(\frac{t^m_S}{P^a_R}\right) + u_z$$ (12)

Intuitively, these calculations show that higher trade barriers from incumbent countries lead to a reduction in the share of affiliate sales being exported ($\alpha t^m_S < 0$), a larger market in the host country $S$ increases the share of affiliate sales sold locally and reduces thus the share which is exported ($\alpha t^m_S < 0$), while a larger export demand increases the export propensity ($\alpha t^m_S > 0$). Importantly, business costs $T_S$ cancel

---

28 Following Baldwin (1985) and Acemoglu et al. (2004) and assuming that the government maximizes its revenues $R(t^m_S, T_S, t^m_S, \chi_S)$ subject to a constraint on social welfare that ensures political stability, e.g. $U(t^m_S, T_S, t^m_S, \chi_S) \geq \bar{U}, \chi_S$ may be thought of as a (negative) economic shock reducing social welfare ($\partial U/\partial \chi_S < 0$). Then, a government will be forced to lower both business costs $T_S$ and tariffs $t^m_S$ to reduce the distortions in the economy and sustain the social welfare at a level consistent with political stability (see, for instance, Bagwell and Staiger (2002). A sufficient condition for these conclusions is that $U(t^m_S, T_S, t^m_S, \chi_S)$ is quasiconvex in $t^m_S$ and $T_S$ and $R(t^m_S, T_S, t^m_S, \chi_S)$ quasiconcave. Again, a country that lowers its tariff $t^m_S$ in response to a sufficiently large adverse shock, will have little or nothing to loose from joining GATT/WTO and fulfilling the accession condition $t^m_S \leq \bar{t}$, while at the same time benefitting from better access to foreign markets.

29 The coefficients in (12) are given by $\alpha_0 = \frac{\partial Share_{SR}}{\partial t^m_S} \bar{t}$, $\alpha_0 = \ln Share_{SR}$, and a bar above a variable denotes the population mean of it.
from (12) since they affect both local sales and export sales identically.\footnote{To see this, note that \( Share_{SR_z} \) can be written \( Share_{SR_z} = \frac{T_{HR}}{T_{HS}^\alpha} \left( \frac{T_S}{T_S+T_S} \right)^{\sigma-1} \left( \frac{c_{SS}}{c_{SR}} \right)^{\sigma-1} \), where \( c_{SS} \approx (1 + T_S) w_S \) and \( c_{SR} = (1 + T_S) (1 + T_S) w_S \). Hence, \( (1 + T_S) \) drops out of the cost ratio \( c_{SS}/c_{SR} \) in \( Share_{SR_z} \). This is also the reason why we choose the export share as dependent variable rather than - say - exports or local sales in levels. Moreover, we show in a Technical Annex to this paper that the comparative static results on the export share are preserved even in the presence of multiproduct firms.} In addition, the export share to country \( R \) is, by definition, not affected by country \( S \) trade barriers \( t_{SR} \). Finally, fixed cost \( f \) and all policies influencing them are sunk and thus not relevant for the export share either.

Now, we turn to the investment decision. To derive an estimation equation for the investment decision, let \( \Theta_z^* \) be the latent productivity level of a firm \( z \) consisting of an observable \( \Sigma_z \) and an unobservable white-noise random variable \( \varepsilon_z \). Making use of the definition of the cut-off productivity \( \Theta_{PFDI} \) in (7) and Proposition 1, the investment decision can be written:

\[
\Theta_z^* = \Sigma_z + \varepsilon_z, \quad FDI_z = 1[\Theta_z^* > \Theta_{PFDI}]
\]

(13)

If we assume that the error term \( \varepsilon_z \) is normally distributed\footnote{Alternatively, one can assume a logistic distribution of \( \varepsilon_z \) to derive a logit model. It will be one of our robustness checks to consider this alternative assumption.}, then the probability that firm \( z \) will invest is \( \text{Prob}[FDI_z|\Theta_{PFDI}, \Sigma_z] = E[FDI_z|\Theta_{PFDI}, \Sigma_z] = \Phi(\Theta_{PFDI} - \Sigma_z) \), where \( \Phi(\cdot) \) is the cumulative standard normal distribution. Log-linearizing the probability of an investment \( \Phi(\Theta_{PFDI} - \Sigma_z) \) in its arguments, we obtain:\footnote{Note that \( \beta \equiv \frac{\partial \Phi(\Theta_{PFDI} - \Sigma_z)}{\partial x} \cdot x \), \( \alpha \equiv -\phi(\Theta_{PFDI} - \Sigma_z) \Sigma_z, \phi \equiv \ln(\phi) \), and \( \varepsilon_z \equiv \phi(\Theta_{PFDI} - \Sigma_z) \varepsilon_z \) is again white noise. We discuss in this section only consistency of estimators. For this purpose, the linear probability model holds without loss of generality. In the empirical estimations, instead, we will return to probit and logit models which are more efficient than the linear probability model.}

\[
FDI_z = \beta_0 + \beta_{1HS} \ln(1 + t_{HS}) + \beta_{tSR} \ln(1 + T_{SR}) + \beta_{T_S} \ln(1 + T_S) + \beta_\Sigma \ln \Sigma_z + \beta_{1_S} \ln \left( \frac{I_S}{P_S - \sigma} \right) + \beta_{I_H} \ln \left( \frac{I_R}{P_{HR}} \right) + \beta_{w_S} \ln w_S + \beta_{w_H} \ln w_H + \beta_{1HR} \ln(1 + t_{HR}) + v_z
\]

(14)

where the error \( v_z \) is white noise. Calculations show that higher import tariffs increase the tariff-jumping motive to invest \( (\beta_{1HS} > 0) \), higher export tariff barriers to incumbent members provides less incentive for export-platform investment \( (\beta_{tSR} < 0) \), which is also the case for an increase in domestic policy costs \( (\beta_{T_S} < 0) \). Moreover, more productive firms are more likely to invest \( (\beta_\Sigma > 0) \). This is also the case with larger host country market \( (\beta_{1S} > 0) \), a larger export market \( (\beta_{I_H} > 0) \) and higher home country wages \( (\beta_{w_H} > 0) \), whereas higher host country wages decrease investment incentives \( (\beta_{w_S} < 0) \).
4.1 Deriving the causal effects of GATT/WTO accession on FDI

In principle, we should estimate the impact of GATT/WTO on FDI by assessing in a first step the impact of GATT/WTO accession on trade barriers, and the impact of trade barrier reductions on the occurrence of FDI and its composition in a second step. Unfortunately, we do not have data for trade costs and therefore need to estimate the effect of accession on FDI in reduced form replacing the tariff variables with a dummy variable for GATT/WTO membership. A further problem is that we have no direct measure of business costs, $T_S$.

In order to examine the properties of a reduced-form estimate of accession on the export share $\ln Share_{SR}$ in (12) and the investment decision $FDI_z$ in (14), let us first spell out how the country $S$ accession choice and its other policy choices are related. Proposition 3 and Assumption A2 can then be log-linearized in a first-order Taylor expansion around the mean values of the exogenous variables and in particular around $\bar{\chi}_S$:

$$\ln(1 + t_{HS}) = \varphi_0 + \varphi_{\chi S} \ln \chi_S + \varphi_{WTO}WTO_S$$
$$\ln(1 + T_S) = \psi_0 + \psi_{\chi S} \ln \chi_S$$
$$\ln(1 + t_{SR}) = \kappa_0 + \kappa_{WTO}WTO_S.$$  \hspace{1cm} (15)

Thus, a government with a higher preference for rent collection $\chi_S$ sets higher import tariffs ($\varphi_{\chi S} > 0$) and higher domestic policy costs ($\psi_{\chi S} > 0$), whereas the accession to GATT/WTO induces applicant governments to lower import tariffs beyond what they would do unilaterally ($\varphi_{WTO} < 0$) in exchange for lower export barriers since incumbent countries lower their import tariffs ($\kappa_{WTO} < 0$).

These effects are illustrated in Figure 3. Note that $\varphi_{WTO}$ in Figure 3(ii) represents the causal effect of GATT/WTO on trade policy in country S - without GATT/WTO this tariff reduction would not have occurred, because only under the roof of a multilateral institution can a reciprocal tariff reduction occur where country S makes a concession to country H in exchange for a concession from country R.\hspace{1cm} (34)\hspace{1cm} Note that Figure 3(ii) also reveals a pure selection effect $\varphi_{\chi S}$ representing liberal trade policy irrespective of accession, whereas Figure 3(iii) shows a policy effect $\psi_{\chi S}$ which mirrors an improved business climate due to more liberal government preferences, again irrespective of accession. As we will show, in order to estimate consistently the effect of GATT/WTO accession on FDI, it will be critical to isolate the causal effect of GATT/WTO accession on trade policy $\varphi_{WTO}$ from the pure selection effect $\varphi_{\chi S}$ and the policy

$^{33}$We will focus our empirical analysis on the set of countries that switch GATT/WTO status during sample life. Since countries with $\bar{\chi}_S$ are just indifferent about their choice, it is reasonable to assume that our sample countries are in its vicinity, i.e. in the first sample years marginally above and after accession marginally below $\bar{\chi}_S$.

$^{34}$A three-country Heckscher-Ohlin model with similar chain-trade patterns (H exports to S, S exports to R, and R must then export to H) is used in Maggi (1999) to show the advantage of a multilateral enforcement mechanism relative to a bilateral one. Hence, our model is consistent both with a microfoundation for why GATT/WTO exists and how its rules are enforced.
effect \( \psi S \)

Proposition 3 contains also the information on the accession choice of country \( S \), which can be written in log-linear form:

\[
WTO^*_S = \gamma_0 + \gamma_S \ln \chi_S + Z^*_S \gamma + \epsilon_S, \quad WTO_S = 1[WT0^*_S > 0]
\]

where \( WTO^*_S = W^S_{WTO} - W^S_{NWTO} \) is the latent variable, i.e. the increase in government welfare from joining the GATT/WTO. As illustrated in Figure 3(i), Proposition 3 implies \( \gamma_S < 0 \), since governments with stronger preferences for rent collection \( \chi_S \) are less likely to join. \( Z_S \) can be thought of as a vector of potential instrumental variables with \( \gamma_j \neq 0 \), and where \( \epsilon_S \) is the remaining white-noise exogenous variation in \( WTO \). By construction, the instruments are not correlated with government preferences, \( \text{cov}(\chi_S, Z_S) = 0 \).

**Export share.** To examine the effect of accession to the GATT/WTO on the export share, we insert the policy rule (15) into equation (12) and obtain a reduced form of the data generating process from the theoretical model:

\[
\ln \text{Share}_{SR_z} = \alpha_{\text{const}} + \alpha_{WTO}WTO_S + \alpha^\prime X_z + u_z,
\]

where \( \alpha_{\text{const}} = \alpha_0 + \alpha_{tSR} \cdot \kappa_0 \), \( \alpha_{WTO} = \alpha_{tSR} \cdot \kappa_{WTO} \), \( X_z \) contains the stacked vector of all remaining covariates from (12), and \( \alpha \) is the corresponding coefficient vector. When regressing now \( \ln \text{Share}_{SR_z} \) on \( WTO_S \) and the vector \( X \) and our theoretical model is the data generating process, then it is obvious from (17) that the OLS estimate of the regression coefficient on the \( WTO_S \) variable, \( \hat{\alpha}_{OLS}^{WTO} \), converges to:

\[
\text{plim}(\hat{\alpha}_{OLS}^{WTO}) = \alpha_{tSR} \kappa_{WTO} > 0, \quad \text{(Causal effect)}
\]

since the error \( u_z \) is not correlated with \( WTO_S \) by construction. However, the estimate \( \hat{\alpha}_{OLS}^{WTO} \) reveals the causal effect of accession to the GATT/WTO on the share of exports of affiliates, where \( \kappa_{WTO} \) measures how accession lowers incumbent country \( R \)’s trade barriers and \( \alpha_{tSR} \) measures how sensitive the export intensity is to changes in market access to incumbent members. Yet, this is the only causal channel according to our model through which GATT/WTO has an influence on the export share.

As a consequence of \( \text{cov}(u_z, WTO_z) = 0 \), a corresponding instrumental variable estimator \( \hat{\alpha}_{IV}^{WTO} \) with the instrument vector \( Z_S \) converges to the OLS estimator, i.e. \( \text{plim}(\hat{\alpha}_{IV}^{WTO}) = \text{plim}(\hat{\alpha}_{OLS}^{WTO}) \).

---

35 The equation (15) entails the assumption that \( \text{cov}(WTO_S, X_z) = 0 \). This assumption is standard in econometric textbooks. (See Wooldridge (2002), p. 61ff.) It essentially says that the direct effect of omitted variables on the variable of interest dominates indirect effects via third variables. In this case, \( WTO_S \) can be regarded as a perfect proxy for the tariff \( t_{SR} \).
Investment decision. To examine the effect of accession to the GATT/WTO on the export share, we
insert the policy rule (15) in equation (14) and obtain from simple algebra a reduced form of the data
generating process from the theoretical model:

\[ FDI_z = \beta_{const} + \beta_{WTO}WTO_S + X_z\beta + r_z, \quad r_z = \beta_{\chi_S} \ln \chi_S + v_z \] (19)

where \( X_z \) is again the vector of the covariates other than the policy variables as given in (14) and \( \beta \)
the corresponding coefficient vector.36

Now regressing \( FDI_z \) on \( WTO_S \) and \( X_z \), it is obvious from (19) that the OLS estimate \( \beta_{WTO}^{OLS} \)
of the coefficient for \( WTO_S \) is inconsistent, because the error term \( r_z \) is correlated through the latent policy
preference \( \ln \chi_S \) with \( WTO_S \). Indeed, \( \beta_{WTO}^{OLS} \) converges to:

\[
\text{plim}(\hat{\beta}_{WTO}^{OLS}) = \beta_{WTO} + \frac{\text{cov}(WTO_S, r_z)}{\text{var}(WTO_S)}
\]

\[
= \left\{ \begin{array}{c}
\beta_{1HS} \nu_{WTO} + \beta_{1SR} \kappa_{WTO} \\
\beta_{1HS} \nu_{WTO} \cdot (+) \quad \kappa_{WTO} \cdot (-) \end{array} \right. 
\]

\[\text{Bias term} \]

if our theoretical model provides the data generating process. In (20), \( \beta_{WTO} = \beta_{1HS} \nu_{WTO} + \beta_{1SR} \kappa_{WTO} \)
measures the causal effect of GATT/WTO on the probability of new investment. The first term \( \beta_{1HS} \nu_{WTO} \),
which is negative, is the "tariff-jumping effect". As shown in Proposition 3 and as illustrated in Figure
3(ii), in exchange for increased market access, the S-country government is willing to decrease its own
import tariff beyond what would have been done without GATT/WTO (\( \nu_{WTO} < 0 \)). This reduces the
incentive to invest (since \( \beta_{1HS} > 0 \)). The second term \( \beta_{1SR} \kappa_{WTO} \), which is positive, is the export-platform
effect. When incumbent-countries’ import-tariffs are reduced on exports from the accession country S ( \( \kappa_{WTO} < 0 \)),
this increases the incentive for export platform FDI in country S (since \( \beta_{1SR} < 0 \)). Since the
tariff-jumping effect and export platform effect have opposite signs, the causal effect \( \beta_{WTO} \) is ambiguous.

The second term \( \beta_{\chi_S} \frac{\text{cov}(\ln \chi_S, WTO_S)}{\text{var}(WTO_S)} \) illustrates the bias arising from the correlation of the error term
\( r_z \) through the policy preference \( \chi_S \) with our variable of interest, \( WTO_S \). Note that the sign of this bias
is also ambiguous. First, there is the self-selection effect which causes a downward bias on \( \hat{\beta}_{WTO}^{OLS} \)
through the term \( \beta_{\chi_S} \frac{\text{cov}(\ln \chi_S, WTO_S)}{\text{var}(WTO_S)} \). As illustrated in Figure 3(ii), this occurs since countries that apply
for GATT/WTO experience a change in policy preferences \( \chi_S \), which induce them to have a more liberal
trade policy even without GATT/WTO. Second, GATT/WTO may capture also the effect of domestic
economic policy reforms on the probability of new investment if these occur simultaneously with accession.

This is the domestic policy effect. As illustrated in Figure 3(i) and (iii), a decrease in policy preferences
\( \chi_S \) induces both accession and a domestic policy reform, which reduces business costs \( T_S \). The latter term
\( \beta_{T_S} \psi_{\chi_S} \frac{\text{cov}(\ln \chi_S, WTO_S)}{\text{var}(WTO_S)} \) will then cause an upward bias of \( \hat{\beta}_{WTO}^{OLS} \).

36The coefficients in (19) are defined as follows: \( \beta_{const} = \beta_0 + \beta_{1HS} \cdot \nu_0 + \beta_{1SR} \cdot \kappa_0 + \beta_{T_S} \cdot \psi_0 \), \( \beta_{WTO} = \beta_{1HS} \nu_{WTO} + \beta_{1SR} \kappa_{WTO} \), and \( \beta_{\chi_S} = \beta_{1HS} \nu_{\chi_S} + \beta_{T_S} \psi_{\chi_S} \).
Finally, to identify the causal effect, we will apply instruments $Z_S \in Z$ in a regression of $FDI_z$ on $WTO_S$ and $X$ to obtain from (16) and (19) immediately:

$$\text{plim} \hat{\beta}^{\text{IV}}_{\text{WTO}} = \frac{\text{cov}(FDI_z, Z_S)}{\text{cov}(WTO_S, Z_S)} = \beta_{\text{WTO}}.$$  

(21)

Hence, the IV estimate isolates the two causal effects of GATT/WTO on the probability of new investments.

5 Econometric analysis

To estimate the effect of GATT/WTO accession on FDI, we use affiliate data on Swedish multinationals from the Research Institute of Industrial Economics (RIIE) database. The database concludes almost all Swedish MNEs in the manufacturing sector and is available for the years: 1965, 1970, 1974, 1978, 1986, 1990, 1994 and 1998. Detailed information for the Swedish MNEs and the producing foreign affiliates is available on variables such as employment, production, internal and external trade flows, and R&D.\textsuperscript{37} We neither have Swedish plants’ exports in final goods (apart from exports to own production affiliates). Nor does our dataset include firm observations in years when it has no production affiliate anywhere abroad. Vice versa, we exclude countries where no Swedish firm has ever invested to exclude irrelevant alternatives (Wooldridge, 2002, p. 619). Although we know how much Swedish affiliates export to locations other than home, we do not know which those locations are.

To ensure that we have observations before and after accession of each country in the estimation sample, we restrict the sample to the set of countries with Swedish FDI which accede GATT/WTO after 1965 and before 1998. As noted in Figure 1 (iii), there are 21 such host-countries. Most of them are typical emerging market economies with Switzerland the only exception and Ireland maybe a borderline case.\textsuperscript{38}

For the Swedish investments in these acceding countries, we will regress the (log) export share of the sales in affiliate $a$, with mother firm $z$ in country $s$ in time $\tau$, $share_{azs\tau}$, on the covariates derived in the reduced form (17) and the binary variable with value 1 if the Swedish MNE, firm $z$, has started a new affiliate in country $s$ at period $\tau$, $FDI_{zs\tau}$, on the covariates given from the reduced form in (19). We augment these regressions with additional control variables not captured by our model and an extensive varying set of dummy variables for the year, country, industry, or firm. The measures of the control variables are discussed next.

\textsuperscript{37}An extended data description including a questionnaire is available in Braunerhjelm and Ekholm (1998).

\textsuperscript{38}One of our unreported robustness checks is to exclude those countries with the result that this is not crucial for our estimates.
5.1 Explanatory variables

Let us now discuss the explanatory variables which are of four types: the variable of interest, core variables, additional control and instrumental variables. The variable of interest is the GATT/WTO dummy variable that takes value one if an observation relates to an affiliate located in a country that is member of GATT/WTO. Next, we discuss the core variables which are more closely attached to the theoretical model.

5.1.1 Core control variables

The first important core variable in the model is total factor productivity, capturing $\Sigma z$ in (13). Following Helpman et al. (2004), we measure this as world sales (firm size) of parent firm $z$ in period $\tau$. From Proposition 1, we expect the larger and more productive firms to invest more abroad. From (12), the export share is not affected by the productivity level. However, this hinges on the assumptions that there are no fixed cost of exporting and no productivity-independent variable trade barriers in our model. Therefore, we include firm size also in the share equation and leave it to the empirical analysis to decide on this assumption.

When examining the remaining list of core conditioning variables, we find them to correspond to the usual control variables of a gravity estimation equation. The home market size, $(Y_s/P_s^{1-\sigma})$, is proxied by real GDP of the host country (gdp). The third-country market size, $(Y_R/P_R^{1-\sigma})$, is proxied by the foreign-market potential measure (market_potential) of Hanson (1998) which is a distance weighted measure of world real GDP. Trade barriers are picked up by various dummy variables that indicate whether a country is member of a regional trade agreement (RTA), and by the measure of openness of country $S$ (open), i.e. the ratio of exports plus imports per nominal GDP. The trade barriers between the host country and Sweden $t_{HS}$ is, at least partially, picked up by the variable distance between Sweden and host country (dist). In addition to trade cost, this variable takes into account information cost and differences in culture and language. The expected signs from those gravity variables are straightforward.

The variable wage cost of the host country, $w_s$, is captured by the variable GDP per capita, gdppc. This variable affects only the probability of new investment but not the export share. We include gdppc nevertheless in the share equation to control for the level of development of a host country.

39 We calculated a model extension where there are transport costs which depend only on the number of units shipped, but not on the value of them. Then, the export share rises in productivity among exporting firms.

40 In particular, we control for ASEAN, CACM, CEFTA, EU, MERCOSUR, and NAFTA.

41 While there generally exist alternative measures for trade barriers, only open has a sufficient coverage in the time and cross-country dimension. The disadvantage is its potential collinearity with our GATT/WTO variable which will be examined in depth in the last section before the conclusion.

42 See, for example, Brainard (1997) for such an approximation. Data on more direct measures of factor endowments or factor prices is not available over the required time and country dimension.

43 High-tech firms may not find appropriately educated workers for their technology which may lead to a specialization in low-tech activities in such a host country. But then the export share may be low, since this country cannot be integrated in
The fixed cost \( f \) is captured by an industry-average measure of the plant scale \((\text{pscale})\), which is the average number of employees in Swedish plants with more than 200 employees on the 4 digit industry level to which firm \( z \) belongs at period \( \tau \).\(^{44}\) Fixed cost affect negatively the probability of new investment, but not the export share.

Finally, we capture the Sweden-specific wage cost variable, \( w_H \), by time-fixed effects, since this variable does not vary across the cross-section dimension in our data. Finally, the tariff on imports of country \( R \) from \( H \), \( t_{HR} \), which is a tariff internal to GATT/WTO and thus not discriminatory is also captured by time-fixed effects. The time effects will also control for the growth in world trade.

5.1.2 Other control variables

In addition to the core variables derived from the model, we control also for other effects well-known to influence FDI decisions that were not incorporated into the formal model. In particular, we add R&D expenditure, \( rk_d \), derived from Norbäck (2001) which is included to control for firm specific assets. It is calculated as the total expenditure on Research & Development in firm \( z \), in % of company sales, at period \( \tau \). Moreover, we allow for information learning effects of foreign investors on a host country. Then, new investments are more likely if the same company has already previously invested in a host country (\textit{EXPERIENCE}).

Additional control variables that proxy for domestic economic policy and quality of institutions are whether a government is characterized as left-wing (\textit{left wing}) and therefore may be inclined to redistribute income at large scale, or as alternatives the degree of civil liberty rights (\textit{civil liberty}), or the index of economic freedom from Freedom House (\textit{econ freedom}). We also employ an index of international capital flow restrictions from the IMF (\textit{capital restrictions}), that may capture policies targeting FDI rather than trade by intercepting capital repatriation or financing through the mother company. Next, good quality of institutions and domestic economic policy will spur investment. For this reason, we consider the growth rate of gross capital formation (\textit{capital growth}) in our estimation. Finally, to capture accession choice as countermeasure against economic crisis we calculated the deviation of GDP per capita from a home-countries’ long run trend as another control variable (\textit{business cycle}).

The country and industry data is taken from World Development Indicators, Penn World Tables, and SCB (Statistics Sweden).

5.1.3 Instrumental variables

In the IV-estimations, we include a first-stage which models (16). Instruments \( Z_S \) must (i) not be correlated with the error term in the estimation of the second stage in (12) and (14) to obtain consistent

\(^{44}\)See Norbäck (2001).
estimates (exclusion criterion), but (ii) they must be sufficiently correlated with the GATT/WTO membership decision (16) to avoid the weak-instrument problem. Unfortunately, one needs to be sure of the validity of one instrument to be able to test the validity of the other instruments by an overidentifying restrictions test. Therefore, this principal instrument needs to be carefully chosen.

Our principal instrument is latitude of the host country. Latitude is correlated with GATT/WTO at least for one reason. As illustrated in panel (i) of Figure 4, accession countries closer to the equator tend to be less developed and therefore less specialized in manufacturing.

In particular, GATT was mainly concerning liberalization of manufacturing tariffs in its beginning. Hence, countries specialized in goods other than manufacturing had less interest to participate in the GATT in early periods (see panel (ii) of Figure 4). Latitude and economic policy preferences are, however, not likely to be correlated since policy preferences are so diverse. For instance, economic freedom could be argued to be a measure close to policy preferences for redistribution. From panel (iii) in Figure 4 we note that there is no systematic relation of the economic-freedom measure with latitude. As another example, governments with distortionary business cost should also experience a lower capital growth rate. Again, we can see from panel (iv) in Figure 4 that there is no relation of latitude with the capital growth rate within the sample of accession countries. Finally, FDI may require a sufficient technological absorption capacity of the local workforce and a sufficiently large home market both in final and intermediate goods to efficiently exploit its technological leadership and scale and scope economies which may both be less evolved in the South. However, the control variables \( \text{gdp.p.c.}, \text{gdp}, \) and \( \text{market potential} \) will cleanse the error term of the FDI regression from these effects such that it is not correlated with the instrument latitude.

5.2 Accession to GATT/WTO and affiliate trade

We begin with the export share estimations. Table 1 presents the results from the regressions on the Swedish foreign-affiliate share of exports to countries other than Sweden. Specification (1) ignores potential

45See, for instance, Subramanian and Wei (2007).

46Obviously, latitude is also a valid instrument if the cause for the endogeneity problem is simultaneity or reverse causality, because a geography variable cannot be caused by economic activity.

47Another argument against the validity of the instrument latitude may be that bad climate has prevented Europeans to settle themselves in some countries but encouraged to export institutions to extract resources from society, instead. Such institutions may be highly persistent over time and prevent participation in globalization through lack of property right enforcement today (Acemoglu et al., 2001). However, we do not have a sample of all countries in the world but constrain ourselves to countries which switch membership status during our sample period. Hence, we hardly have any countries in our sample where Europeans exported bad institutions during colonization to extract resources from society rather than to create good institutions and settle there themselves. For example, the country closest to the equator in our sample is Singapore which obtained arguably good institutions contrary to the claim against the latitude instrument. Consequently, Singapore entered GATT relatively early in 1974.
omitted variable bias to obtain a benchmark. Specifications (2)-(4) control for potential time-invariant omitted variables by country, industry, and affiliate fixed effects. Specification (5) constrains the sample to affiliates founded during the sample period. Specifications (6)-(11) add control variables that may proxy for domestic economic policies.

The results show that a membership in GATT/WTO has a consistent positive and highly significant impact on the export share of affiliates to third countries just as predicted from theory. Hence, it could be argued that the Swedish MNEs use the acceding countries as an export platform towards the rest of the world, since the trade frictions are now lower. These results hold across all specifications of Table 1 almost always at the 1% significance level.

In line with theory are also the signs on the coefficients of the other core variables. Larger market potential \((market\ potential)\) spurs always significantly the export share, and the domestic market size \((gdp)\) favors, instead, mostly significantly the local sales relative to exports.

Of the other control variables, previous experience of a firm in a host country increases the export share, R&D intensity decreases the export share in most cases, firm size is insignificant as predicted by theory, and GDP per capita decreases the export share in specifications without country fixed effects. Finally, the openness variable \((open)\) is mostly not significant.

When adding additional control variables for domestic economic policy reform that may occur simultaneous to accession, neither left wing governments, nor the degree of economic freedom, nor restrictions on international capital movements, nor capital growth as proxy for investment climate, nor the business cycle state seem to influence the export share. Only more civil liberty rights is weakly significant in decreasing the export share but the significance disappears when leaving country fixed effects away (not reported). Hence, proxies for domestic economic policy and institutions seem not to explain the export share, as was predicted by our model.

5.2.1 Instrumental variable estimates

Next, we turn to instrumental variable (IV) estimation to test whether the export share is indeed not suffering from omitted policy variable bias. The IV-estimation can be done with a Full Maximum Likelihood estimation, where the second stage dependent variable is continuous and the potential endogenous variable binary. The principal instrument is latitude of the host country which is augmented by an additional instrument, economic freedom, to increase efficiency. An overidentifying restrictions test, which is reported in panel (d) of Table 2, cannot reject the validity of economic freedom as instrument given that latitude is valid. An F-test rejects any weak-instrument problems.\footnote{The weak-instrument problem causes IV standard errors to be excessively large, estimates biased in small samples, and even inconsistent with non-standard distribution function in large samples (e.g. Wooldridge, 2002, p. 101ff). While there} The GATT/WTO estimate is
hardly changed when comparing the IV estimate in panel (a), Table 2, column (1), with the OLS estimate in panel (c) of the same column. Consequently, the Rho-test on the correlation between the error terms of the selection equation and outcome equation is insignificant, and endogeneity of GATT/WTO thus rejected.

Since this conclusion rests crucially on the validity of the instruments, we suggest another cross-consistency check. We know from (18) that there is no endogeneity problem expected in the export share estimation. Moreover, we have not found any endogeneity problem in our rho-estimates. Suppose therefore that the GATT/WTO is exogenous in the export share regression. Then, one can add each instrument, one at a time, into an OLS estimation of the share equation. Since a valid instrument must not exert any own independent influence on the export share, and the estimate is consistent by the exogeneity assumption, a t-test on the coefficient of the instrument must be insignificant. If it is not, then either the instrument is invalid or GATT/WTO is not exogenous. Columns (2) and (3) report this test for the instruments latitude and economic freedom, respectively, and instrument validity cannot be rejected.

Since we have found weak significance of the civil liberty control variable in Table 1, we re-do the previous IV estimates including civil liberty as additional control variable. Neither is civil liberty significant, nor is any of the previous IV estimation results qualitatively changed.

Summing up, we have no hints for that there is an omitted variable bias. In particular, this re-ensures us that potential unobservable domestic economic policy reform simultaneous to accession does not affect the export share and does not bias the GATT/WTO estimate of it.

5.3 Accession to GATT/WTO and the establishment of new affiliates

Now, we turn to the estimates of the probability of new investment. Contrary to the estimations on the export share, we expect from (20) an endogeneity problem if we do not properly control for economic policies other than trade policies.

To obtain a benchmark, we begin with estimates that assume exogeneity of GATT/WTO. Specifications (1)-(4) give probit estimates, and probit estimates augmented with country-, industry, and affiliate-fixed effects, respectively. Specifications (5) and (6) provide conditional logit estimates where does not exist an ultimate test for whether a severe weak-instrument bias can be expected, there is widely used a rule of thump based on an F-test statistic on the joint significance of the instruments in explaining the probability of GATT/WTO. An F-value of 10 or larger is considered as sufficient to exclude weak instrument problems (See Bound et al., 1995).

A formal proof of this test is relegated to the Appendix D.

It makes sense to control both for industry and affiliate fixed effects, since some affiliates actually switch industry during their sample life.

The estimates with fixed effects are subject to the incidental parameter problem. Since our variable of interest is not qualitatively affected by the inclusion of fixed effects, we are confident that the potential bias is negligible in our case.
country fixed effects are interacted with industry- and affiliate fixed effects, respectively. Specifications (7)-(12) investigate the same proxy variables for domestic economic policy reform that were already familiar from Table 1. The fit in Table 3 is relatively good with a Pseudo $R^2$ between 0.47 and 0.52.

Looking at the probit estimates in column (1), GATT/WTO accession, a larger market potential, a larger parent firm size, larger openness of a country and larger home market size, previous experience of a Swedish parent in the host country are all positively correlated with a higher probability of new investment. Only GDP per capita and the fixed cost proxy $pscale$ are insignificant contrary to the model prediction - albeit with correct sign. GDP per capita is insignificant because of severe multicollinearity with GDP, and the proxy for fixed costs seems to be too imprecise.

This indicates that Swedish MNEs are more likely to establish new FDI in countries after GATT/WTO entry than before. In the light of our model, the new members have an increased access to the rest of the world. This will spur export platform FDI and inhibit tariff-jumping horizontal FDI. Since we do not control for policy reform other than in international trade, an unobserved simultaneous policy reform may also result in a positive GATT/WTO coefficient.

Most notably, the GATT/WTO dummy survives (at the 10% level) even such extensive fixed effects as country-cross-industry- or country-cross-firm fixed effects. However, some control variables such as $gdp$ and $open$ lose their significance with extensive sets of fixed effects probably because those variables vary stronger in the cross-section than in the time dimension.

Surprisingly, almost all proxies for the quality of domestic economic policy are insignificant. The only notable exemption is the capital growth rate which is weakly positively correlated with the probability of new investment and renders itself the GATT/WTO variable insignificant. This corresponds to our expectation that the GATT/WTO variable picks up partially the effect from domestic economic policy reform that occurs simultaneous to accession but is only incompletely controlled for. The reason for why the other policy measures such as economic freedom, civil liberty rights, and left-wing governments are themselves insignificant is hard to tell. However, there is the suspicion that those variables are too broad a measure of policy to be relevant specifically for FDI.

5.3.1 Instrumental variable estimates

We turn next to the estimation of the probability of new investment by instrumental variables. We employ again Full Maximum Likelihood estimation - albeit this time with both a binary dependent and a binary endogenous variable. Our principal instrument is again the latitude variable which is supplemented by economic freedom, civil liberty rights and the dummy variable for left-wing governments to increase efficiency of the IV estimates. The overidentifying restrictions test in Panel (d) of Table 4, does not reject

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52 See Maddala (1983) for the formal expressions of the likelihood functions.
the validity of the latter three instruments conditional on the validity of the latitude variable. The F-test
does reject weak-instrument problems.

Insert Table 4 about here

The GATT/WTO coefficient renders insignificant in the IV-probit specification in column (1) of Table
4, while the probit estimate on the same sample in Panel (c) is positive and significant. Accordingly,
the Rho indicates a significant correlation between the errors from the probability of new investment
and the probability of GATT/WTO membership estimations. Hence, there is an endogeneity bias in
the probit estimate. In the light of (20), the positive GATT/WTO coefficient from ordinary probit
estimates results exclusively from not controlling properly for policy reform that occurs simultaneous to
accession. Excluding this channel through IV estimation results in an insignificant GATT/WTO effect
that is attributed to the two trade effects of GATT/WTO - tariff jumping and market access, which seem
to neutralize each other.

Again, we suggest a new cross-consistency check to test for the validity of instruments, since their
choice is crucial for our result. Since we got an insignificant IV estimate and (20) suggests that in theory
there are two opposing effects behind the GATT/WTO impact on the probability of new investment,
we assume that the true effect is indeed zero. Then, one can add each instrument, one at a time, into
an ordinary probit estimation of the probability of new investment where one leaves the GATT/WTO
variable out. Since a valid instrument must not exert any own independent influence on the probability of
new investment, and the estimate is without GATT/WTO variable consistent by the assumption that the
true coefficient is zero, a t-test on the coefficient of the instrument must be insignificant. If it is not, then
either the instrument is invalid or the population GATT/WTO coefficient is not zero with a significant
probability.53 This validity test for each instrument can be read off the Table 4 from columns (2)-(5) as
the t-values in brackets beneath the coefficients for the instruments in Panel (a). None of the instruments
is anywhere close to being significantly different from zero.

5.4 Accession to GATT/WTO and world-wide trade policy

Our empirical results are that (i) there is no causal impact of GATT/WTO membership on FDI, while (ii)
GATT/WTO membership does cause a rise in the export share. These results have jointly an important
53 This test is also formalized in Appendix D where we also demonstrate that this test has sufficient power. This finding rests
on a Monte Carlo experiment, where the true data generating process is taken from the theoretical model with coefficients
close to the ones obtained from the empirical analysis and tested against a data generating process where there is a true
causal effect of GATT/WTO but the instrument is invalid and causes a downward bias of IV estimation.

Interestingly, we can see that the validity test becomes significant in indicating instrument invalidity as soon as the
correlation of the error term is so strong that the endogeneity test indicates significant endogeneity. Applying this result
to our estimates, we can thus exclude that an invalid instrument alone could yield an insignificant GATT/WTO coefficient
in our IV estimation of the probability of new investment. Hence, there must be at least to some extent a domestic policy
effect that upward biases the probit/logit estimate of GATT/WTO when not instrumenting.
implication on the trade policy impact of GATT/WTO accession. To see this, combine the estimates \( \hat{\alpha}_{WTO}^IV > 0 \) in (17) and \( \hat{\beta}_{WTO}^IV = 0 \) in (19) with the casual effects in (20), and (18), to obtain:

\[
\text{plim}(\hat{\beta}_{IV}^WTO) = \beta_t^{HS}(+) \varphi_{WTO}(+) + \beta_t^{SR}(+) \kappa_{WTO}(+) = 0 \quad (22)
\]

\[
\text{plim}(\hat{\alpha}_{IV}^WTO) = \alpha_t^{SR}(+) \kappa_{WTO}(+) > 0 \quad (23)
\]

From the theoretical model in (12), we know that higher tariffs on exports from country S to the incumbent country R must reduce the share of affiliate exports, \( \alpha_t^{SR} < 0 \). But then from (23), accession must imply a reduction in incumbents trade barriers \( t_{SR} \) upon accession, i.e. \( \kappa_{WTO} < 0 \) must hold in the policy equation (15).

Moreover, from the theoretical model in (14), we know that higher import tariffs on exports from country H to the accession country S, increases the incentive to invest into an affiliate in country S through tariff-jumping, \( \beta_t^{HS} > 0 \), whereas an increase in export tariffs reduces the profitability of an investment, \( \beta_t^{SR} < 0 \). But then since we know that accession must imply a reduction in incumbents trade barriers upon accession, i.e. \( \kappa_{WTO} < 0 \), it follows that our finding of the investment decision not being affected by accession, \( \hat{\beta}_{IV}^WTO = 0 \) must imply that country S reduces its import barriers \( t_{HS} \). That is, from (22), \( \varphi_{WTO} = -\frac{\beta_t^{SR}(+) \kappa_{WTO}(+)}{\beta_t^{HS}(+)} < 0 \) holds in the policy equation (15).

To summarize:

**Proposition 4**: Suppose that Assumption A1 is true. If we obtain (i) \( \hat{\beta}_{WTO}^IV = 0 \) in the regression of FDI on WTO in (19), while (ii) \( \hat{\alpha}_{WTO}^IV > 0 \) is obtained in the regression of \( \ln \text{Share}_{SR} \) on WTOs in (17), then accession to GATT/WTO must have a causal effect on world-wide trade policy, that is, accession to GATT/WTO must reduce trade barriers not only in the accession country (fall in \( t_{HS} \) through accession), but also in incumbent countries (fall in \( t_{SR} \) through accession).

We should note that our result in Proposition 4 differs substantially from Rose (2004b), where it is argued that trade policy is not affected by GATT/WTO membership. In contrast, we find that the trade policies in both the accession- and incumbent countries are affected. The causal increase in the export share of affiliates reconciles only with a reduction in incumbent tariffs vis-a-vis the accession country, while the zero causal effect of accession on the investment decision can only be reconciled with a dampening of the tariff-jumping incentive to invest, i.e. a reduction in import tariffs in the accession country.

### 5.5 Domestic policy reform simultaneous to accession

Another empirical observation is that there is a significant upward bias of the GATT/WTO estimate in probit or logit estimates without instrumenting. This has an interesting implication on the non-causal
effects that come along with accession. To see this, we consider the bias term of the GATT/WTO estimate, i.e. the difference of the IV estimate from the estimate without instrumenting under the null hypothesis that the theoretical model is true:

\[
\text{Bias} \equiv \text{plim}(\hat{\beta}_{\text{OLS}}^{\text{WTO}}) - \text{plim}(\hat{\beta}_{\text{IV}}^{\text{WTO}}) = \{ \beta_{\text{HS}}^{(+)} \varphi_{\chi_S}^{(+)} + \beta_{\text{T}}^{(-)} \psi_{\chi_S}^{(+)} \} \frac{\text{cov}[(\ln \chi_S, \text{WTO})]}{\text{var}(\text{WTO})}.
\]

which is obtained from (20) and (21).

From the theoretical model, we know that a government whose policy preference for redistribution $\chi_S$ rises will increase the import tariff ($\varphi_{\chi_S} > 0$) independently of whether GATT/WTO exists or not, which in turn encourages tariff-jumping FDI ($\beta_{\text{HS}}^{(+)} > 0$). However, a government that rises its import tariff due to a change in policy preference is also less likely to be member of GATT/WTO ($\text{cov}[(\ln \chi_S, \text{WTO})] < 0$). Hence, this self-selection effect causes a downward bias ($\text{Bias} < 0$).

Instead, the same government will also choose higher business cost ($\psi_{\chi_S} > 0$) which intercepts FDI ($\beta_{\text{T}}^{(-)} < 0$). Since business cost are not controlled for in the estimation, part of this detrimental effect of an increase in business cost on FDI is attributed to the GATT/WTO coefficient in estimates without instrumenting, while IV methods extract the true causal effects. Hence, this domestic economic policy effect causes an upward bias ($\text{Bias} > 0$).

It follows that our finding of an upward bias when estimating the marginal correlation of GATT/WTO with the probability of new investments can only be reconciled with the theoretical model if the domestic economic policy effect dominates the self-selection effect. But this implies necessarily that the domestic economic policy effect exists and is significant. This is summarized in the next proposition.

**Proposition 5:** Suppose that the theoretical model of section 3 is true and in particular Assumption A1, A2 and A3 hold. If we obtain (i) $\hat{\beta}_{\text{IV}}^{\text{WTO}} = 0$ in the regression of FDI on WTO in (19) with a valid instrument, while (ii) $\hat{\beta}_{\text{OLS}}^{\text{WTO}} > 0$ is obtained in this regression without instrumenting, then domestic economic policy reforms must occur simultaneous to accession and are significant in attracting FDI.

The result of Proposition 5 formalizes the suspicion that we had from inspecting the data in section 2.

6 Discussion

In this section we discuss a number of other effects which might be associated with accession to GATT/WTO and which might impact on FDI. We start by discussing different commitment effects in terms of trade policy. We then turn to a discussion of how results would change if accession will have an impact on other domestic policies which was assumed away in the previous analysis. We also discuss extensions in the type of FDI and some additional econometric issues.

**Credibility of future trade policy.** There may also be a commitment effect of WTO membership on FDI. In order to discuss this, we can extend the previous model to two periods. The timing of decision
now becomes crucial. First, there will be the accession decision of the country $S$, then there will be the setting of government policy in terms of tariffs $t_{SR,1}$ and $t_{HS,1}$ in period 1 which is taken to be an exogenous but observable random draw representing the preferences of a government in office. Thereafter, firms irreversibly decide on their location over both periods. The first period ends then with production, pricing, and sales decision, and market clearing. In the second period, there is a new random draw of government policies, $t_{SR,2}$ and $t_{HS,2}$, representing a change of the government party. Finally, there is production, pricing, sales, and market clearing in period 2. For simplicity, we take all variables except for the above mentioned policy parameters as constant over time and we assume away any time preference. Firms are assumed to be risk neutral.

In the Appendix, we show that also in this setting with credibility effects of accession our results in Proposition 4 holds since firms in the investment decision trade off less tariff-jumping incentives against stronger export platform incentives. Thus, improved credibility of the host government from accession may not increase FDI.\footnote{In the export share equation, the value of future commitment is not likely to affect the export share, since it depends on today’s trade barriers but not future trade barriers, as firms are likely to be sufficiently flexible in re-directing sales in dependence of changes of relative prices within time periods during which an intention to become GATT/WTO turns to full membership.}

**Credibility of domestic policies.** Since accession is implemented through a bargaining process one can think of situations where the incumbent countries raise demands on taxation in the accession country. To see this note that higher business costs $T_S$ on affiliates to the country H MNEs implies less profit repatriation to country H. To incorporate this into the model assume the following policy equation for business costs in country H:

$$
\ln(1 + T_S) = \psi_0 + \psi_{xs} \ln x_S + \psi_{WTO} WTO
$$

where $\psi_{WTO} < 0$ captures the assumption of incumbent countries demanding lower taxation on affiliates.

Then the causal effect of GATT/WTO in (20) changes to:

$$
\text{plim}(\beta^{IV}_{WTO}) = \{\beta_{t_{HS}} \varphi_{WTO} + \beta_{t_{SR}} \kappa_{WTO}\} + \beta_{T_S} \vartheta_{WTO} = 0
$$

(25)

where $\beta_{T_S} < 0$ is the effect of increased taxation on the investment decision. Since $\beta_{WTO} = 0$ in the investment equation (20), the presence of a strictly positive credibility effect on taxation $\beta_{T_S} \vartheta_{WTO} > 0$ implies only that the negative tariff jumping effect $(\beta_{t_{HS}} \varphi_{WTO} < 0)$ must be even stronger in order to compensate both the positive export platform effect $(\beta_{t_{SR}} \kappa_{WTO} > 0)$ and the credibility effect $(\beta_{T_S} \vartheta_{WTO})$. Therefore, with accession having a negative effect on business costs $T_S$ in the accession country our estimates suggest even larger effects on trade cost reduction in the accession country.
**Accession and domestic policies.** In the analysis, we have assumed that inflows of FDI and the impact of foreign firms through trade is too small to affect the accession country’s choice of domestic policy in terms of business costs, $T_S$. This seems intuitive in many instances but there may be situations where this might not hold. One possibility, which simulation of the model in a technical annex confirms, is that, if foreign firms become dominating, accession may lead to an incentive for the government to tax FDI by increasing business costs $T_S$.

In terms of Figure 3(iii), this would imply a discrete shift at $\chi$ with $T_S^{WTO} > T_S^{NWTO}$. Since this implies that $\vartheta_{WTO} > 0$ in (25), the increase in taxation implies that the estimate $\beta_{WTO}^{IV} = 0$ may be consistent with accession having no effect on import tariffs in the accession country. $\varphi_{WTO} = 0$, while accession needs still be associated with increased market access since $\kappa_{WTO} > 0$ must still hold since business cost do not affect the estimates in the export-share regression (17). Recent results by Subramanian and Wei (2007) points in this direction. However, in a fully fledged model with multiple accession countries tax competition may prevent such effects. In most countries, openness of the country is presumably too small for this effect to be substantial.

**Vertical FDI.** In our analysis, we have ignored vertical FDI, i.e. the production of affiliates for export to the home-country Sweden and the import of intermediate goods by affiliates from Sweden. Both types of FDI have been shown empirically to be less relevant for Sweden (Braconier et al., 2005). Moreover, they do not upset the model structure either. It is quite likely that exports to Sweden do not behave qualitatively different to exports to third countries. In fact, we re-did Tables 1 and 2 for the dependent variable total export share where total exports include those to Sweden and found very similar results to the estimates of the share of exports to third countries.\(^{55}\)

Intermediate inputs render affiliate production sensitive to host country import tariffs. However, since these tariffs apply only to part of the sales value of the product, affiliate production will always be strictly less sensitive to the import tariff than exports of the entire product from Sweden. Hence, the comparative static results of import tariffs on the FDI cut-off level will be preserved.

**Endogeneity of the openness variable.** Another problem may arise from endogeneity of the openness variable $open_s$. Such an endogeneity can be expected, because open is likely to depend on host- and third-country import tariffs, formally:

$$open_s = -\xi_{tHS}tHS - \xi_{tSR}tSR.$$  \hspace{1cm} (26)

But then $open_s$ is also correlated with the latent policy preference and thus subject to endogeneity. Such a problem does not arise in the export share estimation for the same reason why GATT/WTO is not endogenous. However, the problem may arise in the estimation of the probability of new investment. The straightforward solution would be to allow for two endogenous variables. The loss in efficiency would be

\(^{55}\)Estimates are available from the authors upon request.
tremendous and the estimation model computationally quite involved. Instead, we derive theoretical bias terms adding (26) into the data-generating process (14), (15) and (16) and obtain the last proposition.

**Proposition 6**: Suppose that the model (14), (15), (16) and (26) is the data generating process. If \( \text{cov}(\text{open}_S, \text{WTO}_S) = 0 \), then (i) an IV estimation of the WTO coefficient with dependent variable \( \text{FDI}_z \) and explanatory variables \( \text{WTO} \) and \( \text{X} \) containing \( \text{open}_S \) converges to the same value as this estimation without the \( \text{open}_S \) variable, (ii) the estimate is consistent, i.e. \( \text{plim} \hat{\beta}_{\text{IV}}^{\text{WTO}} = \beta_{\text{WTO}} \).

**Proof**: See appendix E. qed.

We re-estimate the IV specification on the probability of new investment without the \( \text{open}_S \) variable in Table 4, specification (6) and find that the WTO estimate does not differ much from the one in specification (1). Since part (i) of the Proposition 5 is observed in the estimates, the condition \( \text{cov}(\text{open}_S, \text{FDI}_S) = 0 \) will approximately be fulfilled. But then part (ii) of the Proposition 5 holds and the IV estimate of the WTO variable is consistent in specification (1) of Table 4. In any case, the IV estimate without the explanatory variable \( \text{open}_S \) can be shown to be consistent.

### 7 Conclusions

We derive a gravity equation for estimating MNE activity from a three-country model with heterogeneous MNEs and address with this methodology the Rose (2004a,b) puzzle of a weak link between GATT/WTO membership on one hand and both liberty of trade policy and international trade performance on the other hand. Our approach uses microdata to investigate whether Swedish MNEs increase foreign affiliate trade in GATT- or WTO-accession countries and whether they engage in more new investments. We find that GATT/WTO accession spurs drastically foreign affiliate trade, but has no causal impact on new investment decisions.

In the empirical analysis, we are guided by a heterogeneous firm model of FDI with endogenous accession decision of the host country to understand the causal effects of GATT/WTO on FDI and foreign affiliate trade. Accession is beneficial to countries whose political equilibrium favors low import tariffs anyhow. Still, those countries are willing to accept an additional tariff concession in exchange for better market access to incumbents through the Most-Favored-Nation clause of GATT/WTO. However, the same type of countries chooses to undertake other domestic economic policies favorable to FDI which are hard to control for empirically. With this information from theory, we are able to design a research strategy that pays particular attention to omitted variable bias and self-selection bias in the membership decision. When deriving the probability limits of IV estimators under the assumption that the data generating process is driven by our model, we are able to disentangle the theoretical channels through which GATT/WTO accession affects MNEs and attribute them to the estimates.

This way we can give indirect evidence that GATT/WTO accession increases market access to incumbent countries which spurs intra-firm trade and export platform motivated FDI. However, we have
also indirect evidence for that GATT/WTO accession causes a reduction in accession country import barriers which reduces FDI driven by the tariff-jumping motive. This explains why the net causal effect of GATT/WTO accession on new investments is insignificant. Finally, we are also able to isolate two self-selection effects. First, countries that liberalize their trade regime also tend to liberalize their domestic economic policy which in turn spurs FDI independently of but simultaneously to GATT/WTO accession. Second, we also account for that some countries may have reduced their import trade barriers even in the absence of GATT/WTO.

In general, one suspects that accession to WTO may have a stronger impact than accession to GATT, because WTO contains many regulations beyond pure tariff constraints such as intellectual property rights regulation, trade related investment measures, etc. Unfortunately, the number of accession cases is too small to differentiate the impact of WTO from GATT in a proper statistical inference and we have been left with capturing some average effect. A proper distinction may, however, become feasible in the future, if the remaining outsider countries join WTO.
References


7 Appendix A: FDI Regimes

We prove Proposition 1. Before we begin with the proof, we define the set of location strategies and give some conditions that are later used in the proof. There are six location strategies of H-country differentiated goods firms:
\[ HFDI = \{ H, S, R \} \tag{27} \]
\[ EFIRM = \{ H, s_H, r_H \} \]
\[ PFDI = \{ H, S, r_S \} \]
\[ SFDI = \{ H, S, r_H \} \]
\[ PFDI' = \{ H, s_R, R \} \]
\[ SFDI' = \{ H, s_H, R \} \]

We use the notation convention that capital letters denote a production facility in the respective country and small letters indicate that a country is served by exports from a plant located in the country indicated by the subscript index, e.g. \( r_S \) means that country R receives exports of a plant located in country S. The location choice set HFDI is a mnemonic for horizontal FDI, EFIRM for firms that serve all markets abroad by exports from Sweden, PFDI for export platform FDI, and SFDI for satellite FDI, where an affiliate in the host country serves only the host country market. The cases SFDI' and PFDI' are mirror images to PFDI and SFDI (just re-label S and R), respectively.

We first state a useful lemma.

**Lemma A1:** If one export platform FDI firm exists among those with headquarters in H, there does not exist any of the types SFDI, SFDI', and PFDI'.

**Proof:** If one export platform FDI firm exists, then there must hold for some \( z \) that export platform FDI dominates SFDI, i.e. \( \pi^*_S(z) + \pi^*_S(z) + f > \pi^*_S(z) + \pi^*_H(z) + f \), which in turn is the case if
\[ B^*_S > B^*_H. \] (28)

But this condition is independent of \( z \) and thus must hold for any \( z \) if it holds for one \( z \). But then cannot exist any SFDI. Analogous arguments apply to SFDI', and PFDI'. \textit{qed.}

The next lemma follows.

**Lemma A2:** If assumption A1 holds, then there exists a unique productivity level \( \Theta_{HFDI} > 0 \) such that \( \Pi^{PFDI} (z) = \Pi^{HFDI} (z) \).

**Proof:** Since the profit functions \( \Pi^{PFDI} (z) \) and \( \Pi^{HFDI} (z) \) are linear in \( \Theta (z) \) and there exists both at least one horizontal and one export platform firm by Assumption A1, there is a unique \( \Theta (z) = \Theta_{HFDI} > 0 \) such that \( \Pi^{PFDI} (z) = \Pi^{HFDI} (z) \). \textit{qed.}

We can now turn to the proof of Proposition 1. By Lemma A1, we need to focus only on three firm types - exporting firms, export platform FDI, and horizontal FDI.

Note first from (4)-(6) that, as \( \Theta (z) \) goes to zero, the operating profits \( \Theta (z) [B^*_R + B^*_S] \) go to zero. Then, we have
\[ \Pi^{Export} (z) = 0 > \Pi^{PFDI} (z) = f > \Pi^{HFDI} (z) = 2f. \] (29)
Hence, exporting firms must exist at values of $\Theta(z)$ sufficiently close to zero. Inequality (29) together with Lemma A2 and the linearity property of the profit functions are sufficient to conclude $\Pi^{PFDI}(z) > \Pi^{HFDI}(z)$ if $\Theta(z) < \Theta_{HFDI}$. Applying Lemma A2 again, we conclude also $\Pi^{PFDI}(z) < \Pi^{HFDI}(z)$ if $\Theta(z) > \Theta_{HFDI}$. qed.

# Appendix B: Comparative Static Results on Cutt-Off Levels

In this appendix we first state the functional forms of the cut-off levels and then give comparative static results on them:

$$\Theta_{PFDI} \equiv \frac{f}{[B^*_SR + B^*_SS] - [B^*_HR + B^*_HS]}$$

$$= f(\left[(1 + t_{SR})^{-1} - (1 + t_{HS})^{-1} - (1 + t_{SR})^{-1} (1 + t_{SS})^{-1} \right] \frac{I_R}{P_R}$$

$$= \Theta_{PFDI}(t_{HS}, t_{SR})$$

$$\Theta_{HFDI} \equiv \frac{f}{B^*_RR - B^*_SR}$$

$$= \frac{f}{\left[1 - (1 + t_{SR})^{-1} - (1 + t_{SS})^{-1} \right] \frac{I_R}{P_R}$$

$$= \Theta_{HFDI}(t_{SS}, t_{SR})$$

Most partial derivatives are immediately clear. Some need further discussion.

$$\frac{\partial \Theta_{PFDI}}{\partial \left( \frac{I_R}{P_R} \right)} < 0$$

if and only if $B^*_SR > B^*_HR$ which is ensured by condition (28). Next,

$$\frac{\partial \Theta_{PFDI}}{\partial \left( \frac{I_R}{P_R} \right)} < 0$$

if and only if $B^*_SS > B^*_HS$. Suppose the opposite was true, then $\Theta(z) [B^*_SS + B^*_SR] - f < \Theta(z) (B^*_HS + B^*_RR) - f$. The right-hand side of the inequality is the profit of $SFDI'$ and the left-hand side is larger than the profit of $HFDI$. But then $SFDI'$ would dominate $HFDI$ at any $\Theta(z)$ which contradicts Lemma A1 in Appendix A.

$$\frac{\partial \Theta_{HFDI}}{\partial \left( \frac{I_R}{P_R} \right)} < 0$$

if and only if $B^*_RR > B^*_SR$. If this inequality was not fulfilled, then export platform FDI would dominate horizontal FDI for all values of $\Theta(z)$. But this contradicts assumption A1.
9 Appendix C:

9.1 Proof of Proposition 3

We begin with the proof of statement (i) of the Proposition 3. We have from the first order condition with respect to $T_S$:

\[ \frac{\partial U_S}{\partial T_S} + \frac{\partial \Omega_S}{\partial T_S} = \frac{\partial R_S}{\partial T_S} < 0, \]  

(35)

where the inequality follows from the assumptions $\frac{\partial U_S}{\partial T_S} < 0$ and $\frac{\partial \Omega_S}{\partial T_S} < 0$. Then we obtain from standard matrix differentiation and the implicit function theorem:

\[ \frac{dT_N}{d\chi_S} = -\frac{\frac{\partial^2 W_S}{\partial T_S} \frac{\partial \Omega_S}{\partial T_N}}{\frac{\partial^2 W_S}{\partial \chi_S} \frac{\partial \Omega_S}{\partial \chi_N}} > 0, \]  

(36)

when taking into account $\frac{\partial^2 W_S}{\partial T_j \partial T_S} = 0$ from Assumption A3 (i) and where the inequality follows, because $\frac{\partial^2 W_S}{\partial T_j \partial T_S} < 0$ by the assumption of strict concavity of $W_S(\cdot)$ and $\frac{\partial^2 W_S}{\partial T_j \partial \chi_S} = \frac{\partial R_S}{\partial T_j} > 0$ by (35).

Likewise, we can exploit the first order conditions on tariffs, i.e.

\[ \frac{\partial U_S}{\partial T_j} + \frac{\partial \Omega_S}{\partial T_j} = -\frac{\partial R_S}{\partial T_j} < 0, \]  

(37)

where the inequality follows from assumption A3 (ii). Next, when taking into account $\frac{\partial^2 W_S}{\partial T_j \partial T_S} = 0$ from Assumption A3 (i), we find the derivative

\[ \frac{dT_j}{d\chi_S} = \frac{\frac{\partial^2 W_S}{\partial T_j \partial T_S} \left[ \frac{\partial^2 W_S}{\partial T_j \partial \chi_S} \frac{\partial \Omega_S}{\partial \chi_N} - \frac{\partial^2 W_S}{\partial T_j \partial \chi_S} \frac{\partial \Omega_S}{\partial \chi_N} \right]}{\text{Det}} > 0, \]  

(38)

$i = H, R; j = H, R; i \neq j$, where Det is the determinant of the Hessian matrix of $W_S(\cdot)$ which needs to be negative by the concavity assumption A3 (i) (Det < 0). Moreover, $\frac{\partial^2 W_S}{\partial T_j \partial \chi_S} = \frac{\partial R_S}{\partial T_j} > 0$ and $\frac{\partial^2 W_S}{\partial T_j \partial T_S} = \frac{\partial R_S}{\partial T_j} > 0$ by (37), $\frac{\partial^2 W_S}{\partial T_j \partial \chi_S} < 0$ and $\frac{\partial^2 W_S}{\partial T_j \partial T_S} < 0$ by the concavity assumption A3 (i) on $W_S(\cdot)$, and $\frac{\partial^2 W_S}{\partial T_j \partial \chi_S}$ > 0 again by assumption A3 (i). These inequalities explain altogether the sign of $\frac{dT_j}{d\chi_S}$ in (38).

Turning to the proof of statement (ii) in Proposition 3, we note that for any $\tilde{\chi}_S$, at which a country is indifferent to join or stay out of GATT/WTO, must hold by definition

\[ W^{NWTO}_S(\tilde{\chi}_S, t^{NWTO}_S) = W^{WTO}_S(\tilde{\chi}_S, \tilde{t}). \]  

(39)

Next, consider the following derivative at any $\tilde{\chi}$, at which a country is indifferent to join or stay out of GATT/WTO:

\[ \frac{\partial \left[ W^{NWTO}_S - W^{WTO}_S \right]}{\partial \chi_S} \bigg|_{\chi_S = \tilde{\chi}_S} = R_S(t^{m,NWTO}_S(\tilde{\chi}_S), T^{NWTO}_S(\tilde{\chi}_S); t^{NWTO}_S) - R_S(\tilde{t}, T^{WTO}_S(\tilde{\chi}_S); \tilde{t}) > 0, \]  

(40)

where we used the envelope theorem. The inequality in (40) follows, because (i) $t^{m,NWTO}_S(\tilde{\chi}_S) > \tilde{t}$ by Assumption A2 (iii) and $\frac{\partial R_S}{\partial T_S} > 0$ by (37), (ii) $T^{NWTO}_S(\tilde{\chi}_S) = T^{WTO}_S(\tilde{\chi}_S)$ by noting that the
derivative $\frac{dT_s}{d\chi_S}$ given in (36) does not depend on any trade policy because of Assumption A3 (i), i.e.
\[ \partial^2 W_S / \partial t_i S \partial T_S = 0, \]
and (iii) $t_S^{NWTO} (\bar{\chi}_S) \rightarrow \bar{t}$ by Assumption A3 (iii).

From (39) and (40) follows directly that $\chi_S$ is unique and that $W_S^{NWTO} \geq W_S^{WTO}$ if and only if $\chi_S \leq \bar{\chi}_S$. Part (ii) of the proof is completed by noting that $W_S^{NWTO} < W_S^{WTO}$ at $\chi_S = 0$, which follows from (37) and the fact that government revenue $R_S (\cdot) \rightarrow 0$ at $\chi_S = 0$.

Turning to the statement (iii) in Proposition 3, suppose to the contrary that $t_i^{NWTO} (\chi_S) \leq t_i^{WTO} (\bar{\chi}_S)$. Hence, it must hold
\[ \frac{\partial W_i^{WTO}}{\partial t_i} \geq 0 \] (42)
for $t_i \in \left[t_i^{NWTO} (\chi_S), t_i^{WTO} (\bar{\chi}_S)\right]$ by the property of a constraint maximum of $W_i^{WTO}$ in $t_i^{WTO} (\bar{\chi}_S)$ with the constraint $t_i \leq \bar{t}$. Furthermore, holds
\[ T_S^{WTO} (\chi_S) = T_S^{NWTO} (\bar{\chi}_S) \] (43)
from $\partial^2 W_S / \partial t_i S \partial T_S = 0$ by assumption A3 (i). Next, we find
\[ W_S \left(t_S^{NWTO} (\chi_S), T_S^{WTO} (\chi_S), \bar{t}, \bar{\chi}_S\right) \geq W_S \left(t_S^{NWTO} (\bar{\chi}_S), T_S^{WTO} (\bar{\chi}_S), \bar{t}, \bar{\chi}_S\right) \]
\[ > W_S \left(t_S^{NWTO} (\bar{\chi}_S), t_S^{NWTO} (\bar{\chi}_S), t_S^{NWTO} (\bar{\chi}_S), \bar{\chi}_S\right), \] (44)
where the first weak inequality follows from (42) and the second line follows from (a) $\frac{\partial W_S}{\partial t_i S_j} < 0$ by assumption A3 (i), (b) $t_S^{NWTO} (\bar{\chi}_S) > \bar{t}$ by assumption A2 (iii), and (c) from (43). However, (44) contradicts the definition of $\bar{\chi}_S$. Hence, $t_i^{NWTO} (\chi_S) > t_i^{WTO} (\bar{\chi}_S)$ which concludes the first part of the claim.

For the second part, by the definition of $\bar{\chi}$ we have
\[ W_S \left(t_S^{NWTO} (\bar{\chi}), T_S^{WTO} (\bar{\chi}), \bar{t}, \bar{\chi}\right) = W_S \left(\bar{t}, T_S^{WTO} (\bar{\chi}), \bar{t}, \bar{\chi}\right). \]
Next, suppose to the contrary of the Proposition 3 (iii) that $\bar{\chi} = \bar{\chi}_S$. Since $W_S \left(\bar{t}, T_S^{WTO} (\bar{\chi}), \bar{t}, \bar{\chi}\right)$ is an unconstraint optimum, and $t_S^{NWTO} > \bar{t}$ by Assumption A2 (iii), and $\frac{\partial W_S}{\partial t_i S_j} < 0$ by Assumption A3 (i), we must then have:
\[ W_S \left(\bar{t}, T_S^{WTO} (\bar{\chi}), \bar{t}, \bar{\chi}\right) > W_S \left(t_S^{NWTO} (\bar{\chi}), T_S^{NWTO} (\bar{\chi}), t_S^{NWTO} (\bar{\chi}), \bar{\chi}\right), \]
which contradicts the definition of $\bar{\chi}_S$. Hence, $\bar{\chi} \neq \bar{\chi}_S$. Finally, $\bar{\chi} < \bar{\chi}_S$ follows because at $\chi = \bar{\chi}_S$ the constraint $t_S^{NWTO} (\bar{\chi}_S) \leq \bar{t}$ is strictly binding from the argument above, at $\chi_S = \bar{\chi}$ it is not by definition, and $\frac{\partial W_S}{\partial \chi_S} \geq 0$ by Proposition 1 (i). qed.
10 Appendix D

10.1 Validity test if potential endogenous variable is truely exogenous

Consider the true data generating process:

$$\psi_{SR} = \beta \cdot WTO + \varepsilon$$  \hspace{1cm} (45)

where $\psi_{SR}$ is the dependent variable (export share), $WTO$ is the variable that is tested for endogeneity, and $\varepsilon$ is the true i.i.d. error term in the population. Other control variables may be purged by the Frisch-Waugh theorem. In this section, we assume that the $WTO$ variable is actually not endogenous in the estimation of the export share which follows directly from Proposition 4. Moreover, our IV estimates suggest that the $WTO$ variable is not endogenous.

**Assumption A4**: $\text{cov}(WTO, \varepsilon) = 0$.

Under this assumption, one can construct a test of the validity of the instrument $z$ by estimating the following auxiliary regression with OLS

$$\psi_{SR} = \beta_{OLS} \cdot WTO + \alpha_{OLS} z + \varepsilon_{OLS}$$ \hspace{1cm} (46)

The $t$-value on the instrument $z$ in the auxiliary regression above can be regarded as a validity-test statistic. To see this, note that the probability limit of the regression coefficient on $z$ is given by\(^{50}\)

$$p \lim \alpha_{OLS} = 0 + Q_{21} \cdot E[x \cdot \varepsilon] + Q_{22} \cdot E[z \cdot \varepsilon] = Q_{22} \cdot E[z \cdot \varepsilon],$$  \hspace{1cm} (47)

where we define $X = (WTO \: z)'$ and $p \lim [X'X]^{-1} = Q$ and assume $Q$ to be a deterministic $2 \times 2$ matrix with finite entries. The zero in (47) results from assuming that $z$ does not enter the true data generating process in (45), and the second inequality results from assumption A4. But then holds under the null hypothesis of instrument validity, i.e. $\text{cov}(z, \varepsilon) = 0$, that $p \lim \alpha_{OLS} = 0$. Instead, under the alternative hypothesis of instrument invalidity, i.e. $\text{cov}(z, \varepsilon) \neq 0$, we have $p \lim \alpha_{OLS} = Q_{22} \cdot E[z \cdot \varepsilon] \neq 0$.

Since the test statistic is a $t$-test on a regression coefficient, it is well-known to converge under the null hypothesis to a normal distribution in large samples with the usual standard error, perhaps corrected for heteroscedasticity and autocorrelation. We can summarize the discussion in the following proposition:

**Proposition 7**: Suppose assumption A4 holds. Then the OLS estimator of the coefficient $\alpha_{OLS}$ in model (46) is a test statistic that converges to zero under the null hypothesis $H_0$, i.e. instrument is valid ($\text{cov}(z, \varepsilon) = 0$), and remains different from zero under the alternative hypothesis $H_a$, i.e. instrument is invalid ($\text{cov}(z, \varepsilon) \neq 0$).

The previous test can also be extended to a joint hypothesis test. One can use a Hausman-like test to jointly test under the null hypothesis: $\beta_{OLS} = \beta_{IV}$ and $\alpha_{OLS} = 0$, while the alternative hypothesis is $\beta_{OLS} \neq \beta_{IV}$ and/or $\alpha_{OLS} \neq 0$.

\(^{50}\) We simply apply the well-know result for a regression $y = \beta x + \varepsilon$ that the OLS estimate $b_{OLS}$ converges in probability to $p \lim b_{OLS} = \beta + p \lim (x'x)^{-1} \cdot p \lim (x'\varepsilon)$. See, for example, Greene (2005), p. ...

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10.2 Validity test if endogenous variable has truely zero coefficient

There is another special case when one can actually test the validity of instruments and which applies when estimating the probability of new investment \( y \),

\[
y = \beta_{OLS} \cdot WTO + \alpha_{OLS} z + \varepsilon_{OLS}.
\]

This case assumes a priori that the endogenous variable has no impact on \( y \) in the data generating process, which is a bit harder to justify from theory. Still, we know from Proposition 4 that two opposing effects are at work on the \( WTO \) coefficient which may just neutralize each other. Moreover, the IV estimate also suggests that the true effect may indeed be zero.

**Assumption A5:** \( \beta = 0 \) in (45).

However, \( WTO \) may be correlated nevertheless with \( \varepsilon \) and the OLS estimate of \( \beta \) in (45) will converge to \( p \lim \beta_{OLS} = p \lim(WTOWTO)^{-1}p \lim(WTO'\varepsilon) \neq 0 \). Under this assumption, one can construct a validity test by calculating the following auxiliary regression with OLS:

\[
y = \alpha_{OLS} + \varepsilon_{OLS}
\]

The t-value on the coefficient of \( z \) can be regarded as a validity test. The probability limit of the coefficient of \( z \) converges to

\[
p \lim \alpha_{OLS} = 0 + p \lim(z'z)^{-1}E[z'\varepsilon],
\]

where we used assumption A4. Hence, under the null hypothesis, i.e. \( \text{cov}(z, \varepsilon) = 0 \) we have that \( p \lim \alpha_{OLS} = 0 \) and under the alternative hypothesis, i.e. \( \text{cov}(z, \varepsilon) \neq 0 \), we have instead \( p \lim \alpha_{OLS} = p \lim(z'z)^{-1}E[z'\varepsilon] \neq 0 \). Again, since the test statistic is a t-test, it is well-known to converge to a normal distribution in large samples with the usual standard error. This can be summarized in the following proposition:

**Proposition 8:** Suppose assumption A5 holds. Then the OLS estimator of the coefficient \( \alpha_{OLS} \) in model (48) is a test statistic that converges to zero under the null hypothesis \( H_0 \), i.e. instrument is valid \( (\text{cov}(z, \varepsilon) = 0) \), and remains different from zero under the alternative hypothesis \( H_a \), i.e. instrument is invalid \( (\text{cov}(z, \varepsilon) \neq 0) \).

This test can also be extended to a joint hypothesis test. One can use a Hausman-like test to jointly test under the null hypothesis: \( \beta_{OLS} = \beta_{IV} \) and \( \alpha_{OLS} = 0 \), while the alternative hypothesis is \( \beta_{OLS} \neq \beta_{IV} \) and/or \( \alpha_{OLS} \neq 0 \). We have stated these tests only in the context of linear regressions with continuous dependent variables. However, they apply also to probit estimations, since the linear probability model remains consistent in the context of binary dependent variables.

While we give here only the idea of these tests, a simple Monte-Carlo simulation reveals the usefulness of them in Table A1.

Insert Table A1 about here
We assume a data generating process according to our theoretical model with parameterizations roughly corresponding to our estimates to be the null hypothesis. We then obtain from 10,000 repetitions of random draws from this data generating process a size of our test of 4.7% at the 5% significance level. We confront this result with alternative hypotheses where we assume that there is a significant positive and causal effect from GATT/WTO on the probability of new investment. However, an IV estimate is downward biased, because the instrument is correlated at varying degrees with the error term contrary to the IV assumptions.

Interestingly, we can see that both the kitchen sink and the joint validity test become significant in indicating instrument invalidity as soon as the correlation of the error term is so strong that the endogeneity test indicates significant endogeneity. Applying this result to our estimates, we can thus exclude that an invalid instrument alone could yield an insignificant GATT/WTO coefficient in our IV estimation of the probability of new investment. Hence, there must be at least to some extent a domestic policy effect that upward biases the probit/logit estimate of GATT/WTO when not instrumenting.

11 Appendix E: Proof of Proposition 6

Define \( \tilde{Z} = (Z \text{ open}_S X) \) and \( \tilde{X} = (WTO \text{ open}_S X) \). Let \( \tilde{\beta} = (\beta_{WTO} 0 \beta)' \) be the true coefficient vector corresponding to \( X \) from the data generating process given in (14), (15), (16) and (26), where the equality follows from (19). Then we apply the textbook result that the probability limit of the IV estimator \( \hat{\beta}_{IV} = (\beta_{WTO}^{IV} \beta_{open}^{IV} \beta_{X}^{IV})' \) with instrument \( Z \) converges to:

\[
\text{plim} \hat{\beta}_{IV} = \beta + E \left[ X' Z \right]^{-1} \cdot E \left[ Z' r_z \right]. \tag{50}
\]

Exploiting that \( E [Z' \text{ open}_S] = 0 \) and \( E [Z' X] = 0 \) by construction of the instrument vector, \( E [\text{ open}_S' X] = 0 \) by construction of the instrument vector, \( E [X' WTO_S] = 0 \) by (16), and \( E [\text{ open}_S' WTO_S] = 0 \) by assumption in the Proposition 5, (50) reduces to

\[
\text{plim} \begin{pmatrix}
\beta_{WTO}^{IV} \\
\beta_{open}^{IV} \\
\beta_{X}^{IV}
\end{pmatrix} = \begin{pmatrix}
\beta_{WTO} \\
0 \\
\beta
\end{pmatrix} + \begin{pmatrix}
0 \\
E [\text{ open}_S' \text{ open}_S]^{-1} E [\text{ open}_S' r_z] \\
0
\end{pmatrix} \tag{51}
\]

where we used the rule of inversion of partitioned matrices. This proves statement (ii) of the Proposition 5. Statement (i) follows directly from comparing (21) with (51). \textit{QED.}
Figure 1: Mean share of affiliate production exported, mean probability of new investment, and accession dates
(i): Solving the investment choice

(ii): Equilibrium strategy

(iii): The probability of FDI

Figure 2: FDI location choice
(i) The accession decision in country $S$

(ii) Import tariff in country $S$ from country $H$

(iii) Business cost/tax in country $S$

Figure 3: Illustration of Proposition 3
Figure 4: Checking the instrument latitude
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Notes: Country-clustered t-statistics in parentheses; significant at 10%; ** significant at 5%; *** significant at 1%; Constant, dummies for regional trade agreements, year dummies, and other dummies not reported;
Table 2: Share of exports - IV

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Panel (b): first stage estimates

| Latitude                          | 0.057***                     | 0.068***                  |
|                                   | (3.63)                       | (2.87)                    |
| economic freedom                  | 0.387**                      | 0.425**                   |
|                                   | (2.36)                       | (2.38)                    |

Panel (c): OLS estimates for comparison

| OLS GATT/ WTO                     | 1.856***                     | 1.784***                  |
|                                   | (10.18)                      | (9.64)                    |

Panel (d): test results

| Rho                               | 0.01                         | 0.03                      |
|                                   | 0.88                         | 0.86                      |
| weak instr. test                  | 22.73***                     | 11.77***                  |
|                                   | (0.00)                       | (0.00)                    |
| overidentification test           | 0.48                         | 1.83                      |
|                                   | (0.12)                       | (0.18)                    |
| Observations                      | 167                          | 171                       |

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Val. test is test on validity of instrument; See Appendix G; Joint test is a joint test on validity of instrument and exogeneity of WTO; see Appendix G.
Table 3: Probability of New Investment

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<td>(3.75)</td>
<td>(6.15)</td>
<td>(4.08)</td>
<td>(4.26)</td>
<td>(3.49)</td>
<td>(3.67)**</td>
</tr>
<tr>
<td>econ. freedom</td>
<td>0.066</td>
<td>(0.34)</td>
<td>-0.056</td>
<td>(1.43)</td>
<td>0.008*</td>
<td>0.008*</td>
<td>-0.082</td>
<td>(0.28)</td>
<td>0.008*</td>
<td>0.008*</td>
<td>-0.082</td>
<td>(0.28)</td>
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<tr>
<td>int. cap. restrict.</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capital growth</td>
<td>0.14**</td>
<td>(1.63)</td>
<td>(1.52)</td>
<td>(0.60)</td>
<td>(0.83)</td>
<td>(0.23)</td>
<td>(0.85)</td>
<td>(1.49)</td>
<td>(1.36)</td>
<td>(1.37)</td>
<td>(1.46)</td>
<td>(1.50)**</td>
</tr>
<tr>
<td>business cycle</td>
<td>-0.004</td>
<td>-0.004</td>
<td>-0.039</td>
<td>-0.038</td>
<td>0.136</td>
<td>-0.011</td>
<td>-0.005</td>
<td>-0.018</td>
<td>-0.004</td>
<td>-0.003</td>
<td>-0.002</td>
<td>-0.003**</td>
</tr>
</tbody>
</table>

Notes: Country-clustered z-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; constant, year dummies, dummies for regional trade agreements, and any other fixed effects not reported.
Table 4: Probability of new investment – IV

<table>
<thead>
<tr>
<th></th>
<th>Specification with control variable openness</th>
<th>Specification without control variable openness</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>IV estimate (1)</td>
<td>Val. test latitude (2)</td>
</tr>
<tr>
<td>GATT/WTO</td>
<td>0.028</td>
<td>0.172</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(1.5)</td>
</tr>
<tr>
<td>Open</td>
<td>0.213*</td>
<td>0.113***</td>
</tr>
<tr>
<td></td>
<td>(1.84)</td>
<td>(3.81)</td>
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<tr>
<td>firm size</td>
<td>0.115***</td>
<td>0.113***</td>
</tr>
<tr>
<td></td>
<td>(3.9)</td>
<td>(3.81)</td>
</tr>
<tr>
<td>Latitude</td>
<td>-0.004</td>
<td>-0.169</td>
</tr>
<tr>
<td></td>
<td>(0.7)</td>
<td>(1.13)</td>
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</table>

panel (a): second stage estimates

<table>
<thead>
<tr>
<th></th>
<th>panel (b): first stage estimates</th>
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</thead>
<tbody>
<tr>
<td>civil liberty</td>
<td>0.673**</td>
</tr>
<tr>
<td></td>
<td>(2.23)</td>
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<tr>
<td>econ. freedom</td>
<td>0.492*</td>
</tr>
<tr>
<td></td>
<td>(1.71)</td>
</tr>
<tr>
<td>left wing</td>
<td>-2.535***</td>
</tr>
<tr>
<td></td>
<td>(-4.58)</td>
</tr>
<tr>
<td>latitude</td>
<td>0.067**</td>
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<td>(1.98)</td>
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panel (c): probit estimates for comparison

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<thead>
<tr>
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<tr>
<td></td>
<td>0.31*</td>
</tr>
<tr>
<td></td>
<td>(1.8)</td>
</tr>
<tr>
<td></td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(1.37)</td>
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</tr>
<tr>
<td>------------------</td>
<td>-----</td>
</tr>
<tr>
<td><strong>rho</strong></td>
<td>5.53**</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
</tr>
<tr>
<td><strong>weak instr test</strong></td>
<td>28***</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
</tr>
<tr>
<td><strong>overidentification test</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
</tr>
<tr>
<td><strong>joint test</strong></td>
<td>3.44</td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>11332</td>
</tr>
</tbody>
</table>

Robust z statistics in parentheses;
* significant at 10%; ** significant at 5%; *** significant at 1%;
Val. Test is test on validity of instrument; See Appendix E; Joint test is a joint test on validity of instrument and exogeneity of wto; see Appendix E.