ABSTRACT: We provide theoretical and empirical evidence that policy uncertainty can significantly affect firm level investment and entry decisions in the context of international trade. When market entry costs are sunk, policy uncertainty can create a real option value of waiting to enter foreign markets until conditions improve or uncertainty is resolved. Using a dynamic, heterogeneous firms model we show that: (i) investment and entry into export markets is reduced when trade policy is uncertain, and (ii) preferential trade agreements (PTAs) are valuable to exporters even if applied trade barriers are currently low or zero. We derive a structural equation that predicts how firm entry responds to changes in applied tariffs and a theory-based measure of policy uncertainty. Our novel approach using observable trade policies allows us to estimate the impact of policy uncertainty and quantify its aggregate implications. We apply this method to Portugal’s accession to the European Community in 1986 using new firm-level trade data. We find that (i) the trade policy reform accounted for a large fraction of the observed Portuguese exporting firms’ entry and sales upon accession (ii) the accession removed uncertainty about future preferences and (iii) this uncertainty channel accounted for a large fraction of the predicted growth. These results have broader implications for other PTAs and our approach can be applied to analyze other sources of policy uncertainty.

JEL classification: D8, D92, E22, F02, F1, F5, H32, O24.
Keywords: Investment, Trade, Uncertainty, Policy.
1 Introduction

Firms face considerable uncertainty about future conditions affecting their costs, demand and profitability. This uncertainty can arise from purely economic shocks—e.g. to productivity or tastes—or policy shocks—e.g. monetary and fiscal innovations, tax and regulatory reforms. The role of future conditions is particularly important when firms must decide on costly irreversible investments such as adopting a technology, producing a new good or selling in a new market. In these cases, firms may wait for current conditions to be sufficiently good or for uncertainty about future conditions to be sufficiently low before they invest.

We examine the impact of policy uncertainty on a firm’s decision to invest and export to new markets, which is an interesting setting for several reasons. First, exports account for an increasingly large share of firms’ sales and thus global integration has considerably increased their exposure to foreign policy uncertainty. Second, while much trade analysis assumes policy is either fixed or follows a certain deterministic path, we argue that trade policy can be quite uncertain. This uncertainty arises not because trade policy changes very frequently but because when it does, the changes can be quite large and persistent. One recent example was the widespread fear during the great recession that countries would shut their markets to international trade, as they did in the 1930’s.\(^1\) In section 3 we provide additional examples of trade policy uncertainty. Third, there is growing evidence that firms must incur substantial fixed costs before exporting (cf. Roberts and Tybout, 1997). To capture the interaction between these fixed cost investments and policy uncertainty we develop a tractable dynamic heterogenous firm model and derive the impacts of current and future trade policy on investment and export decisions. We then test the predictions of the model and quantify its aggregate implications by combining novel and detailed firm-level and trade policy data.

Our work is also motivated by the importance of domestic policy uncertainty for economic activity, which has been the subject of recent debate.\(^2\) The basic theoretical impacts of uncertainty on investment are understood (cf. Bernanke, 1983 and the references in section 2), and there is some recent evidence for the effects of aggregate volatility shocks.\(^3\) However, there is scant empirical evidence of the importance of policy uncertainty for firms, even though thousands of firms worldwide rank it as ‘one of the most important constraints in doing business’ (World Bank Development Report, 2005). The scant evidence is partly due to the difficulty in measuring policy uncertainty and linking it to specific investment decisions. The

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\(^1\)This fear was further fuelled by the worldwide trade collapse that started in late 2008 and was the sharpest trade contraction since WWII. To counter this uncertainty, leaders of the G-20 repeatedly pledged that “We will not repeat the historic mistakes of protectionism of previous eras.” http://www.londonsummit.gov.uk/en/summit-aims/summit-communique/


\(^3\)Bloom et al. (2007) and Bloom (2009) provide evidence that shocks to stock market volatility delay firm-level investment and attenuate its response to demand shocks. As will become clear, we take a broader view of changes in uncertainty, e.g. a trade agreement that credibly implements free trade eliminates trade policy uncertainty but this affects firm decisions not simply because of a lower variance but also because of a lower mean of the policy. We will separate these effects when relevant.
international trade setting can help address these issues. First, it allows us to construct detailed measures of policy uncertainty that are easy-to-interpret and vary across several dimensions: countries, products and time. Second, we can trace the effects of these measures to specific firm investment and sales decisions that also vary along those dimensions. To the extent that other taxes and regulations are persistent but uncertain, as trade policy is, our findings can be informative for those domestic policies as well.

Our basic theoretical framework can be applied to different settings. However, in order to clearly measure trade policy uncertainty (henceforth TPU) and estimate its effects, we must focus on a specific application. We analyze preferential trade agreements (PTAs), whereby countries eliminate protection relative to a subset of partners, which is the most active form of trade policy in the last 20 years. As of July 2010, there were 283 PTAs in force—a dramatic increase since 1990—and 474 have so far been notified to the World Trade Organization (WTO).4 There are multiple reasons for PTAs and active research on their real value. The increased probability of membership in a PTA can be a source of TPU because in any given year an exporter has a higher probability of obtaining either a price advantage (if it becomes a PTA member) or disadvantage (if another country does). This uncertainty is not fully resolved upon membership since some preferences are subject to renewal, which explains why certain countries receiving unilateral preferences have agreed to liberalize their own markets in exchange for removing preference uncertainty (e.g. the recent Colombia-U.S. PTA). We discuss this motivation for several recent PTAs in section 3.

To examine the impact of TPU on firms we require detailed data. We will argue that Portugal’s accession to the European Community (EC) provides an excellent setting to study this issue for several reasons. First, the focus on a specific country and policy event allows us to cleanly identify the effect and carefully control for a number of factors. Second, we expect the effects of TPU to be most important for small, developing, open economies where trade is central both to consumers and firms.5 So, Portugal’s experience in 1986 can be highly relevant for many developing countries currently seeking secure access to the U.S. and EC markets. Third, Portuguese trade increased dramatically after 1986. As we document in section 3, that increase was largest towards the EC partners, suggesting that it was caused by the accession. Finally, the export expansion upon accession was characterized by considerable entry of Portuguese firms exporting into EC markets even in industries where applied tariffs did not change, which indicates the potential role for the agreement in reducing TPU. In section 3 we show that this expansion cannot be explained by standard aggregate determinants of trade such as income and exchange rates.

While the aggregate results suggest a role for the accession to affect entry investments via a change in expectations about future trade policies they may also be consistent with other explanations. Thus we view


5A large fraction of Portuguese firms are engaged in some form of international trade—about 24%—and account for a large fraction of private sector non-agricultural employment—58% or 46% if we focus only on exporters. These figures for 1987 are based on merged information Quadros de Pessoal and International Trade statistics available from INE.
the aggregate results as motivating evidence for the core of the paper, which is devoted to developing a
dynamic model to show precisely how reductions in TPU increase firm entry and trade and then carefully
testing its predictions with disaggregated data. More specifically, in section 4 we derive a structural equation
that relates the entry decision to current policy and a measure of TPU: the percent loss in profits due to a
negative tariff shock that eliminates tariff preferences.\textsuperscript{6}

In section 5 we test and find evidence for the entry and export predictions by carefully exploring rich
variation in firm entry and policy across different countries (EC-10 vs. Spain), industries and time. We
estimate that Portuguese exporters believed that the probability of losing preferences was not negligible
before accession but it went to zero after full EC accession. So the agreement eliminated that source of
TPU. Overall, the trade policy changes accounted for a substantial share of the observed growth in entry
(61\%) and export value (87\%) in the data. Moreover, we perform counterfactual calculations based on
the empirical estimates and the structural model to decompose the role of changes in applied tariffs vs.
changes in expected tariffs. We find that the applied tariff changes can account only for between 0.4-0.5
of the total policy effect for Spain and 0.1-0.2 for the EC-10, so a large part of the PTA’s effect was due
to the credible elimination of TPU. In this sense our results may have broader implications for evaluating
how the investment and market-entry effects of other types of trade or tax policy reforms depend on their
credibility.\textsuperscript{7}

In the final section we discuss additional applications of our framework and implications of the results.

\section{Related Literature}

To examine the impact of policy uncertainty we focus on a dynamic model of firm investment and entry.
If entry costs are sunk and at least partially irreversible, a prospective firm must consider the time path of
other variables that affect profitability. Dixit (1989) shows that uncertainty about future prices creates an
option value of waiting so firms will delay investments in entry or exit until they receive more information.
In this setting, entry and exit depend on the variance of shocks, their persistence and the size of sunk
costs. Baldwin and Krugman (1989) extend these theoretical insights in a model with uncertainty about
the exchange rate and homogenous firms. They show there is a possibility for “beachhead effects”: after a
firm receives a positive shock and pays the sunk cost of entry into exporting it will not immediately reverse
its investment even if the initial shock is reversed. Thus even temporary shocks can have lasting effects.

There is considerable evidence that firms are heterogeneous, a fact that is particularly important in

\textsuperscript{6} The fact that TPU affects entry only via the loss of preferences reflects the bad news principle that is present in investment
models with an option value of waiting.

\textsuperscript{7} To the extent that some PTAs are more credible than others our results can help explain recent aggregate evidence on
large impacts of some PTAs on trade flows and the mixed results for others (Baier, et al. 2007).
the context of international trade. Starting with Bernard and Jensen (1995) an extensive literature has developed, which documents the fact that exporters tend to be larger and more efficient than non-exporters and tend to self-select into exporting.\footnote{We can also verify this directly in our data for Portugal in the period we are interested: in 1987 the median number of employees for all exporting firms (with at least one employee) was 28, which is 7 times larger than the median number for all private non-agricultural firms in the economy.} Several recent models incorporate firm heterogeneity and show it has important theoretical and empirical implications for trade (cf. Melitz, 2003, and Bernard et al. 2003). In these models the extensive margin may dominate the response of trade flows to reductions in trade barriers (Chaney, 2008). We therefore focus on a dynamic, heterogeneous firms model of export market entry.

Evidence of sunk costs in export-market entry (cf. Roberts and Tybout, 1997), has lead some to consider alternative sources of uncertainty such as exchange rates, demand and productivity that can generate real option problems in trade models. Aggregate and firm-level analysis has focused on exchange rate volatility, about which evidence remains mixed (Baldwin, 1988; Campa, 2004; Das et al., 2007). More broadly, studies of the impact of exchange rate volatility on aggregate trade flows find that effect is negative but “fairly small and is by no means robust” (IMF, 2004, p.6).

The impact of trade and tax policy uncertainty when there are sunk costs of investment, has received far less attention. One difficulty is that most policy processes are not readily adapted to a standard stochastic process and major regime changes may be infrequent. Perhaps because of this difficulty, trade models generally assume policy is static or that reforms are either fully anticipated or unanticipated (cf. Constantini and Melitz, 2008; Burstein and Melitz, 2011). But even if major reforms are rare events they may be important for investment decisions, as recently emphasized in a different context by Barro (2006). The scant work on policy uncertainty is largely theoretical, for example Rodrik (1991) develops a model of capital investment when firms believe an investment tax credit reform may be reversed in the future. If the probability or cost of a policy reversal is high, a reform to promote investment may produce exactly the opposite outcome. Empirically, Aizenman and Marion (1993) show that low persistence of monetary and fiscal aggregates has negative effects on aggregate investment and growth in cross-country regressions.

There is an ongoing empirical debate regarding the value of bilateral and multilateral trade agreements. Early work on the trade effects of PTAs delivered mixed results, e.g. Frankel (1997) reports small and sometimes negative effects of EC membership on bilateral trade between members in the 1960s and 1970s but positive ones in the 1980s and 1990s. Baier and Bergstrand (2007), after controlling for potential selection into agreements, find that PTAs can increase trade by as much as 100%. Other explanations for large trade impacts of some PTAs include competitive reallocation and productivity enhancing investments induced by trade liberalization (cf. Constantini and Melitz, 2008; Treﬂer, 2004). Alternatively, PTAs may imply permanent reductions in trade frictions so future shocks to macro variables may have larger effects on expected profits, which can generate entry as argued by Ruhl (2008). The latter motive is related to
the one we explore but we model the TPU channel and estimate its impact econometrically. Much less is known about how and why trade grows following PTAs because few studies examine the details of the policy change.

Our model captures how a reduction in TPU—caused by switching regimes from unilateral market access to a reciprocal PTA—can increase entry and trade. We test this prediction with an empirical method that closely links the theory to firm-level data. In a related paper, Handley (2012) extends the model we employ to analyze whether the WTO mitigates TPU by requiring countries to bind their tariffs at a maximum level.\footnote{Independent work by Sala et al. (2010) also studies the impact of WTO bindings on exports theoretically but not empirically.} In his setup, the TPU faced by exporters is measured by the gap between applied and WTO bound tariffs. He finds that this form of TPU, which exploits variation in policy commitments within the WTO regime, lowers both the level of product entry and the elasticity of entry to applied tariff reductions in Australia.

3 Trade Policy Uncertainty and Portugal’s European Integration

In this section we provide evidence for the importance of TPU, which helps motivate our theoretical model. We first describe some basic features of the world trading system and highlight several potential sources of TPU that can potentially be captured using our basic framework. We then focus on how certain trade agreements can reduce TPU and provide background information and aggregate evidence for a specific one: Portugal’s accession to the European Community (EC) in 1986, which generated considerable growth in export firm entry and aggregate exports into those markets. We argue that this aggregate evidence is consistent with an uncertainty-reducing role of EC accession but possibly also with other explanations thus in section \footnote{Limão and Tovar (2011) note that the trade restrictiveness index for the typical country in the world is equivalent to a uniform tariff of 14\%, but this jumps to 27\% when non-tariff barriers are included.} we explore specific predictions with disaggregated data.

3.1 Trade Policy Uncertainty in the World Trading System

As we note in the Introduction there are good reasons to be concerned about TPU and yet very little research on its sources and impacts. This may partly be due to the fact that trade policy is perceived not to be very volatile; after all \textit{statutory} tariff rates are legislated at most on a yearly basis. However, this perceived low volatility in statutory tariffs is misleading for two reasons. First, even if statutory trade reforms are infrequent when they occur the changes can be quite large and persistent. Second, \textit{applied} trade policy is more volatile than statutory tariff rates since there are many non-tariff barriers (NTBs).\footnote{Limão and Tovar (2011) note that the trade restrictiveness index for the typical country in the world is equivalent to a uniform tariff of 14\%, but this jumps to 27\% when non-tariff barriers are included.} Several of these NTBs are not strictly (if at all) regulated by the WTO and even the ones that are can be used by countries, sometimes on a “temporary” basis and for specific goods. But even “temporary” measures can remain in
place for months or years.

The ability to use unregulated trade policies can interact with macroeconomic or political shocks to generate considerable uncertainty. For example, there was widespread fear that the recent economic downturn would result in a substantial increase in protectionism. This included the possibility of anti-dumping measures; increases in developing country tariffs from their applied level to the maximum allowed under the WTO; and the use of government procurement measures. Even though the worst fears of a trade war were not realized, the real possibility of the outcome created uncertainty, as evidenced by governments repeated assurances that they would not resort to 1930’s type protectionism.

One of the central reasons for the formation of the GATT was the desire to avoid the disastrous tariff wars in the 1930’s, which shut down many markets to exporters. To this day the GATT’s successor, the WTO, lists as one of its functions and principles: “Predictability through bindings and transparency [to] promote investment (...)” (www.wto.org). However, multilateral agreements are themselves uncertain in terms of timing, negotiation outcomes and implementation. Moreover, the WTO does not fully constrain or regulate all types of trade policy and this generates TPU in periods of crisis, as discussed above, but also in quieter times. A number of examples stand out as long term sources of TPU: first, quality and safety concerns raise the possibility that certain products may be banned from a market, e.g. genetically modified foods in the EU; second, the U.S. threat of import duties to counter Chinese currency manipulation; third, the possibility of using “environmental” duties at the border to offset differences in carbon emissions in production. Even if these policies are unlikely, if they do materialize they would hurt exporters and can thus have important impacts in current investment and export decisions, which our model attempts to capture.

Another source of TPU is the ability to discriminate against different exporters by providing preferential market access. There are currently hundreds of preference schemes reflecting both trade and non-trade motives (Limão, 2007). They are a potential source of TPU in the world trading system for several reasons. First, firms now face an additional source of price uncertainty due to the possibility that a firm from another country will receive a preferential tariff reduction. Second, trade preferences can generate additional uncertainty about any future multilateral tariff reductions. Third, some agreements can increase TPU for the recipients of the preferences themselves. For example, unilateral preferences such as the General System of Preferences are subject to renewal and cancellation risk by the “donors” (the U.S., EU and other developed countries) and can thus generate TPU for the recipients (developing countries).

While preferences may generate an increase in TPU in the world trading system, some reciprocal PTAs may reduce it for its members. They can do so by securing low (often zero) fixed tariff rates and substantially lowering the risk of non-tariff barriers (e.g. U.S. PTA partners were exempt from the steel safeguards). One

\[11\] Limão (2006) and Karacasovalli and Limão (2008) find that preferences provided by the US and EU respectively caused them to maintain relatively higher multilateral tariffs against the rest of the world in the Uruguay Round. Estevadeordal et al (2008) find that PTAs within Latin America generated reductions in external tariffs in those Latin American countries.
particularly useful way to try to isolate and estimate a TPU reducing role of reciprocal PTAs is to consider cases where it primarily secures pre-existing preferences. There are several such cases. For example, Peru and Colombia, which received unilateral preferences from the U.S., sought reciprocal PTAs with the U.S. to secure permanent preferential access and argued this security would be important for export investments (cf. USITC, 2008). Similarly, several countries who sought or are seeking PTAs with the European Union previously received some form of preference. As we will argue below Portugal’s European integration also secured pre-existing preferences. Thus its experience may still be relevant for several other countries.

3.2 Portugal’s European Trade Integration

In this section we summarize the background and some stylized facts of Portugal’s European trade integration. We then provide evidence that the growth in entry and exports after EC accession cannot be fully explained by standard determinants and discuss some additional motivating evidence for our model. The main objective of this section is not to test a specific channel by which accession worked but rather to gauge its aggregate importance and argue that this is a relevant episode to test specific predictions at a disaggregate level, which we do in section 5.

Portugal’s market access to its European partners in the 1970s and early 80s was fraught with uncertainty, until its full accession to the EC in 1986. Prior to joining the EC, Portugal was a founding member of the European Free Trade Area (EFTA), which was signed in 1960. By the late 1960s, EFTA had achieved free trade in industrial products. When the UK and Denmark left EFTA in 1972 to join the EC, the remaining EFTA countries (including Portugal) signed bilateral agreements with the EC that implemented free trade in industrial products by 1977.12

Portugal’s trade with neighboring Spain remained highly restricted until the EFTA-Spain agreement of 1980. This agreement began a partial liberalization of Spain’s tariffs against the EFTA countries. In the first phase from 1980-1983, a three tiered system of reductions on industrial products would reduce tariffs by 25% to 60% with EFTA partners. Portugal was granted even greater reductions of up to 80%.13 A second phase of reductions over a period of indeterminate length was supposed to commence in 1984. The EFTA-Spain agreement contained no definite timetable or scheduled reductions for the second phase and thus the existing preferences in the first phase were potentially incompatible with GATT Article XXIV’s requirement that PTAs implement zero tariffs on substantially all trade. Moreover, the preferential reductions between

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12 While our focus will be on the role of agreements in generating integration, it is interesting to note that dissolving agreements may cause disintegration. We find that Portugal’s trade share with EFTA countries increased from about 20% in 1960 to 30% in 1973. But the exit of Denmark and the UK (which accounted for half of Portugal’s trade with EFTA) to join the EC in 1973 initiated a rapid and strong decline in Portugal’s trade share with these countries.

13 Details of the reductions can be found in the text of the “Agreement Between the EFTA Countries and Spain,” signed May 26, 1979 and entering into force on May 1, 1980. Annex P contains the timetable and list products with tariff reduction for Spain and Portugal. GATT notifications indicate that these scheduled reductions were implemented as planned (“Agreement Between the EFTA Countries and Spain, Information Furnished by Parties to the Agreement” L/5465, March 8, 1983).
Spain and EFTA in place by 1983 were simply extended and then renewed multiple times by an oversight committee. Thus, before 1986, Portuguese exporters faced considerable uncertainty about whether they would maintain preferential access to Spain.\textsuperscript{14}

By 1984 both Spain and Portugal were in protracted negotiations for full accession to the EC. The agreement was finally signed in the middle of 1985 and the accession entered into force on March 1, 1986. Spain was required to fully liberalize industrial tariffs against Portugal immediately to harmonize with the preferences already granted by the existing EC-10 countries to Portugal. Spain’s agricultural tariffs were reduced by 12.5% per year, with respect to Portugal and the EC-10, to achieve free trade in most products by 1993. The EC-10 countries phased in full liberalization by 1992 of agricultural tariffs against Portugal at 14.3% per year. Portugal and Spain also harmonized their tariff with respect to the rest of the world to match the EC common external tariff.

The trade impact of the accession is remarkable. Between 1985 and 1992 real exports grew by 90% and imports by about 300%.\textsuperscript{15} The fraction of firms involved in trade went from 22% in 1986 to 26% in 1992 and employment in firms that trade increased by about 200,000.\textsuperscript{16}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure1.png}
\caption{Portuguese Trade Shares with EC-10 & Spain}
\end{figure}

Much of this aggregate growth was geared towards the EC-10 and Spain. As we can see in Figure 1 the Portuguese trade share with the EC-10 and Spain goes up from 52% in 1985 to 72% in 1992. The other interesting point is that the initial preferential agreement between the EC and Portugal (agreed in 1972, fully implemented by 1977) and Spain and Portugal (early 1980s) left their trade share nearly unchanged at about 50% between 1972 and 1985.\textsuperscript{17}

\textsuperscript{14}This uncertainty about the elimination of tariffs is clear from a GATT report where one of its members noted that the EFTA-Spain agreement “provided only an expectation that at some point in time the duties and other regulations of commerce would be eliminated but no specific provisions existed in this respect. There was a great difference between an expectation and a specific plan and schedule”. “Agreement between the EFTA countries and Spain”, Report of the Working Party,” L/5405, October 24, 1980, p.3

\textsuperscript{15}Authors’ calculations based on data from Pinheiro et al (1997)

\textsuperscript{16}Authors’s calculation from merged information of Quadros de Pessoal and International Trade statistics from INE.

\textsuperscript{17}We can detect more of an effect during this period if we focus on Portuguese export shares alone, which go from 50% to
Starting in 1981 we have access to data from the Portuguese census (INE) that, to our knowledge, has never been analyzed for this period: international trade by Portuguese firms at the transaction level. This allows us to examine whether the growth in trade is accompanied by a larger number of exporting firms. To examine if net entry is differentially larger for preferential markets we contrast it to the growth in the number of firms exporting to large non-preferential markets such as the U.S. As the dotted line in Figure 2 shows there was positive and rather substantial net entry of exporting firms into the U.S. between 1981 and 1985 but almost none between 1985 and 1992. In contrast to this, the number of Portuguese firms exporting to Germany (dashed line) grew by 65 log points between 1985 and 1992.\textsuperscript{18} Entry into the Spanish market was even more pronounced, over 150 log points in the 1985-1992 period with an apparent upward break in the trend around 1985.

![Portugal's Export Firm Entry Growth 1981-1992](image)

Figure 2

This differential growth towards the preferential markets cannot be fully explained by standard determinants of trade flows. To study this we estimate an aggregate gravity equation for Portuguese exports. To address the potential endogeneity of PTAs (e.g. because they may be more likely between countries that already trade more) we include bilateral fixed effects, which control for any time invariant bilateral trade determinants (e.g. distance, colonial ties, etc.).\textsuperscript{19} We also include year effects to control among other things for Portuguese productivity and price changes (since we use nominal export values). Moreover, we control for bilateral nominal exchange rates, price deflators in the import country and their real GDP. By interacting an EC accession time dummy (=1 for 1986 and subsequent years) with the member country dummies we can then test if Portuguese exports to Spain or EC-10 grew differentially relative to the rest of the world. To avoid confounding the trade policy effects of accession with other possible motives why accession may have been beneficial to Portugal, we control for these fixed effects.\textsuperscript{18}

\textsuperscript{18}Although the data only begins in 1981, one of the main drivers of Portuguese exports to Spain and the EC-10 was the accession of Portugal to the EC in 1986. The rise in the EC share from 1985 to 1993 can be seen in the graph in Figure 2.

\textsuperscript{19}Other important Portuguese preferential markets such as the UK displayed a similar trend to Germany, as did France but the latter exhibiting faster growth post-1985.

\textsuperscript{62} in this 13 year period. But export growth is faster after the 1986 accession and the EC share in Portugal exports goes up to 73% in only 7 years. The strong increase in trade shares with the EC after 1985 was not merely a switch away from exporting to other markets. There is strong evidence of trade creation: total real exports in 1993 were almost twice as high as in 1985 (Pinheiro et al., 1997).

\textsuperscript{18}Other important Portuguese preferential markets such as the UK displayed a similar trend to Germany, as did France but the latter exhibiting faster growth post-1985.

\textsuperscript{19}The use of bilateral fixed effects as a way to address PTA endogeneity is argued by Baier and Bergstrand (2007). In our setting these reduce to importer fixed effects since the only exporter in the data is Portugal.
have increased trade, as discussed below, we end our sample in 1990.

The results in the first column of Table 1 show an increase of 23 log points towards the EC-10 in the post-accession period that cannot be accounted for by the standard determinants. That increase is 5 times larger for Spain. Given our interest in the role of investment and entry we also go beyond the standard gravity estimation and use the (ln) number of firms as a dependent variable. Those results, in the second column of Table 1, show that the number of firms exporting to Spain and the EC-10 was significantly higher than to other countries after accession, even after controlling for standard gravity determinants.\(^{20}\)

We now discuss more specific findings; some of these guide our subsequent modelling assumptions. First, we find that the typical new Portuguese exporter to a given market (defined as a firm exporting to a country at \(t\) but not \(t-1\)) is smaller than a continuing firm (about 6 times smaller for Spain and 20 times for the EC-10). This is one reason why we focus on a model of heterogenous firms with fixed costs of entry. Moreover, this size heterogeneity implies that if accession had increased the number of entrants but not the average sales of continuing firms then we should observe a reduction in average sales per firm as we find for the EC-10 in column 3 of Table 1. This is one reason why in our model we focus on the effect of policy uncertainty on entry rather than on sales of existing firms.\(^{21}\)

One of the central objectives of the paper is to determine the relative importance of applied vs. expected policy on export investments and volumes. Analyzing this issue is particularly interesting if policy changes have large effects on the number of firms and this translates into significant new investment and aggregate exports. As the results in column 2 show the accession lead to a large additional number of firms. Moreover, in the working paper we find evidence that this increase mainly reflects new entrants (as opposed to fewer exits) and is thus likely to have required considerable entry investments.\(^{22}\)

In sum, there is evidence of a strong growth in the number of Portuguese firms and aggregate exports towards the EC following accession that can’t be explained by standard determinants. Given that Portuguese

\(^{20}\)We believe this accession effect is not driven by either of the following alternative explanations: monetary integration and infrastructure investments. It is unlikely that the estimated accession effect is due to exchange rate effects or the prospect of a monetary union for two reasons. First, the sample we use ends in 1990—two years before the signing of the Maastricht Treaty setting out the timetable for the Euro and nine years before the exchange rates were irrevocably fixed. Second, if accession affected exchange rates then these effects are controlled for by including its level (as we do in the baseline results) and its volatility, both of which did not affect the accession coefficients (the estimated trade elasticity to volatility is negative but quantitatively inconsequential). Portugal received substantial EC support for transport infrastructure. But this funding only started in 1989 so it could at most have started to reduce trade costs in 1990 and thus can’t explain the large trade increases before then.

\(^{21}\)Average exports by firm to Spain remained unchanged but this is still consistent with the model since Spanish applied protection fell, thus increasing average sales of continuing firms.

\(^{22}\)It would be simple to see that new entrants also generated considerable export growth if we knew accession had not affected the exports of continuing firms. In that case column 1 of Table 1 would reflect only entrants’ exports but otherwise that is an upper bound on the role of entrants on aggregate exports. In the working paper, we provide evidence that even though entrants are smaller they had a significant impact on aggregate exports. First, the raw data shows that entrants (those that did not export just before the agreement was implemented but did so shortly thereafter) account for a substantial share of export growth between 1986 and 1990 (over 54% for Spain and 73% for the EC). Second, we employ a gravity approach to predict the effect of accession for different subsets of firms and find that about 30% of the predicted increase in exports is accounted for by new firms.
exporters already enjoyed some preferences in Spain and zero tariffs in the EC-10 (on manufacturing) these large impacts of accession seem puzzling. The model in the next section provides a potential explanation – the agreement removed policy uncertainty faced by exporters – and shows how to test it.

4 Theory

We now model the impact of policy uncertainty on firms’ investment and export entry decisions. First, we determine the optimal demand, supply, pricing and profits for each firm conditional on exporting. Second, we examine its decision to invest to enter that market and how it is affected by policy uncertainty.

4.1 Demand, Supply and Pricing

The utility function of the representative consumer, $U = Q^\mu q_0^{1-\mu}$, is identical across countries and defined over a numeraire good, denoted by 0, which is homogenous and freely traded on world markets, and a subutility index, $Q$, defined over differentiated goods with constant expenditure share $\mu$. We consider a CES aggregator over a continuum of differentiated goods, indexed by $v$, from the set $\Omega$ of available goods. For simplicity of exposition we focus on a symmetric structure with common elasticity of substitution, $\sigma = 1/(1-\rho) > 1$.\textsuperscript{23}

$$Q = \left[ \int_{v \in \Omega} q_v^\rho dv \right]^{1/\rho} \tag{1}$$

Each country $i$ has aggregate income equal to $Y_i$ and consumers in $i$ face prices $p_{iv}$ so their optimal demand for each $v$, $q_{iv}$, is standard and given by

$$q_{iv} = \frac{\mu Y_i}{P_i} \left( \frac{p_{iv}}{P_i} \right)^{-\sigma} \tag{2}$$

where $P_i = \left[ \int_{v \in \Omega} (p_{iv})^{1-\sigma} dv \right]^{1/(1-\sigma)}$ is the CES price index. The consumer price, $p_{iv}$, includes any existing trade costs. We focus on ad valorem import tariffs and note that they are generally not firm specific but rather product or industry specific, and denote the tariff factor that $i$ sets on the group of products $V$ by $\tau_{iV} \geq 1$, so free trade is represented by $\tau_{iV} = 1$. Therefore, producers of any $v \in V$ receive $p_{iv}/\tau_{iV}$ where $\tau_{iV}$ will be unity if the good is produced and sold in $i$ (i.e. we assume no domestic sales taxes).

We first determine the optimal price and operating profits for each monopolistically competitive firm conditional on supplying a market. The marginal cost parameter, $c_v$, is constant and heterogenous across firms. We can interpret $1/c_v$ as either labor productivity or the productivity of an input bundle, so given a

\textsuperscript{23}We can show that most theoretical and empirical results can be easily extended to a multi-sector structure that allows for different elasticities of substitution within each sector and across sectors. For example, $Q$ could instead be a Cobb-Douglas aggregator across $H$ sectors, each representing a distinct CES aggregate, as we consider in the empirical robustness section.
wage, $w_e$, in the exporting country $e$, the firms’ marginal cost is $w_e c_v$. Since our analysis focuses on firms in a particular exporting country we drop the “$e$” subscript.

In a deterministic setting the firm simply chooses prices (or quantities) to maximize operating profits in each period, $\pi_{iv} = (p_{iv}/\tau_{iv} - w e c_v) q_{iv}$, leading to the standard mark-up rule over cost, $p_v = w c_v / \rho$, and the consumer faces this price augmented by any import tariff in that industry.

\[ p_{iv} = (w c_v / \rho) \tau_{iv} \]  

(3)

Under uncertainty we need to be clear about the timing of the firm’s production and pricing decisions. We allow the firm to make all its production and pricing decisions after the policy and thus demand are known, so only its investment decision will be made under uncertainty. This production flexibility has two basic implications. First, the pricing decision is exactly the same as above. Second, we are making the firms less averse to policy risk, e.g. to variability in tariffs, after they enter the market since they can optimally adjust to shocks and their operating profits are convex in the policy. To clearly see the last point we substitute the optimal price into demand to calculate revenue received by the producer

\[ p_{iv} q_{iv} / \tau_{iv} = (\tau_{iv})^{-\sigma} c_v^{1-\sigma} \mu Y_i (w / P_i \rho)^{1-\sigma} \]  

(4)

We can see that, all else equal, the export values for a firm that has entered a market are directly affected only by the current applied policy—there is no direct effect of uncertainty. This occurs because production occurs after the uncertainty is resolved. Therefore the direct impact of uncertainty on individual firms in our model will arise via the investment/entry margin rather than the intensive margin.\footnote{Uncertainty could affect the intensive margin via the price index if the resulting change in the number of exporting firms is sufficiently large. In the empirical application we consider a small exporter so this effect is negligible (and addressed econometrically), therefore we also abstract from this indirect effect in the model.}

Substituting revenues into the operating profit expression and simplifying we obtain

\[ \pi_{iv} = (\tau_{iv})^{-\sigma} c_v^{1-\sigma} A_i \]  

(5)

where $A_i \equiv (1 - \rho) \mu Y_i (w / P_i \rho)^{1-\sigma}$, summarizes aggregate conditions, e.g. domestic wage, $w$, and foreign demand.\footnote{We are ignoring exchange rates but these can be incorporated and would simply entail redefining $A$ to include a multiplicative effect $\varepsilon_{ex}^\sigma$. Since this variable does not vary across product it will not have a first order effect in our empirical results and thus we do not include it here. Future work may consider interactions in uncertainty processes between tariffs and exchange rates and try to estimate those second order effects.} In general, we can allow for stochastic innovations to $A_i$ that are independent of innovations to tariffs. We control for such dynamics in the empirical section, but we do not model them here.
4.2 Firm Value, Investment and Export Entry Setup

We focus on how foreign TPU affects the decision to enter export markets. Therefore, we assume there are no fixed costs to enter or produce in the domestic market (as in Helpman et al., 2008). As such, for each industry \( V \) there exists a mass of firms in the exporting country equal to \( n_V \); all of which produce for their home market but only a subset of them, to be determined, will export to any given market.\(^{26}\) As we noted above, these firms are heterogeneous only in terms of their productivity, which has a cumulative distribution function \( G_V(1/c) \) that is strictly increasing.

To serve a foreign market a firm must first make a fixed cost investment that is sunk. As noted in section 2 there is evidence that these investments can be large when it comes to serving foreign markets. To understand the basic effect of these costs consider first a deterministic environment where profits are constant. A firm considering entering a new export market invests and enters if the present discounted value of its profits exceeds the investment cost of entry \( K_{iV} \),

\[
\frac{\tau_{iV}}{1 - \beta} \geq K_{iV} \tag{6}
\]

We allow this investment to be destination market and possibly industry-specific in that firms producing \( v \in V \) all face the same cost, but this cost may differ for another industry. In a purely deterministic environment, the discount factor \( \beta \) reflects only the “true” discount rate \( R \), but it is straightforward to show that the expression above also applies when operating profits are constant but there is an exogenous “exit” probability, \( \delta \), in which case \( \beta = (1 - \delta)/(1 + R) \). This defines a zero profit cutoff for unit costs as a function of the tariff, \( c^D(\tau_{iV}) \) for firms considering exporting product \( v \in V \) to country \( i \)

\[
c^D(\tau_{iV}) = \left[ \frac{A_i}{K_{iV} (1 - \beta)} \right]^{1/(\sigma - 1)} \tag{7}
\]

Clearly tariff reductions induce entry since they increase demand and thus allow the fixed cost investment to be covered even by firms that are less productive. The elasticity of the cutoff to a once-and-for-all change in \( \tau \) is \( d \ln c^D / d \ln \tau = -\frac{\sigma}{\sigma - 1} \). It is also clear that the cutoff is common to all firms that face a similar tariff and fixed cost, so for \( v \in V \) all firms with \( c_v < c^D(\tau_{iV}) \) enter. The marginal entrant is the least productive and thus smallest, which is consistent with the finding that new exporters are smaller than incumbents.\(^{27}\)

As we discuss in section 3 there are several potential sources of TPU that exporters face. Moreover, potential exporters can optimally choose not just whether to invest but when to do so. Therefore ongoing policy uncertainty generates an option value of waiting, which can have important effects for investment.

\(^{26}\)This simplification does not affect our basic empirical results since, as we will see, our identification approach controls for industry-time effects and thus accounts for domestic entry into any particular industry.

\(^{27}\)The cutoff elasticity with respect to tariffs exceeds unity because the tariff is not paid by the exporter, so profit increases more rapidly in the tariff than in the cost, as seen in (5).
The analysis below applies for each firm in an export country $e$ that is considering the decision to invest to enter in market $i$ and sell some good $v$ so we drop these subscripts for simplicity.

Formally, the firm’s decision to enter an export market is modeled as an optimal stopping problem.\textsuperscript{28} Firms can be divided into exporters and non-exporters. The value of being an exporter is denoted by $\Pi_e$ and such a firm exits only when hit by a “death” shock since it has no other fixed costs after it enters.\textsuperscript{29} Non-exporters enter a foreign market only when the value of exporting net of the sunk entry costs, $K$, exceeds the option value of waiting, $\Pi_w$. The value of this option in our model arises because in the following period conditions may improve and so the firm may be better off waiting until that occurs and then entering. The investment and entry decision rule for each firm, identified by its unit cost requirement $c$, can be defined as a function of a threshold tariff $\bar{\tau}$ that makes it indifferent between entry and waiting.

$$
\Pi_e(\bar{\tau}, c) - K = \Pi_w(\bar{\tau}, c)
$$

(8)

So, any tariff $\tau_i \leq \bar{\tau}(c)$ triggers entry by any firm with cost $c$. To determine this export cutoff and the impact of policy uncertainty we next describe the policy process and then define these value functions.

### 4.3 Trade Policy Regimes

There is no clear typical empirical (or theoretical) characterization of the stochastic path of trade policy. Our objective here is to provide such a characterization that is both tractable and rich enough to span alternative trade policy regimes. To maintain tractability we choose a specific stochastic process for the foreign policy and assume that domestic exporting firms take it as given. But we argue that the process is general enough to capture alternative determinants of trade policy (e.g. economic or political) and span trade policy regimes with high uncertainty or low uncertainty for example.\textsuperscript{30}

Each period there is some probability $\gamma$ that a policy shock occurs (e.g. a new agreement, a new government, a macroeconomic shock, etc.).\textsuperscript{31} If the shock occurs then a policy maker reconsider the current policy and sets a new one denoted $\tau'$, otherwise the policy is unchanged. Firms form expectations over future policies based on their belief of $\gamma$ and a probability measure of tariff outcomes, $H(\tau')$, with support $\tau' \in [\tau^L, \tau^H]$, where $\tau^H$ is the worst case scenario. We assume that both $\gamma$ and $H$ are similar

\textsuperscript{28}Formally, our approach is similar to Baldwin and Krugman (1989) with some key differences. First, we focus on trade policy, which as we describe below has a different stochastic process and is more permanent than exchange rates. Second, they focus on homogenous firms whereas we incorporate firm heterogeneity, which allows us to analyze the effect of policy uncertainty both between and within industries that already have some export participation.\textsuperscript{29}While the assumption of no per period fixed costs of exporting may seem extreme, Das et al. (2007) find these per period fixed costs are negligible, on average, across all sectors analyzed in their structural model of Colombian exporters.\textsuperscript{30}An interesting and important question is under what conditions trade agreements are motivated by an uncertainty motive and what the relative value is of reducing the mean vs. higher moments of policy. Limão and Maggi (2012) address this question in a setting where the trade policy is optimally chosen by governments.\textsuperscript{31}Similar arrival processes for policy shocks are used by Rodrik (1991) and Hassett and Metcalf (1999) but in a continuous time setting.
across firms within a given industry $V$ so that entry decisions in each industry will depend only on firms’ productivity relative to a cutoff rather than informational asymmetries.

Therefore, at a given point in time, the stochastic path of the policy is characterized by the current tariff, $\tau_t$, and what we call the “policy regime”, which is described by the pair $(\gamma, H)$. Firms believe that the regime is time-invariant and so our results below apply to any given exogenous $\gamma$ and $H$. We will then compare equilibrium firm behavior across different regimes. One advantage of this characterization is that it can encompass alternative settings in the form of different regimes. When $\gamma \in (0, 1)$ the model captures a setting with imperfectly anticipated shocks of uncertain magnitude. Alternatively, if $\gamma = 1$ and $H$ is degenerate at some value of $\tau'$ then the model captures a perfectly anticipated reform where the government credibly committed to $\tau'$ in the following period. When $\gamma = 0$ the government has committed to the current tariff, $\tau_t$. The model can also capture staged tariff reductions that are typical in agreements, provided that their implementation is not certain.

We will not examine all possible alternative regimes but rather focus on the ones that seem most relevant for the analysis of trade agreements. In particular, the following section considers two experiments. First, we contrast reductions in the current tariff within a credible policy regime (where reduction is expected to be permanent, $\gamma = 0$) vs. reductions within a regime where the policy is expected to be reversed ($\gamma > 0$). Second, since one of the stated goals of trade agreements is to reduce TPU, we will examine firm behavior under a regime with TPU ($\gamma > 0$) and one without ($\gamma = 0$), holding the current policy value fixed. We note that the changes in the policy distribution that are entailed by the latter experiment may generate changes in both the mean and higher order moments of $\tau$, as is the case in most trade agreements. For didactic purposes we will point out how to isolate the effects due to the mean vs. other moments when possible.32

4.4 Value of Credible vs. “Incredible” Policies

The prospective exporter’s decision to enter or wait given the current trade policy $\tau_t$ depends on a set of value functions, which we now derive. We then solve for the equilibrium value of exporting to examine the value of credible vs. “incredible” (i.e. non-credible) policy changes. Since the value functions apply for each firm with cost subscript $c_v$, we omit this to simplify the notation.

The expected value of starting to export at time $t$ conditional on observing $\tau_t$ is

\[ \text{Expected value} = \sum_{t=0}^{\infty} \frac{1}{(1+E)^t} \tau_t + \frac{1}{(1-E)^t} E(\tau') \]

To do so note that the long-run mean of the policy is in the limit solely determined by the mean of the distribution $H(\tau')$, denoted $E(\tau')$, as are all other moments. However, since $\tau_t$ has persistence whenever $\gamma < 1$, this parameter will generally affect the policy distribution. If we want to examine the impact of a change in regime that maintains the policy mean unchanged we can do so by considering changes in $\gamma$ starting at the long-run mean. To see this, note that the expected value of the policy at any future period $n$ is $E_t(\tau_{t+n}|\tau_t) = (1-\gamma)^n \tau_t + (1-(1-\gamma)^n) E(\tau')$. So $E_t(\tau_{t+n}|\tau_t) = E(\tau')$ if $\tau_t = E(\tau')$. It is simple to see that in this case decreasing $\gamma$ also lowers higher order moments such as the variance, e.g. $\text{Var}_t(\tau_{t+1}|\tau_t = E(\tau')) = \gamma \text{Var}(\tau')$. 

32 To do so note that the long-run mean of the policy is in the limit solely determined by the mean of the distribution $H(\tau')$, denoted $E(\tau')$, as are all other moments. However, since $\tau_t$ has persistence whenever $\gamma < 1$, this parameter will generally affect the policy distribution. If we want to examine the impact of a change in regime that maintains the policy mean unchanged we can do so by considering changes in $\gamma$ starting at the long-run mean. To see this, note that the expected value of the policy at any future period $n$ is $E_t(\tau_{t+n}|\tau_t) = (1-\gamma)^n \tau_t + (1-(1-\gamma)^n) E(\tau')$. So $E_t(\tau_{t+n}|\tau_t) = E(\tau')$ if $\tau_t = E(\tau')$. It is simple to see that in this case decreasing $\gamma$ also lowers higher order moments such as the variance, e.g. $\text{Var}_t(\tau_{t+1}|\tau_t = E(\tau')) = \gamma \text{Var}(\tau')$. 

15
\[ \Pi_e(\tau_t) = \pi(\tau_t) + \beta \left[ \frac{1 - \gamma}{1 - \beta(1 - \gamma)} \Pi_e(\tau_t) + \frac{\gamma}{1 - \beta} \mathbb{E}\Pi_e(\tau') \right]. \] (9)

which includes current operating profits upon entering and the discounted future value. With probability \( 1 - \gamma \), there is no policy shock and the firm value next period is still \( \Pi_e(\tau_t) \). With probability \( \gamma \), a policy shock arrives changing the policy to some value, \( \tau' \), and so the third term is the \textit{ex-ante} expected value of exporting following a shock, which is given by

\[ \mathbb{E}\Pi_e(\tau') = \mathbb{E}\pi(\tau') + \beta \mathbb{E}\Pi_e(\tau') \] (10)

Note that \( \mathbb{E}\Pi_e(\tau') = \mathbb{E}\pi(\tau')/(1 - \beta) \), which is time invariant and simplifies the analysis.\(^{33}\) Note however that the conditional mean of the tariff and expected value of exporting, \( \Pi_e(\tau_t) \), still vary over time since they depend on the current tariff.

We then compute the expected value of waiting as

\[ \Pi_w = 0 + \beta \left[ \frac{1 - \gamma}{1 - \beta(1 - \gamma)} \Pi_w + \frac{\gamma}{1 - \beta} \mathbb{E}\Pi_e(\tau') \right] \] (11)

A non-exporter at time \( t \) receives zero profits from that activity today. In the following period the continuation value is still \( \Pi_w \) if no policy shock arrives (the first term) or if the shock still entails a tariff above the trigger (the second term). If a policy shock arrives, it will be below \( \bar{\tau} \) with probability \( H(\bar{\tau}) \) and the firm will find it optimal to pay \( K \) and transition to the exporting state. The conditional expected value of exporting if \( \tau \leq \bar{\tau} \) in the last term is given by

\[ \mathbb{E}\Pi_e(\tau' \mid \tau' \leq \bar{\tau}) = \mathbb{E}\pi(\tau' \mid \tau' \leq \bar{\tau}) + \beta \left[ (1 - \gamma) \mathbb{E}\Pi_e(\tau' \mid \tau' \leq \bar{\tau}) + \gamma \mathbb{E}\Pi_e(\tau') \right] \] (12)

This equation is structurally the same as (9), but it is time invariant. The key difference is that profit flows are evaluated \textit{ex-ante} at the conditional expected value of exporting for a firm that enters following a more favorable policy shock.

The set of four equations (9), (10), (11) and (12) is linear in four unknowns: \( \Pi_e(\tau_t) \), \( \mathbb{E}\Pi_e(\tau') \), \( \Pi_w \) and \( \mathbb{E}\Pi_e(\tau' \mid \tau' \leq \bar{\tau}) \). Thus we can solve explicitly for the value exporting and waiting at the current tariff for a firm that has a threshold tariff \( \bar{\tau}(c) \). We still omit \( c \) from \( \pi(.) \) for notational simplicity.\(^{34}\)

\[ \Pi_e(\tau_t, c) = \frac{\pi(\tau_t)}{1 - \beta(1 - \gamma)} + \beta \gamma \frac{\mathbb{E}\pi(\tau')}{1 - \beta(1 - \gamma)} \] (13)

\[ \Pi_w(c) = \frac{\beta \gamma H(\bar{\tau}(c))}{1 - \beta(1 - \gamma H(\bar{\tau}))} \left\{ \frac{\mathbb{E}\pi(\tau' \mid \tau' \leq \bar{\tau}(c))}{1 - \beta(1 - \gamma)} + \beta \gamma \frac{\mathbb{E}\pi(\tau')}{1 - \beta(1 - \gamma)} - K \right\} \text{ if } \tau_t > \bar{\tau}(c) \] (14)

\(^{33}\) The reason is simple: the distribution of future tariffs, \( H(\tau') \), is time invariant so even if there is a new tariff at \( t + 1 \) this provides no additional information at time \( t \) about future tariffs.

\(^{34}\) The expression for \( \mathbb{E}\Pi_e(\tau' \mid \tau' \leq \bar{\tau}) \) is given in the appendix.
The interpretation of $\Pi_e(\tau_t,c)$ is straightforward: after investment, the value of exporting conditional on $\tau_t$ equals the discounted value of expected profits. If $\gamma$ were zero this would be the deterministic value $\pi(\tau_t)/(1 - \beta)$. But with a probability $\gamma > 0$ the policy will change and the ensuing per period expected profits are $E\pi(\bar{\tau})$. If the current tariff is above a given firm’s trigger, $\tau_t > \bar{\tau}(c)$, then it does not export today and its value, $\Pi_w(c)$, would be zero if the tariff remained above that trigger, but with some probability $\gamma H(\bar{\tau})$ the tariff will fall below the trigger and so the firm will incur $K$ and export. The expected value of exporting is then captured by the remaining terms in brackets, which are similar to those in $\Pi_e$ except we must use $E\pi(\tau' | \tau' \leq \bar{\tau})$ instead of $\pi(\tau_t)$.

We can now ask what is the value of being an exporter under alternative policy settings.

First, a lower current tariff increases the expected value of exporting at any $\gamma$, as is clear from (13). We would like to ask if this increase is higher if the tariff reduction is credible, that is if $\gamma = 0$ so the exporters expect the policy to remain unchanged or if it is “incredible”, i.e. expected to be revised with probability $\gamma > 0$. The first basic point is that the credible agreement is more valuable for the exporter since the tariff reduction is permanent, that is

$$\frac{\partial}{\partial \tau_t} \Pi_c(\tau_t, c, \gamma = 0) = -\frac{\partial}{\partial \tau_t} \frac{\pi(\tau_t)}{1 - \beta} > -\frac{\partial}{\partial \tau_t} \frac{\pi(\tau_t)}{1 - \beta(1 - \gamma)} = -\frac{\partial}{\partial \tau_t} \Pi_c(\tau_t, c, \gamma > 0)$$

(15)

This complementarity between reductions in current tariffs and uncertainty suggests one reason why some PTAs may not succeed in expanding trade by much: they reduce only applied tariffs but not uncertainty. In the empirical section we will quantify this effect and show its potential importance.\[35\]

The second point, which is related to the first, is that even if the initial agreement is “incredible” so $\gamma_{pre} > 0$, and it has been in place for some time there may still be considerable value to making it credible, i.e. of having $\gamma_{post} = 0$. In these cases the agreement need not change current policies at all but simply make them certain. If the current tariff in the initially incredible agreement is sufficiently low, e.g. if $\tau_t = 1$, then the reduction of uncertainty increases the value of exporting as shown by the expression below.\[36\]

$$\Pi_c(\tau_t = 1, c, \gamma_{post} = 0) - \Pi_c(\tau_t = 1, c, \gamma_{pre} > 0) = \frac{\pi(1) - E\pi(\tau')}{1 - \beta} \frac{\beta \gamma_{pre}}{1 - \beta(1 - \gamma_{pre})} > 0$$

(16)

This value of moving from an uncertain free trade regime to a certain one provides one motive why the recipients of unilateral preferential tariffs spend considerable resources in attempting to make them permanent through formal PTAs. Examples include GSP preferences provided by most developed countries.

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\[35\] Note that this result holds even if we evaluate the marginal tariff reduction at the long-run mean, i.e. even in a case when the reduction in $\gamma$ by itself preserves the policy mean but eliminates its variance.

\[36\] The positive effect obtains if free trade profits are higher than average profits, which is guaranteed if there are no import subsidies. More generally, the condition holds for any current tariff that is sufficiently low, i.e. $\tau_t^{*\gamma} > E(\tau^{*\gamma})$. Note that if $\tau_t$ is at its long run mean then lowering $\gamma$ reduces the value of exporting due to the convexity of the profit function in $\tau$. Despite this convexity, in the following section we show that a reduction in $\gamma$ increases firm entry for any $\tau_t$ including cases where it is at the mean.
as well as European and U.S. special preferences to developing countries. Since the EC-10 and Spain’s preferences toward Portugal prior to 1986 were uncertain, this change in value captures one of the important channels by which entry into the EC benefited Portuguese exporters. To determine if uncertainty reduction was an important factor we now examine the predictions of the model for investment and entry into foreign markets, which we will then estimate.

4.5 Policy Impacts on Investment and Entry

Using (14), (13) and the expression in (8) we can determine the threshold tariff that would leave any given firm with costs \( c \) indifferent between starting to export or waiting. From an empirical perspective it will be more useful to recast this in a different way and ask what firms will invest and enter at any given current tariff. We have assumed that firms can be ranked by their productivity (the inverse of unit costs \( 1/c \)) according to a strictly increasing CDF. Therefore, for any current tariff \( \tau_t \), we can determine a cutoff cost \( c_{t}^{U} \) that satisfies \( \tilde{\tau}(c_{t}^{U}) = \tau_t \).

A firm with costs equal to \( c_{t}^{U} \) is indifferent between investing today and starting to export or waiting. As will be clear that will also be true this period for all firms with lower costs if they had not yet started to export. The model has a closed form expression for \( c_{t}^{U} \) in terms of the current tariff. First, we set the difference between \( \pi \) and \( w \) equal to entry costs and by simplifying the terms we obtain

\[
K = \frac{\pi(\tau_t, c_{t}^{U})}{1 - \beta(1 - \gamma)} + \frac{\beta \gamma}{1 - \beta} \frac{\mathbb{E}(\tau_t, c_{t}^{U})}{1 - \beta(1 - \gamma)} + \frac{\beta \gamma}{1 - \beta} \frac{H(\tau_t)[\pi(\tau_t, c_{t}^{U}) - \mathbb{E}(\tau_t)| \tau \leq \tau_t, c_{t}^{U}]}{1 - \beta(1 - \gamma)}
\] (17)

Entry requires that the fixed cost does not exceed the sum of the three terms on the RHS, each of which has an intuitive explanation for the marginal entrant. The first term is the discounted flow of profits at the current tariff. We note that in a deterministic model, the firm would discount by \( \beta \) rather than \( \beta(1 - \gamma) \) and the next two terms would disappear. The second term is the present value of expected profits, ex-ante, following a shock. The third term is non-positive: it is the present value of the expected loss of entering today, given that the next policy change is at or below the tariff entry trigger.

We combine the expression in (17) with the operating profit function in (5) to solve directly for \( c_{t}^{U} \) as a function of the current tariff. The full expression is in the appendix, after some simplification we obtain

\[
c_{t}^{U} = \frac{\left[1 - \beta + \beta \gamma \omega(\tau_t)\right]^{\frac{1}{1 - \gamma}} - \left[\frac{A}{K(1 - \beta)}\right]^{\frac{1}{1 - \gamma}}}{\left[1 - \beta + \beta \gamma\right]^{\frac{1}{1 - \gamma}}}
\] (18)

Note that the deterministic model cutoff, \( c_{t}^{D} \), is a special case, which obtains here if \( \gamma = 0 \). Otherwise, the cutoff condition also depends on the uncertainty term, denoted by \( U_t \), which captures the frequency of policy shock arrivals and expectations about future tariffs. We can show that uncertainty in this model
generates a lower cutoff, requiring firms to be more efficient to enter, than a deterministic tariff at the level $\tau_t$. To do so note that we must have $U_t \leq 1$, which requires that $\omega(\tau_t) \leq 1$, as is clear from the equation above. In the appendix we derive this term as

$$\omega(\tau_t) - 1 = - (1 - H(\tau_t))^{\frac{\tau_t - \sigma}{\tau_t}} - \frac{E(\tau^{-\sigma} | \tau \geq \tau_t)}{\tau_t^{\sigma}} \leq 0$$

This is the proportional reduction in operating profits expected to occur if we start at the trigger tariff $\tau_t$ and a policy shock occurs that (with probability $1 - H(\tau_t)$) worsens conditions by generating a tariff above that trigger level. This inequality is always strict except when the trigger is exactly at the maximum of the tariff distribution in which case the cutoff is the same as the deterministic one evaluated at that maximum tariff. Note also that even though the policy shock can trigger a lower or higher tariff, it is only the latter possibility that affects the decision.\(^{37}\)

In sum, the model predicts that policy uncertainty increases the hurdle for firms to invest and enter into new markets relative to the deterministic case. This occurs despite the convexity of operating profits in tariffs. The cutoff equals the deterministic level at $\gamma = 0$ and any increases in $\gamma$ lower this cutoff under the real option approach at any initial tariff below the maximum. This includes cases when $\tau_t$ is at its long run mean, so that any increase in $\gamma$ represents a mean preserving change in the policy distribution.\(^{38}\)

The closed form solution for the cutoff provides other useful insights that we explore in the empirical work. First, we can derive an uncertainty entry cost premium, $s$, which we define as the minimum entry subsidy rate required for the marginal firm under deterministic policy to enter under uncertainty. Formally, this is given by the subsidy rate $s$ on fixed costs such that $c^{UL}_t(\tau, \gamma > 0, (1 - s) K) = c^{DL}_t(\tau, \gamma = 0, K)$. Using \(^{18}\) we obtain $s_t = 1 - U_t^{\sigma - 1}$. Note that if the same rate, $s$, is offered to all firms that had not exported under uncertainty then we obtain the same distribution as under certainty or under a case when tariffs are credibly expected not to rise so $\omega(\tau_t) = 1$. Since $s$ is a summary statistic for the impact of uncertainty on entry that requires no firm specific information on productivity we will provide an estimate for it.

We also use \(^{18}\) to derive the estimation equation. As an intermediate step it is useful to record the semi-elasticity of the cutoff with respect to $\gamma$

$$\frac{d \ln c^{UL}_t}{d \gamma} \bigg|_{\tau_t} = \frac{\beta}{1 - \beta(1 - \gamma)} \frac{1 - \beta}{1 - \beta(1 - \gamma \omega(\tau_t))} \frac{\omega(\tau_t) - 1}{\sigma - 1} \leq 0$$

which is negative given $\omega(\tau_t) \leq 1$.

\(^{37}\)This is an example of the “bad news” principle first identified by Bernanke (1983) and is due to the fact that good news has a symmetric effect on payoffs whether the firm is already in or not (since it can enter after the shock) whereas bad news will only affect those that are already in.

\(^{38}\)We can also consider the impacts of increased uncertainty on entry in terms of mean-preserving changes in the long-run distribution, $H$. More specifically, there are mean preserving spreads of $H$ that reduce $\omega$ and thus the entry cutoff. To see it most clearly consider for example, moving some of the mass around $\tau_t$ above it and some below it in a way that leaves the mean $E(\tau)$ unchanged. This lowers $1 - H(\tau_t)$ for given $E(\tau^{-\sigma} | \tau \geq \tau_t)$, where the latter can be kept approximately unchanged if the extra mass at the upper tail is appropriately distributed.
Consider now the impact of applied tariffs on the cutoff. In the absence of uncertainty that elasticity is simply \(-\frac{\gamma}{\sigma-1}\), as shown for the deterministic case. It is simple to see that is also the limit value for \(\frac{d\ln c_U^t}{d\ln \tau_t} \bigg|_{\gamma \to 0}\). Since most work, theoretical and empirical ignores the uncertainty component we will take that as our null hypothesis, \(\gamma = 0\), and test if this uncertainty parameter has any first order effects. To do so we employ a first order, log linear Taylor approximation to \(c_U^t (\gamma_t, \tau_t)\) around \(\gamma = 0\) and the original applied policy values \((\tau_0)\). We provide the derivation in the appendix. The general form for any period \(t\) is

\[
\ln(c_U^t) \bigg|_{\tau_t=\tau_0, \gamma=0} = \frac{\beta}{1-\beta} \frac{\omega(\tau_0)-1}{\sigma-1} - \frac{\sigma}{\sigma-1} \ln r_t + \frac{1}{\sigma-1} \ln \frac{A_t}{K_t(1-\beta)} + r_t
\]

where \(r_t\) captures second and higher order terms of the approximation. This shows that increasing uncertainty has a first order effect and reduces the cutoff even if we are initially at \(\gamma = 0\) (i.e. in the deterministic case). This is true for any trigger value of the tariff and strictly so if that trigger is below the maximum tariff. It also holds for cases when the current applied tariffs are zero, which stresses the point that even firms that currently, and possibly for some time, have faced zero tariffs may not enter if there is some chance that policy will be reversed in the future. We also see that increasing applied tariffs around \(\gamma = 0\) changes the cutoff by \(-\frac{\gamma}{\sigma-1}\), the deterministic elasticity.\(^{39}\)

In sum, we have shown that one potential benefit of an agreement with a country that already applies low policy barriers is to remove uncertainty about those policies. We have also shown that such an agreement will generate entry and identified one potential way to measure the degree of that uncertainty, \(\omega(\tau_0)-1\). The final point that we note is that even though the real option approach we employ is somewhat more complicated than the standard net present value (NPV) calculation (which only allows firms to make a once and for all entry decision) it has two distinct advantages. First, the real option approach clearly captures the behavior of firm investment more closely since they have the option to wait and time their investments. Second, some qualitative and quantitative results are different under the two approaches, as we show in the working paper. Most notably, increases in \(\gamma\) at given high tariffs can raise the value of exporting (see footnote \(^{36}\)) and this would increase entry under the NPV approach but lowers it under the real option approach.

\(^{39}\)While the applied tariff effect around no uncertainty is similar to the deterministic case, it will be attenuated by the presence of uncertainty. We provide the exact expression in the appendix, but the intuition should be clear from equation \(^{15}\) in the last section: a reduction in current tariffs will not lead to as much entry if it may be reversed in the future. This implies that in the presence of considerable uncertainty, e.g. prior to an agreement, the estimated coefficient on the applied tariff in the equation above will be biased towards zero. In the empirical section we estimate this tariff attenuation effect and the complementarity between applied tariffs and uncertainty reduction on entry decisions.
5 Evidence

We now use the theoretical framework to address two questions. What are the first order effects of current policy and uncertainty on firm entry into exporting? Do trade agreements reduce uncertainty? We will address these in the context of Portugal’s accession to the EC in 1986, which, as we argued in section 3.2, secured pre-existing preferences in some goods and lowered tariffs faced by Portuguese exporters in others. We first describe how to compute a theory-based measure of uncertainty related to the lost profit term, \( \omega(\tau) \); and how to relate the unobserved cost cutoff to observables, namely firm export decisions. We then describe the data and implementation, the baseline estimates for entry, and their quantification. The baseline estimates follow the model closely and so are parsimonious, so we also provide some robustness tests. The final section goes beyond entry and examines the implications for export values.

5.1 Empirical Approach

5.1.1 Measuring policy uncertainty

To construct \( \omega(\tau_t) \) we require a specific tariff probability distribution \( H \). We employ a discrete distribution that is tractable and covers the main cases that are present in our data. After a policy shock exporters consider three potential tariff values, low, medium or high.

\[
\tau_l = \tau_{ts}, \quad \Pr(\tau_{ts}) = p_s \quad \text{for each } s \in \{l, m, h\}
\]

We take \( \tau_l = 1 \) so it captures the industrial goods that Portugal exported to the EC free of ad valorem tariffs both after the accession and before it. The high tariff, \( \tau_h \), captures the EC rate that is applied to GATT/WTO members that did not receive any preferences. This may somewhat underestimate the degree of uncertainty in these goods but seems a reasonable approximation of what the Portuguese exporters may have feared as the worst case scenario. The medium tariff, \( \tau_m \), represents an intermediate level; it captures the possibility of transitional preferences that were mostly a feature of Spanish policy towards Portugal prior to the agreement. It is important to stress that the latter were transitional and could not remain for long since they were not GATT legal, as we discuss in section 3.2. Therefore although we did observe "medium" tariffs during the mid 80's, the Portuguese exporters likely placed a probability close to zero \( (p_m \approx 0) \) that these would remain since either an agreement would be signed and tariffs would transition to the low state or negotiations would fail and no preferences would remain.

In the Supplementary Appendix we show that if the tariff was initially high or medium then we can use (19) to derive

\[
\omega(\tau_{liV}) = 1 = -p_{hiV} \left[ 1 - (\tau_{liV}/\tau_{hiV})^\gamma \right]
\]

(21)
The term in square brackets is the percentage profit reduction conditional on a shock that moves tariffs from $\tau_{iIV}$ to the worst case scenario, $\tau_{hiIV}$, which happens with probability $p_{hiIV}$. The same term applies to cases when the initial tariff is low and $p_{miIV}$ is negligible.\(^\text{40}\) Alternatively, if we consider only a two state world, $s = h, l$, the expression above applies to tariffs with either history. Note that the tariffs are different across markets and industries. Moreover, the applied tariff may change over time but the worst case tariff, $\tau_{hiIV}$, is constant in the data over the short period of time we analyze. With information on these tariffs and an elasticity assumption (which we describe below) we can construct industry and time varying measures of this profit reduction measure.

We cannot observe the probabilities that exporters place on a worst case scenario, $\gamma_i p_{hiIV}$. However, we can estimate this as part of the entry equation, provided we assume it is roughly common across industries and countries, i.e. we can estimate $\gamma p_h$. The similarity across countries in our application is more reasonable if we restrict our attention to $i =$Spain, EC-10, which are the markets that Portugal secured access to. Our goal is then to test if there was a regime change, i.e. if $\gamma p_h$ fell after accession.

### 5.1.2 Unobserved cutoffs and firm export entry

While we do not directly observe whether firms have costs above or below the cutoff we do observe the number of firms and their export status at the country-product level. Our model focuses on variation in policies over time and across products and the cutoffs we derived are common across some sets of firms. In particular, producers of a variety $v$ exporting to $i$ will all face a tariff that does not discriminate by firms, but rather by product or industry classification, denoted $V$, and so those producers also face the same critical cutoff $c_{t_iV}^U$. Therefore we examine the fraction of exporters in an “industry” $V$ to each country pair. This approach has another advantage: it does not require us to be able to follow specific firms over time, which is important since we are unable to do this between 1985 and 1986.

The number of firms (or varieties if the firm exports more than one product) exporting in $V$ to market $i$ is at least equal to the mass of domestic producers in $V$, $n_{tIV}$, times the fraction of those firms with costs below the cutoff, $G(c_{t_iV}^U)$. Therefore the relationship between the observed number of firms, $n_{tIV}$, and these theoretical measures is

$$\ln n_{tIV} = \ln G(c_{t_iV}^U) + \ln n_{tIV} + u_{tIV} \quad (22)$$

where $u_{tIV}$ is a random disturbance term due to measurement error. The term can also capture the potential for “legacy” firms: those that survive until period $t$ even though they have costs above $c_{t_iV}^U$. This cannot occur if current conditions are better than in the past, so a sufficient condition to rule out legacy firms is

\(^{40}\) In the Supplementary Appendix we show that if $p_m$ were large then there would be an additional term where the high probability and tariff are replaced by the medium ones. We ignore this extra term since, (a) there is no obvious empirical counterpart for the medium probability term, (b) it would be highly correlated with the high value, and (c) we have good reasons to believe $p_m \approx 0$ given these were transitional tariffs that could not be sustained under GATT rules.
that $c_{tV}^{U} \geq \max\{c_{tV}^{U} \forall T < t\}$. In this case, $G(c_{tV}^{U})$ exactly captures the fraction of exporters to this market. In the case of Portugal in the mid-80’s exporting conditions were improving, as is clear from the observed high entry rates into EC countries. Therefore, we do not think legacy firms pose a significant issue in this particular setting. Nonetheless, our working paper we argue that our approach and results are robust to certain instances where legacy firms are present.

If the productivity follows a Pareto distribution with minimum productivity $1/c_V$ then $G(.) = \left(\frac{c_{tV}^{U}}{c_V}\right)^k$. So entry has a constant elasticity with respect to the cutoff, the shape parameter $k$, which we assume is similar across industries.

5.1.3 Baseline model

Our basic estimation equation can then be obtained by substituting $\omega(\tau_{tV})$ from (21) into the cutoff expression (20); and then substitute this into the share equation in (22) and use the Pareto distribution to obtain for each $t, i, V$

$$\ln n_{t_iV} = k \left[ -\gamma_T p_{Th} \frac{\beta}{1 - \beta} \frac{1 - (\tau_{tV}/\tau_{hiV})^\sigma}{\sigma - 1} - \frac{\sigma}{\sigma - 1} \ln \tau_{tV} \right] + k \left[ \frac{1}{\sigma - 1} \ln \frac{A_{ti}}{K_{iV}(1 - \beta)} + r_{IV} - \ln c_V \right] + \ln n_{iV} + u_{t_iV}$$

(23)

We recall the three assumptions in the baseline estimation to identify the effect of uncertainty: (i) the shape parameter $k$ is constant over time and common across $V$ (but the other parameter $c_V$ may vary); (ii) the elasticities of substitution are constant over time and similar across sectors; (iii) the probability of reversal to a high tariff $\gamma_{p_{Th}}$ is common across industries, $V$ and countries, $i$ (but firms have market and industry specific information about the impact of that worst case scenario on profits). Recall that at any point in time firms treat the regime as time invariant. In the estimation we want to test if the regime changed after accession, so we include a $T$ subscript in $\gamma_T p_{Th}$ where $T = 0$ denotes parameter values for years pre-accession and $T = 1$ post-accession. In the robustness section we will discuss the impact of relaxing some of these assumptions.

We can then write the estimation equation in terms of parameters and observable variables as follows

$$\ln n_{t_iV} = b_{\gamma_T} \tilde{\omega}_{t_iV} + b_r \ln \tau_{t_iV} + a_{ti} + a_{iV} + a_{tV} + \tilde{u}_{t_iV} \quad \text{for each } t, i, V$$

(24)

where $\tilde{\omega}_{t_iV} = \frac{1 - (\tau_{tV}/\tau_{hiV})^\sigma}{\sigma - 1}$ captures the uncertainty measure and its impact on entry is estimated by $b_{\gamma_T} = -\gamma_T p_{Th} \gamma_T / (1 - \beta)$. The coefficient on the applied tariff is $b_r = -k\sigma / (\sigma - 1)$. The $a_x$ terms represent country-year, country-industry and industry-time effects that absorb among other things, the demand and cost conditions in $A_{ti}$, the investment cost $K_{iV}$ (and any time invariant costs of exporting, e.g.
transport or other non-tariff barriers, that we abstracted from in the theory), the productivity distribution heterogeneity across industries \( c_V \) as well as other terms that vary at the “x” level and were previously included in the remainder term, \( r_{tiV} \), and in \( u_{tiV} \). The remaining part of the disturbance that varies at the \( tiV \) level are included in \( \tilde{u}_{tiV} \).

We estimate (24) in differences taking a period after the agreement was implemented, \( t = 1 \), and one before it, \( t = 0 \).

\[
\Delta_t \ln n_{tiV} = b_{01} \tilde{\omega}_{1iV} - b_{00} \tilde{\omega}_{0iV} + b_{r} \Delta_t \ln \tau_{tiV} + a_t + a_V + \tilde{u}_{tiV} \quad \text{for each } i, V
\]  

(25)

We are interested in testing if there was more entry in industries with higher initial uncertainty, \(-b_{00} > 0\), and whether the agreement reduced the probability of a worst case scenario \((-b_{00} > -b_{11})\), or even eliminated it \((b_{11} = 0)\). If uncertainty played a significant role we will then quantify it. To identify these effects it is important that, even in the change equation, we control for importer effects, which absorb any shocks specific to those markets. We also control for industry effects to capture any productivity, regulation or other industry shocks that had a common effect on firm entry to both EC-10 and Spain, the most obvious being Portugal’s own trade liberalization. Therefore the identification will rely on differential tariffs and uncertainty that Portuguese exporters within each industry faced in the EC vs. the Spanish market.

5.2 Data and Implementation

To estimate (25) we collect detailed data on trade policy for Spain and the original EC-10 countries before and after the agreement, as described in more detail in the data Appendix. So the uncertainty measure varies not only across industries but also across members of the agreement. For some industries the policy data are recorded at a fine level of disaggregation, so they could potentially be matched to 6-digit NIMEXE classifications for the trade data, which includes over 5000 products (NIMEXE is the predecessor of the Harmonized System). We do not test the model at this disaggregated level for a few reasons. First, the model suggests that we define industries according to a set of characteristics (such as productivity distribution) that is common across a set of firms and clearly broader than the 6-digit level. Second, most of the variation in the policy occurs across industries, rather than within them at the product level. About 80% of the variation in applied tariffs and 75% of variation in the uncertainty measure in exporting to the EC-10 before the agreement are accounted for by differences across 2-digit industries (of which there are 99). Those fractions are lower for Spain but still more than half of the variation is accounted for by cross-industry differences. Third, even in 2-digit industries where there is some variation in tariffs, an exporter’s perception of the worst case scenario is likely to be broader than what is implied by the worst case for a single 6-digit good
since he may either export multiple goods and/or fear tariff changes simply because they are reclassified.\footnote{41}

To construct the uncertainty measure we first take $\tau_{bi}$ for a product to be the ad valorem conventional GATT tariff that country $i$ (EC-10 or Spain) had before the agreement.\footnote{42} We take $\tau_{di}$ to be the tariff that $i$ actually applied to Portuguese exports in that product before the agreement, where we employ data on the set of preferences that these countries provided to Portugal, as described in section 3.2. We then construct the uncertainty measure in (21) using elasticity values that are consistent with the data for these countries ($\sigma = 3$). In the robustness section we provide supporting evidence for this choice of elasticity and show the results are robust to alternative values. We then aggregate this measure and the applied tariff to the 2-digit industry level using a simple average.

The tariffs that Portuguese firms exporting to Spain faced in the years 1985 and 1987 appear in Table 2. The average industry in Portugal enjoyed preferential tariffs that were nearly 50\% below the tariff levied on the rest of the world. Moreover, we find that this difference is not driven by any one set of goods or industries. Using the measure of profits lost previously derived we calculate that if Portugal were to lose these preferences, the typical exporter would see his profits reduced by over 16\% per annum. Note also that despite the preferences, Portugal did not enjoy duty-free access to Spain prior to the agreement, it faced tariffs of almost 8\% on average. Therefore there is scope for gains from applied tariff reduction, uncertainty reduction and the complementarity effect between the two, which we described in the theory. With respect to the EC-10, the table shows Portugal enjoyed lower preferential tariffs by 1985 but the proportional loss in profits was nearly as high as in Spain at 15\%. The magnitude of EC tariff reductions in 1987 is small since tariffs in industrial products were already zero prior to accession.

5.3 Baseline Estimates

Table 3 provides estimates of the parameters in (25). We find that entry is negatively affected by applied tariffs, as predicted by the theory. Moreover, the coefficient on initial uncertainty, $-b_{70}$, is positive, implying that entry was strongest in the industries that initially faced higher uncertainty.\footnote{43}

One potential concern with the results in column 1 would arise if ad valorem tariffs were only one part of the protection faced by Portuguese exporters that changed. If protection that used other instruments fell by more in industries with higher uncertainty this would bias our estimates. Therefore we control for changes in “non-tariff barriers” and specific tariffs in columns 3 and 4 respectively. Both have the predicted negative sign but they are insignificant. Neither affects the baseline results for uncertainty and applied ad

\footnote{41}If we were to run the model at the 6-digit level there would be a large number of zeroes. Since our estimation equation is in logs we would eventually have to drop those categories, which could be where uncertainty was most important.

\footnote{42}If that tariff was not bound in the GATT then we use the autonomous ad valorem tariff that $i$ applied.

\footnote{43}Note that the policy measures vary across industry and for Spain vs. the EC-10 but not within industry across the EC-10. Therefore we compute clustered standard errors that allow for arbitrary correlation across EC-10 countries within each industry, and similarly for Spain.
valorem tariffs. The results are also robust to including other policy measures (in columns 5 and 6), which we discuss in detail in the robustness section, either individually, or in combination.

The results discussed thus far exclude any uncertainty measure for the period after the agreement. This reflects an implicit assumption that the coefficient on that variable is insignificant, i.e., that the agreement was credible and eliminated the preference reversal, $b_{\gamma 1} = 0$. We test this hypothesis directly in column 2 by including the potential profit loss term evaluated at the post agreement tariffs, $\tilde{\omega}_{1V}$. We find that this variable has no significant effect, i.e., we can’t reject that $p_{h1}\gamma_1 = 0$, nor can we reject that the probability of a reversal has fallen, i.e. $p_{h1}\gamma_1 < p_{h0}\gamma_0$. This insignificance of uncertainty after the agreement and the fact that the restricted version in column 1 is preferred by standard information criteria (shown in the last two rows of Table 3), leads us to focus on the restricted as the baseline.\footnote{The results that we discuss subsequently will be qualitatively unchanged if we included the post uncertainty variable. Moreover, while the magnitude of the tariff and initial uncertainty are somewhat different, their ratio is fairly similar with or without post uncertainty, and as we will see it is that ratio that is key to the quantification.}

The theory implicitly assumes single product firms. However, it can be easily re-interpreted as applying to a firm’s decision to invest in order to introduce a new product into a country and that is why we focus on the growth of firm-product pairs, i.e. varieties. New varieties include both those firms entering new market-industry pairs and firms expanding the number of products within a given market-industry pair. Three pieces of evidence indicate that our data and estimates mainly reflect firm entry into a new market-industry. First, the typical Portuguese exporter sells only two varieties (at 6-digit Nimexe) both in 1985 and 1987 (the average is also approximately unchanged at 6). Second, the average variety entry in our sample is 36\% and most of this is accounted for by firm-industry growth, 33\% (Table 2). Moreover, the latter also accounts for about 0.84 of the variation in variety growth. Finally, when we use market-industry growth as a dependent variable we find results similar to those using varieties in table 3. In fact, the implications for the estimated probability of reversal are the same, as we subsequently show in Table 7.\footnote{The regressions equivalent to Table 3 using growth of number of exporting firms to a market are available on request and in a previous version of the working paper.}

Our baseline estimation strategy already addresses several potential concerns. Recall that we difference out time invariant country–by-industry effects and explore variation over time and within industry across countries. One potential concern is pre-existing growth trends in specific destination markets or industries (either global demand or Portuguese supply trends in specific industries). These trends could bias our results and we address the concern by including industry and country effects in the baseline specification in changes. These industry and country effects also address other potential sources of bias, which we now note. First, they control for possible changes in fixed or sunk costs that are industry or destination market specific (e.g. accession could have lowered fixed or sunk costs of entry through streamlining of customs procedures or raised them through additional rules of origin). Second, the accession may have changed the share of intermediate goods in Portugal’s exports as well differentially across industries, but industry effects
would capture this change. Third, the increase in trade between Portugal and the EC could have affected exchange rates, but this aggregate shock is addressed by the country effects.

Our baseline results appear to be robust not only to the potential concerns noted above, but also others, that we will discuss in section 5.5. Therefore we now focus on examining the relative impact of the policies. One simple measure of this impact is how much variation in entry each of the variables explains. For the full sample we find that a one standard deviation reduction in applied tariffs leads to a 0.14 standard deviation increase in entry whereas for the uncertainty variable that effect is 0.4, which is almost 3 times larger. Using the model structure we can go considerably beyond this in quantifying the impact of each policy and their complementarity.

5.4 Quantification and Counterfactuals

We now employ the baseline results in Table 3 to estimate the probability of reversal and quantify the importance of uncertainty on entry and value of exporting.

5.4.1 Policy Reversal Estimates

Recall from our discussion of the estimating equation (24) that the coefficients for initial uncertainty and tariffs in column 1 of Table 3 map to the parameters of the model as follows: 

\[-b_0 = p_{ho} \gamma_0 \beta k / (1 - \beta)\]

and

\[b_\tau = -k\sigma / (\sigma - 1)\].

Therefore we can estimate the probability of reversal before the agreement as

\[
\hat{p}_{ho\gamma_0} = \frac{\hat{b}_0}{b_\tau} \frac{\sigma}{\sigma - 1} \frac{1 - \beta}{\beta}.
\]

The first row of Table 4 shows that the baseline estimate is 0.39 \((\sigma = 3)\).\(^{46}\) Given that we placed no constraint on the estimation it is remarkable that the estimate falls in the theoretically feasible range between zero and one. Moreover, we compute its standard error to be 0.17, which allows us to reject that it is zero. This indicates that exporters in 1985 believed that the policy was neither fixed, i.e. \(\gamma_0 \neq 0\), nor certain to improve, i.e. \(p_{ho} \neq 0\), so the reform was not fully anticipated. We also re-estimate the baseline in column 1 of Table 3 at alternative values of \(\sigma = 2.4\) and find that the reversal point estimates are all in the feasible range; they increase slightly in \(\sigma\), but the differences are insignificant. Thus we focus on the intermediate estimate generated by \(\sigma = 3\), which is also the more relevant elasticity for this data, as we argue in the robustness section.

\(^{46}\)We assume \(\beta = 0.85\), which is consistent with the Portuguese data. Recall that \(\beta = (1 - \delta) / (1 + R)\) so our assumption is equivalent to alternative reasonable combinations of these parameters. Our choice was determined by using the average real interest rate for Portugal in 1983-1995, \(R = 0.03\), and an annual death shock probability \(\delta = 0.125\). The latter is similar to what other authors assume (cf. Constantini and Melitz, 2008, p.24) and is also consistent with the Portuguese data where we find that annual firm exit rates from production is about 0.17 (calculated from Quadros de Pessoal) which is an upper bound for the exogenous death shock probability since it includes endogenous exit decisions.
Given that $\gamma p_H$ captures an *ex-ante* average exporter belief, it is hard to definitively argue that a particular estimate is too high or low. In order to provide additional quantification it is useful to ask what reform scenarios the estimates are compatible with and whether any seem unreasonable. The baseline reversal estimate of $p_{ho}\gamma_0 = 0.39$ is consistent with two extreme beliefs before the agreement. Either the policy shock is fully anticipated, $\gamma_0 = 1$, and preferences are lost with probability $p_{ho} = 0.39$, or preferences will surely be lost, $p_{ho} = 1$, but the timing of the policy change is uncertain with an arrival rate of $\gamma_0 = 0.39$.

While we can bracket our subsequent quantification estimates using these extremes we choose to focus instead on an intermediate case that seems more reasonable and where $\gamma_0 = 0.62(= p_{ho}^{0.5})$ so the policy shock was likely but not certain, i.e. $\gamma \in (0.5,1)$.

### 5.4.2 Policy Impacts on Entry

Since our estimates of $\gamma$ imply it is at least 0.39 and entry is concave in this parameter we will not quantify the impact of entry using the first order approximation in the regression estimate since this will overestimate its impact. We will instead employ the estimated coefficients to compute the impact implied by the theory holding all else equal:

$$
\ln (n_i|\gamma_1/n_i|\gamma_0) = \ln \left[G(c_i^{\gamma_1}|\gamma_1)/G(c_i^{\gamma_0}|\gamma_0)\right] = k \left[\ln U_1 - \ln U_0 \right] 
$$

where we focus on the baseline estimates where uncertainty is removed, i.e. $U_1 = 1$. Note that the expression in brackets can be rewritten in terms of the estimated parameters, $-b_{\gamma_0}$ and $b_{\gamma}$, the data $\tilde{\omega}_{i1}$ and a given assumption on the arrival rate such as $\tilde{\gamma}_0 = 0.62$, which we can then average over the observations. \(^{48}\) In table 4 we show that this removal of uncertainty alone generates a growth in entry of about 8 log points, which is similar across alternative $\sigma$. Given there were about 40428 country×(firm-product) pairs in total in the sample this predicts an additional 3167 pairs by 1987. The impact of uncertainty removal can generate as much as 24 log point growth for those industries where the fraction of profits lost is highest.

We now turn to the elasticity of entry with respect to tariffs. In the absence of uncertainty that is simply

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\(^{47}\) The intermediate magnitudes seem more reasonable than any of the extremes given the historical context provided in Section 4. These intermediate estimates are consistent with the following exporter beliefs in late 1984: talks would collapse and preferences removed with probability $p_{ho}\gamma_0 = 0.39$; or talks would continue, but no policy shocks would arrive, and the current regime would continue with probability $1 - \gamma_0 = 0.38$ or talks would succeed and the accession would go forward with probability $(1 - p_{ho})\gamma = 0.23$. The no change probability seems reasonable given the already long path since the start of the discussions. While the belief of success would seem low given the ex-post realization of the event, we think it may reasonably reflect the information embodied in the 1985 export decisions. To see why note that about half of all shipments in 1985 had already occurred by March and likely reflect decisions to invest that were made 3-6 months earlier, i.e. in 1984, so well before the accession agreement was signed in June of 1985. Moreover, the typical shipment date in 1986 is May, which is two months later than usual (and two months after the agreement came into force). This suggests exporters waited for reasons other than avoiding tariffs, since in most industries the average applied tariff was at or near zero for EC-10 countries.

\(^{48}\) Conditional on this, the result does not require any assumption for $b_\gamma$, since its value is subsumed in the parameter estimate.
given by $b_r$. So, to the extent that uncertainty was eliminated, the reduction of applied tariffs, generated about 4% growth in entry overall, distributed as follows: 2% into EC-10 (their mean reduction was only 0.7 p.p.) and 20% for Spain (mean reduction of about 7 p.p). Therefore the total predicted entry due to removal of applied tariffs and uncertainty is about 12 log points (.04+.08), slightly lower for EC-10 (10) and higher for Spain (28).

We are also interested in decomposing the relative importance of applied tariff reductions if uncertainty had remained unchanged. To compute this counterfactual recall that the applied tariff also affects the uncertainty term, $U$, so we must determine the total effect of the tariff and how attenuated that entry elasticity is under uncertainty, i.e. $\frac{d \ln n_t | \gamma_0}{d \ln \tau_t} / \frac{d \ln n_t | \gamma=0}{d \ln \tau_t}$. From (22) we see that this ratio is equal to the ratio of the cutoff elasticities, $\frac{d \ln c_U}{d \ln \tau_t} / \frac{d \ln c^D}{d \ln \tau_t}$, which we derive in the appendix, eq. (36). Therefore we estimate this attenuation factor using

$$
\frac{d \ln n_t | \gamma_0}{d \ln \tau_t} / \frac{d \ln n_t | \gamma=0}{d \ln \tau_t} = 1 - \frac{\beta \gamma_0}{1 - \beta + \beta \gamma_0 \omega_i} \frac{d \omega_i}{d \ln \tau_t} \sigma
$$

(28)

Using the definition of expected profits lost in eq. (21) we obtain $\frac{d \omega_i}{d \ln \tau_t} \sigma = p_{hi} V \left( \frac{\tau_{hi}}{\tau_{hi}} \right)$. We employ this and rewrite the expression above in terms of the estimated parameters and data. In Table 4 we show that this factor is 0.56, so under the initial uncertainty the same tariff reductions would have generated only about half as much entry than if uncertainty was absent. Another way to put this is that the impact of the tariff reduction when the uncertainty was also removed is substantially magnified. The result is not sensitive to the choice of $\sigma$.

In Table 5 we employ the estimates above to decompose the total predicted entry into three components: reduction in uncertainty at initial tariffs, reduction in applied tariffs at initial uncertainty and the remainder, which captures the complementarity effect. The first column shows the result for EC-10 and Spain combined. Out of the total predicted growth, which was 12 log points, a share 0.65 (\approx 8/12) is due to the uncertainty removal at initial tariffs, another 0.15 is due to the complementarity effect. The model predicts that on average accession would have only generated 0.19 of this entry if tariffs had been reduced at the initial uncertainty. For the EC, if uncertainty had been unchanged then tariff reductions (mostly in agricultural products) would have generated almost no entry. Even for Spain tariff reductions alone would have generated only about 0.4 of the predicted entry.

One final point regarding quantification is what fraction of the entry observed in the data can the policy changes implied by the theory predict. As we see, in Table 2 varieties increased by 0.36 so the model accounts for about 1/3 of this. There was a substantial increase in the mass of Portuguese producers in

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49 The magnitude of the attenuation does depend on how much of the reversal, $p_{hi}$, is due to the arrival shock. The effect is bounded by the extremes: if the arrival shock is very likely ($\gamma = 1$) the attenuation is .71, if it is unlikely ($\gamma = .39$) then the attenuation is .35.
this period, 0.16 between 1985-1987 (authors calculations from Quadros de Pessoal). Recall that this is exogenous in our model. Thus we can also ask what is the share of predicted entry probability explained by policy, \( \Delta \ln \left( \frac{n_{iV}}{n_{iV}} \right) \), we show in Table 5 that trade policy changes explain almost all this increase in the data for the EC, and 0.6 overall.\(^{50}\)

5.4.3 Policy Impacts on the Value of Exporting

We can also estimate the relative importance of applied tariffs and uncertainty on the value of exporting rather than entry decisions. To do so we consider a similar counterfactual to the one before: what is the predicted total change in the value of exporting, \( \Pi_e \), and what fraction is accounted for by the uncertainty removal at initial tariffs, the tariff reduction at initial uncertainty and the complementarity effect.

Using (13) the growth due to the policy changes in the expected export value function for a given firm is

\[
\frac{\Pi_e(\tau_1, \gamma_1 = 0)}{\Pi_e(\tau_0, \gamma_0)} - 1 = \frac{1 - \beta (1 - \gamma)}{1 - \beta} \frac{\tau_0^{\gamma}}{\tau_0^{\gamma} + \frac{\beta}{1 - \beta} \mathbb{E} (\tau_0^{\gamma})} - 1
\]

(29)

We can see that this growth rate is similar across all firms that export to the same market-industry pair. Therefore we can calculate this for each \( iV \) pair. To do so we use \( \mathbb{E} (\tau_0^{\gamma}) \approx (1 - p_{ho}) + p_{ho} \tau_0^{\gamma} \), where the approximation is exact in a two-state world. The results in Table 6 employ the baseline estimates for \( \gamma = 0.62 \) and \( \sigma = 3 \), previously discussed. When we average this over all industries and find that those firms export value grew by 9.6% (overall), more so for Spain (22%) than EC-10 (7.9%).

We then ask what effect would have been observed if only uncertainty had been removed at the original tariffs. We can again employ (13) to obtain

\[
\frac{\Pi_e(\tau_0, \gamma = 0)}{\Pi_e(\tau_0, \gamma > 0)} - 1 = \frac{1 - \beta (1 - \gamma)}{1 - \beta} \frac{\tau_0^{\gamma}}{\tau_0^{\gamma} + \frac{\beta}{1 - \beta} \mathbb{E} (\tau_0^{\gamma})} - 1
\]

(30)

which yields an average growth of exporter value of 5.5% overall. However, the effect is very uneven: for the EC this effect accounts for almost 0.8 of the total effect. But for Spain it accounts for none of the effect. The reason is that Spain still had relatively high tariffs on Portugal and if uncertainty about them were removed, i.e. if they were made permanent, then they would not increase but they would also not decrease either. This provides a nice illustration of the point we noted in the theoretical section that reductions in \( \gamma \) generate increases in the expected value of exporting when the applied policies are already low (the case of the EC) but not if the tariffs are close to their mean (Spain). But even in the latter case the uncertainty removal at given initial tariffs generates considerable entry, as predicted by the real option approach and confirmed by the estimates in the previous subsection for Spain.

\(^{50}\)The model only explains 1/3 in Spain indicating that other factors were important. Real income in that country for example increased by 0.1 log points in the period and was expected to continue growing, as it did, by 0.2 between 1985-1989.
Given the last result for Spain it would be tempting to conclude that the applied tariff reductions alone were responsible for the large gain. However, we recall that applied tariff reductions under uncertainty have a limited effect on exporter value, as shown in (15). We can verify this directly by calculating the impact of tariff reductions at the initial uncertainty by again employing (13)

\[
\Pi_e(\tau_1, \gamma_0) - \Pi_e(\tau_0, \gamma_0) = \frac{\tau_1^{1-\sigma} - \tau_0^{1-\sigma}}{\tau_0^{-\sigma} + \frac{\beta\gamma}{1-\beta}\mathbb{E}(\tau_0^{-\sigma})}
\]

For Spain this implies an average growth of 4.8% so it accounts for only 0.22 of the total predicted effect with the remaining, 0.78, being driven by the complementarity from applied tariff reductions made permanent by eliminating the probability of reversal.

An alternative way of measuring the cost of “incredible” reforms is the uncertainty entry cost premium, which we defined previously as the minimum entry cost subsidy rate required for the marginal firm under deterministic policy to enter under uncertainty \(s_{iV} = 1 - U_{iV}^{-1}\). To induce entry at the same level as when there is no uncertainty the government would have to subsidize the 3167 firms predicted to enter above. For the industries with highest uncertainty we find a subsidy rate of .22; on average we find it is .08. Without information on \(K_{iV}\) we can’t estimate the exact subsidy costs but the model allows us to compute an order of magnitude. The subsidy cost for a particular industry-country pair is \(s_{iV} \cdot K_{iV} = s_{iV} \pi_{iV}^D / (1 - \beta)\), where \(\pi_{iV}^D\) is the equilibrium operating profit of the marginal entrant under certainty. Thus the subsidy per entrant for the highest uncertainty industries (\(s = 0.22\)) would cost \(1.5\pi_{iV}^D\) when \(\beta = 0.85\).51

51 The government could offer lower subsidies to more productive firms and still obtain the same entry outcome. However, productivity-specific subsidies would require information that the government does not possess.

5.5 Robustness: entry estimates

We now discuss some additional robustness tests of the baseline results.

Column 5 of Table 3 adds the change in the standard deviation of the tariff faced by Portugal in each industry, i.e. \(\Delta (\text{stdev ln } \tau_{iVv})\) where \(v \in V\). This can help address concerns that the model is misspecified and the true measure of uncertainty is not the one we have used. However, this standard deviation variable is insignificant and does not change the value or significance of the theoretically based uncertainty measure.

We now provide some supporting evidence and sensitivity analysis to the choice of elasticity of substitution, \(\sigma\). There are two assumptions: first, the typical elasticity within industry \(V\) is similar to the typical elasticity in another industry. Below we provide some direct evidence based on estimated elasticities for this sample that supports this assumption. Second, the elasticity of substitution across industries is similar to the typical elasticity within them. We do not have estimates for cross industry elasticities to fully justify this second assumption and thus we examine directly whether the results are robust to it.
Thus far our discussion has mostly focused on the case when the elasticity of substitution of \( \sigma = 3 \). As we describe in our working paper, this is consistent with median estimates from Broda et al (2008) for Spain and the other EC-10 countries. Nonetheless, we also re-estimated the baseline regression for different elasticities and our central results are not sensitive to using \( \sigma = 2, 4 \) (Table 4). We also find that the median elasticity across industries at our level of aggregation not does exhibit a lot of variation and is fairly similar across these countries.\(^{52}\)

The elasticity of substitution may be lower across industries than within. Our model can be extended to accommodate this. In particular, if we assume that the subutility index \( Q \) in (1) is a Cobb-Douglas aggregator with shares \( \mu_V/\mu \) then the elasticity of substitution across industries is unity (so smaller than \( \sigma \)) and the relevant price index is now industry specific, \( P_{iV} \). Therefore, the key difference in the theory is that the \( A \) term is now

\[
\ln A_{iV} = \ln(1 - \rho)\mu_V Y_{ti} \left( \frac{w_t}{P_{iV}} \right)^{1-\sigma}
\]

Our baseline estimation is in differences and we can show that a number of components that this alternative specification of demand introduces are differenced out. Moreover, the use of industry and country effects implies that we are only left with the residual variation in \( P_{iV} \) that varies simultaneously at the country and industry level, which we denote by \( \Delta \ln p_{iV} \). This residual variation is only an issue if it is correlated with the policy measures. Recall that \( P_{iV} \) reflects the prices of all varieties sold in that industries in country \( i \) so it will be dominated by varieties other than Portugal’s (since the latter is a small exporter). Therefore we do not think that Portugal’s expansion into their markets had a substantial direct effect on \( \Delta \ln p_{iV} \).

However, there may be omitted variable bias if a third factor affected these indices and was correlated with the changes in policy faced by Portugal. The most obvious candidate would be if the EC-10 or Spain were simultaneously reducing their tariffs on the rest of the world and those reductions were correlated with the policy changes they were implementing for Portugal. This was not the case for the EC-10 external tariff in the period we consider. However, Spain was reducing its external tariffs on the rest of the world (to converge to the EC-10 common tariff) and these reductions were correlated to the ones faced by Portugal. Therefore we use changes in Spain’s tariffs to the rest of the world to proxy for \( \Delta \ln p_{iV} \).

The results that control for industry and country specific price index changes are presented in column 6 of Table 3. We find a positive relationship between the price index and entry. This is as predicted by the theory: an increase in the price index in an export market makes Portuguese exporters more competitive and thus raises entry. This effect is insignificant and including it does not change the baseline results regarding uncertainty or the applied tariff effects. The same is true if we also include all the other applied policy controls in columns 2, 3 and 4. Since these controls are insignificant and do not affect the key coefficients we

\(^{52}\) We did identify three industries with somewhat higher elasticities (Nimex codes 18, 47 and 87) so we also re-estimated the baseline specification (column 1 of Table 3) and verified the results are unchanged.
focus on the baseline result without them, which is also preferred by standard information criteria.

A separate robustness issue we investigate is the role of agricultural products. One potential concern with the agricultural products is that they are subject to non-tariff barriers. If these NTBs are not changing then they are controlled for by the country industry effects, \( a_{IV} \). If they are changing, as we know they are for Spain, and are doing so in a way that is correlated with our uncertainty measure this would bias our estimates. One way to address this is to control for NTB changes directly. We did so in column 3 of Table 3 and verified the results did not change. One may also object to applying a monopolistic competition framework to agricultural goods and argue that they should be dropped altogether. We are agnostic about this but nevertheless when we do drop basic agricultural goods we still find that the uncertainty measure still has an effect similar to the baseline.\(^{53}\)

Table 7 provides two other robustness tests. First, we re-estimate the baseline using entry of firms per industry into a market. This alternative dependent variable leads to the same probability of reversal, as we can see comparing column 2 with the baseline in column 1. Thus the entry effect we capture is mostly one of firm entry in an industry, as previously argued. Second, in column 3 we re-estimate the baseline using growth in varieties between 1987 and the average in three years prior to the agreement (1983-1985). The probability of reversal is still positive and significantly different from zero. Its value is slightly lower than when we focus on 1985 as the pre agreement period, which suggests that in 1983-4 the exporters believed policy was less likely to change. A similar result holds for firms (column 4).

In sum, the baseline estimates are fairly robust to alternative potential concerns.

### 5.6 Policy Impacts on Total Exports

While our main interest is on the impact of policy on entry and export firm value, we can also employ our framework to analyze the value of exports. In this section we present the basic estimation equation, which we relate to the structural parameters and then use to quantify the relative impacts, in an exercise analogous to the one for entry in Table 5.

Total exports in any given industry to a particular market are the product of the number of varieties exported to that market (first bracket) and the average sales, denoted by \( R_{tIV} \).

\[
R_{tIV} = \left[ n_{IV} G \left( c_{tIV}^{U} \right) \right] \times \tilde{R}_{tIV}
\]

\((32)\)

We obtain \( \tilde{R}_{tIV} \) by averaging \( c_{tIV}^{U} \) over all exporting firms so it is affected by applied tariffs and reflects

\(^{53}\)However, the applied tariff coefficient is now insignificant. This is not surprising since the tariff reductions by the EC-10 mostly occurred in those agricultural products so the remaining ones in the sample were those already receiving significant tariff concessions. This again stresses that uncertainty reduction was a key motive for entry.
the entry cutoff. Using the expression for \( \hat{R} \), the Pareto distribution and the derived cutoff, \( c_{i,V}^l \), we obtain the export equation as a function of uncertainty and applied policy measures, as detailed in the appendix. The estimating equation in differences can be written in a format similar to the one for entry

\[
\Delta_t \ln R_{i,t,V} = B_{\gamma_t} \Delta_t \hat{\omega}_{i,V} - B_{\gamma_0} \hat{\omega}_{i,V} + B_t \Delta_t \ln \tau_{i,t,V} + a_i + a_{i,V} + \tilde{u}_{i,V} \quad \text{for each } i, V
\]  

(33)

where the coefficient for uncertainty is now \( B_{\gamma_t} = -\gamma_t p_0 b \frac{1}{(k - (\sigma - 1))} \) and for the tariff it is \( B_t = -\frac{k_0}{\sigma - 1} \).

We estimate this equation based on the difference between 1987 and 1985, as done for the entry model, and find that both of these variables have the expected sign and are statistically significant. We also find that the post agreement uncertainty effect is insignificant. The exact parameter estimates for \( B_{\gamma_t} \) and \( B_t \) themselves are not as interesting as the quantification exercises that they allow us to perform so we focus on the latter. For example, using the baseline assumption of \( \sigma = 3 \), we derive the implied probability of reversal; the point estimate is 0.45 and we can’t reject that it is equal to the estimate obtained with the entry equation (0.39). We then use this reversal estimate, assuming \( \gamma = 0.45^{0.5} \), and the structure of the model to predict the impact of policy on exports.

Similarly to the entry exercise, the total predicted export growth due to policy is given by the sum of the uncertainty removal at initial tariffs, \( \ln R_{i,V} \big|_{\gamma_t=0} / \ln R_{i,V} \big|_{\gamma_t>0} \) (derived in the appendix), and the tariff reduction in the absence of uncertainty \( B_t \Delta_t \ln \tau_{i,t,V} \). We find this is 34 log points for the EC-10 and Spain combined. The average growth in the data is 55 log points (as seen in Table 2) so the policy change predicts a large fraction of this. The predicted change accounts for an even larger fraction of the observed value if we net out the increase in the mass of firms, the term \( n_{i,V} \), which is exogenous in the model and grew about 16 log points. When we take this into account the model explains 0.87 of the remaining growth, as shown in the last column of the first row of Table 8.

In Table 8 we also decompose that predicted growth in a way that is analogous to the entry results in Table 5. The fraction of the 34 log points accounted for by the uncertainty removal at initial tariffs is 0.59. To calculate the counterfactual impact of tariff reductions at the initial uncertainty we first derive the attenuation effect, \( \frac{d \ln R_{i,t,V}}{d \ln \tau_{i}} \bigg|_{\gamma=0} \bigg/ \frac{d \ln R_{i,t,V}}{d \ln \tau_{i}} \bigg|_{\gamma>0} \), in the appendix and estimate it is 0.69. This is less than unity and thus confirms the complementarity of tariff and uncertainty reductions for export values.\(^{55}\) We can see that complementarity effect accounts for almost a quarter of the predicted growth for Spain, which is about the same fraction as the uncertainty effect at initial tariffs. For the EC most of the growth was due to the direct uncertainty removal effect (0.75), which is reasonable since most tariffs were already at zero.

\(^{54}\)Note that the predicted export growth is higher than the growth due to entry, suggesting that the policy changes also affected average exports. Such an effect would arise naturally if firms could make technology upgrading or capacity building investments after entry. Such upgrading is likely given the large increase in export values for existing firms, that we derived previously. In related work we show that our model can be extended to incorporate such upgrading decisions.

\(^{55}\)It is not as pronounced as the 0.56 factor for entry since now tariffs have a direct effect on exporters that are already in the market regardless of uncertainty.
This contrast in the sources of growth of exports provides another interesting motive to consider both the EC-10 and Spanish case since some recent PTAs may look more like the EC-10 case (e.g. Colombia securing pre-existing preferences received in the U.S. market) and others like Spain’s (e.g. Korea obtaining tariff reductions and securing them).

6 Conclusion

We provide a framework to study the effect of TPU on firm investment and export decisions. Despite its dynamic nature, the model is highly tractable and delivers clear predictions for how to empirically compute TPU and estimate its impact. Applying this to a specific setting that is particularly appropriate, we find that, (i) before accession to the EC, Portuguese exporters stood to lose about 16% of exporting profits if they lost their preferences in the EC-10 or Spanish markets and (ii) they believed such an event had a real probability of occurring before the PTA. The agreement eliminated this TPU and the overall trade policy changes can account for a considerable share of firm entry and export value in the data (more for the EC-10 than for Spain). If, counterfactually, the applied tariff reductions had been implemented at the original TPU level then only 20% of the total predicted firm entry growth would have been realized. These results have policy implications for the many countries still receiving unilateral preferential tariffs, which are subject to the discretion and uncertainty of policy making, as Portugal was before 1986. Thus our results provide one reason why these programs are not always successful in promoting trade and investment and how this may change if those preferences are secured through formal PTAs.

Our framework can be used and extended to address various other interesting questions. First, the basic structure of the model can be applied to other settings. One example is tariff bindings in the WTO (as in Handley, 2011). Another is the U.S. threat of non-renewal of China’s MFN status and whether its elimination in 2001 (upon China’s WTO entry) can explain the subsequent export boom to the U.S. Second, the model is tractable enough that it can be extended to include effects of uncertainty on intensive margin decisions (e.g. via technology upgrading decisions as in Bustos, 2011) and endogenous exit. Third, the model can also be extended to analyze the role of own TPU on imported intermediates, which may play an important role in increasing firm productivity (cf. Goldberg et al, 2010). Another interesting extension is to examine the interaction of uncertainty between trade policy and demand conditions, to analyze for example the role of TPU during the great trade collapse.\footnote{A related application is the interaction of trade elasticities with other sources of uncertainty, such as exchange rates. We did not find much evidence for adverse effects of exchange rate volatility in the 1981-1990 period, but these effects may have grown more important during the lead up to adoption of the Euro.}

Our estimates also have broader implications. For example, the finding that the elasticity of entry and exports with respect to applied tariff changes is considerably attenuated in the presence of uncertainty has
implications for explaining trade flows and the resulting welfare gains. To see this, note that if those
elasticities are estimated under uncertainty (but neglect to account for it) then ex-ante predictions based
on them will tend to underestimate the entry and export impact of subsequent credible reforms. Second,
ex-post analysis of PTAs often find large trade effects even if applied policies are low. From this it is often
inferred that either those applied policies are correlated with other unmeasured but applied trade costs that
were also reduced, or that their trade elasticity is very high. Our results provide an alternative explanation:
the large trade impact is partly due to the elimination of TPU. This uncertainty can also help explain the
border puzzle: why trade across an international border is considerably smaller than within a country even
when trade costs appear similar. Appropriate trade elasticities are central in the evaluation of “static”
welfare gains from trade in CGE and new trade theory models (cf. Arkolakis et al, Forthcoming). The
attenuation effects suggest we must be careful about which elasticities we should use for such evaluations;
more fundamentally our results suggest that these evaluations should focus on models that are inherently
dynamic.

In conclusion, our results highlight why and how much trade policy uncertainty affects investment and
entry into new markets. While credibility is often mentioned as an important component of a policy reform,
it is generally difficult to measure its impact. To the extent that our approach and results do just that they
may be of broader interest to economists and policy makers interested in evaluating the impact of other
policy reforms on firm-level decisions.
A Theory Appendix

1. Value Function ($\mathbb{E} \Pi_e (\tau' \mid \tau' \leq \bar{\tau})$)

The set of equations in (9), (10), (11), and (12) is linear in the four unknowns. The solution to the current values of exporting, $\Pi_e(\tau_i)$, and waiting, $\Pi_w(\tau_i)$, are respectively (13) and (14) in the text. The unconditional expected value of exporting is $\mathbb{E} \Pi_e (\tau' \mid \tau' \leq \bar{\tau}) = \beta \gamma \mathbb{E}[\pi(\tau') | \tau' < \bar{\tau}] (1 - \beta)$ and the conditional value is

$$
\mathbb{E} \Pi_e (\tau' \mid \tau' \leq \bar{\tau}) = \frac{\beta \gamma \mathbb{E}[\pi(\tau')] - \mathbb{E}[\pi(\tau') | \tau' < \bar{\tau}] (1 - \beta)}{(1 - \beta + \beta \gamma)(1 - \beta)}
$$

2. Cutoff expression ($C_i^1$)

We combine the expression in (17) with the operating profit function in (5) to solve directly for $c_i^1$ as a function of the current tariff

$$
c_i^1 = \left\{ \frac{A}{K} \left[ \frac{\tau_i^{-\sigma}}{1 - \beta (1 - \gamma)} + \frac{\beta \gamma \mathbb{E}(\tau^{-\sigma})}{1 - \beta (1 - \gamma)} + \frac{\beta \gamma H(\tau_i) [\tau_i^{-\sigma} - \mathbb{E}(\tau^{-\sigma} | \tau \leq \tau_i)]}{1 - \beta (1 - \gamma)} \right] \right\}^{1 - \gamma}
$$

Using this and the definition below for $\omega(\tau_i)$ we obtain (18) in the text.

3. Profit loss expression and bound ($\omega(\tau_i) \leq 1$)

We denote the maximum tariff by $\tau_h$.

$$
\omega(\tau_i) = \left[ \mathbb{E}(\tau^{-\sigma}) + H(\tau_i) [\tau_i^{-\sigma} - \mathbb{E}(\tau^{-\sigma} | \tau \leq \tau_i)] \right] / \tau_i^{-\sigma}
$$

$$
= \left[ \int_1^{\tau_h} \tau^{-\sigma} dH(\tau) + H(\tau_i) [\tau_i^{-\sigma} - \int_1^{\tau_i} \tau^{-\sigma} dH(\tau)] / \tau_i^{-\sigma} \right]
$$

$$
= \left[ \int_1^{\tau_h} \tau^{-\sigma} dH(\tau) + H(\tau_i) [\tau_i^{-\sigma}] \right] / \tau_i^{-\sigma}
$$

$$
= [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i) + H(\tau_i) \tau_i^{-\sigma}] / \tau_i^{-\sigma} \leq 1
$$

where the last inequality follows from $(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i) + H(\tau_i) \tau_i^{-\sigma} \leq \tau_i^{-\sigma}$ and the fact that the LHS is a weighted average of two terms, one equal to $\tau_i^{-\sigma}$ and the other equal to $\mathbb{E}(\tau^{-\sigma} | \tau > \tau_i)$, which is less than $\tau_i^{-\sigma}$. When the current tariff is at the maximum of the support of $H(\tau)$ such that $\tau_i = \tau_h$, then the difference in brackets and the term $(1 - H(\tau_i))$ are both zero.

4. Current tariff impact on profit loss ($d\omega(\tau_i)/d\tau_i \geq 0$)

As $\tau_i$ increases, the profit lost from being hit with a shock to a higher tariff is reduced so $d\omega/d\tau_i > 0$

$$
d\omega(\tau_i)/d\tau_i = [-\tau_i^{-\sigma} h(\tau_i) + h(\tau_i) \tau_i^{-\sigma} - \sigma H(\tau_i) \tau_i^{-\sigma - 1}] / \tau_i^{-\sigma} + [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i) + H(\tau_i) \tau_i^{-\sigma} ] (\sigma \tau_i^{-\sigma - 1})
$$

$$
= [-\sigma H(\tau_i) \tau_i^{-1}] + \sigma \tau_i^{-\sigma - 1} [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i) + H(\tau_i) \tau_i^{-\sigma}] + \sigma \tau_i^{-\sigma - 1} [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i) + H(\tau_i) \tau_i^{-\sigma}]
$$

$$
= \sigma [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i)] / \tau_i^{-1} \geq 0
$$

In semi-elasticity terms, this becomes

$$
d\omega(\tau_i)/d\ln \tau_i = \sigma [(1 - H(\tau_i)) \mathbb{E}(\tau^{-\sigma} | \tau \geq \tau_i)] / \tau_i^{-\sigma} \in [0, \sigma]
$$

(35)

This implies that as the current tariff $\tau_i$ increases, the proportional gap between the deterministic and uncertain cutoff narrows. We can see that if $\tau_i = \tau_h$ the derivative goes to zero. Then $d\ln c_i^1 / d\ln \tau_i = -\sigma/\sigma - 1$ and the elasticity of the cutoff under uncertainty evaluated at the tariff maximum equals the elasticity at the deterministic cutoff.
5. Attenuated tariff impact on entry under uncertainty: $\frac{d \ln c_t^U}{d \ln \tau_t} / \frac{d \ln c_t^D}{d \ln \tau_t} \in [0, 1]$

Using the expression for $c_t^U$ from the text, we log differentiate and derive

\[
\frac{d \ln c_t^U}{d \ln \tau_t} - \frac{d \ln c_t^D}{d \ln \tau_t} = \frac{d \ln U_t}{d \ln \tau_t}
\]

(36)

\[
\frac{d \ln c_t^U}{d \ln \tau_t} = - \frac{\sigma}{\sigma - 1} + \frac{1}{\sigma - 1} \left( 1 - \beta + \beta \gamma \omega \right) \frac{d \omega_t}{d \ln \tau_t}
\]

\[
\frac{d \ln c_t^D}{d \ln \tau_t} = - \frac{\sigma}{\sigma - 1} \left[ 1 - \beta + \beta \gamma \omega \right] \frac{d \omega_t}{d \ln \tau_t}
\]

\[
\frac{d \ln c_t^U}{d \ln \tau_t} / \frac{d \ln c_t^D}{d \ln \tau_t} = 1 - \frac{\beta \gamma \omega}{1 - \beta + \beta \gamma \omega} \frac{d \omega_t}{d \ln \tau_t}
\]

As we show in (35), $\frac{d \omega_t}{d \ln \tau_t} \in [0, 1]$, so entry is less responsive to tariff changes under uncertainty except at the two limiting cases when $\gamma = 0$ (deterministic $\tau$) and when $\tau_t$ is at the maximum.

6. Uncertainty impact on entry cutoff ($\frac{d \ln c_t^U}{d \tau_t} \leq 0$)

In the empirical work we focus on the semi-elasticity and we derive this comparative static here

\[
\frac{d \ln c_t^U}{d \gamma} = \frac{d \ln U_t}{d \gamma}
\]

\[
= \frac{1}{\sigma - 1} \left( \frac{d}{d \gamma} \ln(1 - \beta (1 - \gamma \omega)) - \frac{d}{d \gamma} \ln (1 - \beta (1 - \gamma)) \right)
\]

\[
= \frac{\beta}{\sigma - 1} \frac{1 - \beta}{(1 - \beta (1 - \gamma))} \frac{1 - \beta}{(1 - \beta (1 - \gamma))} (\omega - 1)
\]

We thus have $\text{sign} \left( \frac{d \ln c_t^U}{d \gamma} \right) = \text{sign} \left( \frac{\omega - 1}{1 - \beta (1 - \gamma \omega)} \right) \leq 0$, which is negative since we showed above that $\omega \leq 1$.

Using the derivative, we can write the first order effect around $\gamma = 0$ used in the estimation

\[
\frac{d \ln c_t^U}{d \gamma} \bigg|_{\gamma=0} = \frac{\beta}{1 - \beta} \frac{\omega - 1}{\sigma - 1}
\]

(37)

7. First-order Cutoff Approximation

We take a first-order Taylor approximation of $\ln c_t^U$ around $\tau_t = \tau_0$ and $\gamma_t = 0$.

\[
\ln c_t^U (\gamma_t, \tau_t) = \ln \left( c_t^D \times U_t \right)
\]

\[
= \ln c_t^D (\ln \tau_0, \gamma_t = 0) + \ln U (\ln \tau_0, \gamma_t = 0) +
\]

\[
+ (\ln \tau_t - \ln \tau_0) \frac{\partial \ln c_t^D (\ln \tau_0, \gamma_t = 0)}{\partial \ln \tau} + (\ln \tau_t - \ln \tau_0) \frac{\partial \ln U_t (\ln \tau_0, \gamma_t = 0)}{\partial \ln \tau}
\]

\[
+ (\gamma_t - 0) \frac{\partial \ln c_t^D (\ln \tau_0, \gamma_t = 0)}{\partial \gamma} + (\gamma_t - 0) \frac{\partial \ln U_t (\ln \tau_0, \gamma_t = 0)}{\partial \gamma} + \tau_t
\]

Using the definition for $c_t^D$, equation (37), noting that $\partial \ln U_t / \partial \ln \tau \big|_{\gamma=0} = 0$ and simplifying we obtain the expression in equation (37) in the text.

\[
\ln c_t^U \big|_{\tau_t=\tau_0, \gamma_t=0} = \gamma_t \frac{\beta}{1 - \beta} \frac{\omega - 1}{\sigma - 1} \ln \tau_t + \frac{\sigma}{\sigma - 1} \ln \tau_t + \frac{1}{\sigma - 1} \ln \frac{A_t}{K_t (1 - \beta) + \tau_t}
\]

(38)
B Data and Estimation Appendix

B.1 Data sources and definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aggregate Regressions (Table 1, 1981-1990):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports (ln)</td>
<td>Nominal value of exports in euro of all goods to country i in year t.</td>
<td>a</td>
</tr>
<tr>
<td>Number of Firms Exporting (ln)</td>
<td># of uniquely identified shippers with positive exports to i in year t.</td>
<td>a</td>
</tr>
<tr>
<td>Exports per Firm (ln)</td>
<td>ln(Exportsit/Number of firmsit)</td>
<td>a</td>
</tr>
<tr>
<td>Real Importer GDP (ln)</td>
<td>Country i, year t in billions of importer currency.</td>
<td>b</td>
</tr>
<tr>
<td>Importer Price Index (ln)</td>
<td>ln(nominal GDP)-ln(real GDP) in local currency</td>
<td>b</td>
</tr>
<tr>
<td>Annual Exchange Rate</td>
<td>Simple average of ln monthly rate, where latter is defined as ln((escudo/importer currency)/200.482). The fixed conversion factor from esc to euro is 200.482 and plays no role in the regressions.</td>
<td>b</td>
</tr>
<tr>
<td>Ex-Rate Volatility(ln)</td>
<td>Standard deviation of log monthly changes in the year.</td>
<td>b</td>
</tr>
<tr>
<td><strong>Firm and policy data in estimates of Tables 2-8:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in Number of Firms(ln)</td>
<td>ln(# firms exporting to i in V, 1987)-ln(# firms exporting to i in V, 1985) where i is an EC-11 country and V corresponds to a NIMEXE 2-digit industry</td>
<td>a</td>
</tr>
<tr>
<td>Change in Number of Firm-Varieties(ln)</td>
<td>ln(# varieties exported to i in V, 1987) - ln(# varieties exported to i in V, 1985), “varieties” defined as distinct 8-digit NIMEXE products exported by each firm</td>
<td>a</td>
</tr>
<tr>
<td>Change in exports(ln)</td>
<td>ln(exchange value to i in V, 1987) - ln(exchange value to i in V, 1985)</td>
<td>a</td>
</tr>
<tr>
<td>Pre Tariff (GATT)</td>
<td>lnτ where τ is 1+advalorem rate at product level that GATT members faced in Spain or EC-10, which is then averaged to Nimex-e 2-digit industry.</td>
<td>c,d</td>
</tr>
<tr>
<td>Pre Tariff (Portugal)</td>
<td>lnτ where τ is 1+advalorem rate at product level Portugal faced in Spain or EC-10, which is then averaged to Nimex-e 2-digit industry.</td>
<td>c,d</td>
</tr>
<tr>
<td>Post Tariff (Portugal)</td>
<td>lnτ for immediate post agreement period that Portugal faced in Spain or EC-10, constructed as described in previous section.</td>
<td>c,d</td>
</tr>
<tr>
<td>Applied Tariff Standard Deviation Change</td>
<td>Δstd(lnτ) where the standard deviation is over tariffs Portugal faced in each Nimex-e 2 industry; the change is between the pre and post tariff.</td>
<td>f</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Proportional reduction in per period profits if the tariff faced by an exporter reverts from the preferential tariff received prior to accession (Pre Tariff above) to the tariff received by all non-preferential partners (i.e. the GATT member tariff).</td>
<td>g</td>
</tr>
<tr>
<td>NTM Share Change</td>
<td>Change in coverage ratio measured by fraction of products in 2-digit industry subject to a specific tariff or other NTB.</td>
<td>c,d</td>
</tr>
<tr>
<td>Specific Tariff Share Change</td>
<td>Difference in the share of lines in 2-digit industry with specific tariffs between post and pre-agreement period.</td>
<td>f</td>
</tr>
<tr>
<td>Price Index Proxy Change</td>
<td>Difference in Spain’s external tariff, ln(1+ad valorem rate), between post and pre-agreement period</td>
<td>f</td>
</tr>
<tr>
<td><strong>Other data (Figures and text):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import &amp; Export to GDP ratios</td>
<td>Referenced in section 3 of text</td>
<td>h</td>
</tr>
<tr>
<td>Trade Shares</td>
<td>Fig. 1, IMF Direction of Trade Statistics</td>
<td></td>
</tr>
<tr>
<td>Export firm entry growth</td>
<td>Fig. 2, ln(# firms exporting to i at t)-ln(# firms exporting to i in 1985)</td>
<td>i</td>
</tr>
<tr>
<td>Export price index (ln)</td>
<td>1985 base chain price index for exports.</td>
<td>h</td>
</tr>
<tr>
<td>Employment</td>
<td>Number of employees</td>
<td>i</td>
</tr>
<tr>
<td>Firm identifier (NPC)</td>
<td>Unique code to match firms between 1981-1985. Portuguese customs changed this code in 1986 and it is consistent for 1986 onwards but not between 1985 and 1986</td>
<td>INE</td>
</tr>
<tr>
<td>New exporter in year t</td>
<td>Firm exporting to a market at t but not in t-1</td>
<td>i</td>
</tr>
<tr>
<td>Gross entry rate in year t</td>
<td>(Total # new exporters in t)/(# exporters t-1).</td>
<td>i</td>
</tr>
<tr>
<td>Gross exit rate in year t</td>
<td>(# exporters with positive exports in t-1 and none in t)/(# exporters with positive exports in t)</td>
<td>i</td>
</tr>
</tbody>
</table>

Notes (additional details in supplementary appendix):

a. Authors’ calculations based on INE data.
b. IMF International Financial Statistics (IFS), volatility uses monthly data.
f. Authors’ calculations based on tariff schedules.
g. Authors’ calculations using equation (21) with σ = 3 in the baseline regressions.
h. Authors’ calculations from in Pinheiro et al (1997). Indices are yearly price deflators of export goods to all destinations.
i. Authors’ calculations using trade data matched to firm employment data (Quadros Pessoal) by INE.
B.2 Aggregation to Total Exports

In this appendix we derive the estimating equation for total exports presented in the text and the expressions used to decompose the policy effects in Table 8.

In the text we note that the total export value to a given country in an industry $V$ is

$$ R_{tiV} = [n_{iV} G (c^U_{iV})] \times \tilde{R}_{tiV} $$

(39)

where average sales $\bar{R}_{tiV} \equiv A_{tiV} \sigma \tilde{\tau}_{tiV} \hat{c}$ are obtained by averaging (4) over all exporting firms and with a Pareto, $\hat{c} = \frac{k}{k-(\sigma-1)} (c^U_{tiV})^{1-\sigma}$. Using $G (c^U_{iV}) = (c^U_{iV} / c_V)^k$, the cutoff expression and simplifying we obtain

$$ \ln R_{tiV} = (k - \sigma + 1) \ln c^U_{tiV} - k \ln c_V + \ln n_{iV} + \ln \frac{k}{k-(\sigma-1)} - \sigma \ln \tilde{\tau}_{tiV} + \ln A_{tiV} + \ln \sigma $$

(40)

where $\alpha_{tiV} = \frac{k-\sigma+1}{\sigma-1} \ln \frac{A_{tiV}}{\tilde{\tau}_{tiV}(1-\beta_\gamma)} + \ln n_{iV} - k \ln c_V + \ln \frac{k}{k-(\sigma-1)} + \ln A_{ti} + \ln \sigma$.

The impact of removing uncertainty at initial tariffs on exports used in Table 8 is therefore

$$ \ln R_{tiV}|_{\gamma_i} - \ln R_{tiV}|_{\gamma_0} = - \frac{k - \sigma + 1}{\sigma - 1} \ln \left[ \frac{1 - \beta + \beta \gamma_0 (\tilde{\tau}_{tiV})}{1 - \beta + \beta \gamma_0} \right] $$

(41)

The total impact of applied tariff changes under uncertainty is

$$ \frac{\partial \ln R}{\partial \ln \tau} = - \frac{k \sigma}{\sigma - 1} \left[ 1 - \frac{k - \sigma + 1}{k} \frac{\beta \gamma}{1 - \beta + \beta \gamma_0} \frac{\partial \tilde{\omega}_i}{\partial \ln \tau_i} \frac{1}{\sigma} \right] $$

(42)

The leading term is the full elasticity of total exports to tariff changes and the term in brackets is the attenuation, which is equal to $\frac{\partial \ln R}{\partial \ln \tau}|_{\gamma_0=0}/\frac{\partial \ln R}{\partial \ln \tau}|_{\gamma_1=0}$, and is reported in Table 8. It is straightforward to show that the attenuation term is always between zero and one.

To obtain the estimation equation (33) in the text, we take a first order approximation of the uncertainty term around $\gamma = 0$ and substitute that and the constructed measure $\tilde{\omega}_{tiV}$ in (40) to obtain

$$ \ln R_{tiV} = B_T \tilde{\tau}_{tiV} + B_I \ln \tau_{tiV} + a_{ti} + a_{iV} + a_{tV} + \tilde{a}_{tiV} $$

(43)

where $B_T = -\gamma_T \beta_T \frac{k}{k-1} (k-(\sigma-1))$, $B_I = -\frac{k \sigma}{\sigma - 1}$ and the $a_x$ terms capture all the terms in $\alpha_{tiV}$ defined above. If we then difference this equation we obtain (33).
References


Table 1: Portuguese Export Growth Margins 1981-1990

<table>
<thead>
<tr>
<th>Dependent variable (ln):</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>0.232***</td>
<td>0.451***</td>
<td>-0.219***</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>0.0829</td>
<td>0.0411</td>
<td>0.0710</td>
</tr>
<tr>
<td>Exports/firm</td>
<td>1.146***</td>
<td>1.159***</td>
<td>-0.0129</td>
</tr>
<tr>
<td>Spanish GDP (ln)</td>
<td>1.045***</td>
<td>0.598***</td>
<td>0.447*</td>
</tr>
<tr>
<td>Imp. Price Index (ln)</td>
<td>0.167**</td>
<td>0.0185</td>
<td>0.148**</td>
</tr>
<tr>
<td>Exchange rate (ln)</td>
<td>0.211***</td>
<td>-0.00118</td>
<td>0.212***</td>
</tr>
<tr>
<td>Observations</td>
<td>1305</td>
<td>1305</td>
<td>1305</td>
</tr>
<tr>
<td>Adj R2</td>
<td>0.92</td>
<td>0.97</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Notes:
Includes dummies for country and year. Robust standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1. Sample: Aggregate values to each country of destination where data is available. For variable definitions, sources and summary statistics see Appendix B.
Table 2: Summary statistics for firm-level baseline regressions

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Spain</th>
<th>EC-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Number of Firms*</td>
<td>33.0</td>
<td>91.1</td>
<td>24.7</td>
</tr>
<tr>
<td></td>
<td>(55.1)</td>
<td>(62.6)</td>
<td>(48.7)</td>
</tr>
<tr>
<td>Change in Number of Varieties*</td>
<td>35.7</td>
<td>101</td>
<td>26.4</td>
</tr>
<tr>
<td></td>
<td>(60.7)</td>
<td>(69.1)</td>
<td>(48.7)</td>
</tr>
<tr>
<td>Change in Exports*</td>
<td>55.3</td>
<td>135</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td>(157)</td>
<td>(150)</td>
<td>(155)</td>
</tr>
<tr>
<td>Pre Tariff** (Portugal)</td>
<td>3.13</td>
<td>7.89</td>
<td>2.45</td>
</tr>
<tr>
<td></td>
<td>(5.66)</td>
<td>(5.10)</td>
<td>(5.40)</td>
</tr>
<tr>
<td>Pre Tariff** (GATT)</td>
<td>8.67</td>
<td>14.1</td>
<td>7.95</td>
</tr>
<tr>
<td></td>
<td>(5.14)</td>
<td>(7.75)</td>
<td>(4.20)</td>
</tr>
<tr>
<td>Post Tariff** (Portugal)</td>
<td>1.74</td>
<td>1.33</td>
<td>1.79</td>
</tr>
<tr>
<td></td>
<td>(3.91)</td>
<td>(3.51)</td>
<td>(3.96)</td>
</tr>
<tr>
<td>Tariff Change** (Portugal)</td>
<td>-1.39</td>
<td>-6.56</td>
<td>-0.66</td>
</tr>
<tr>
<td></td>
<td>(2.90)</td>
<td>(4.78)</td>
<td>(1.44)</td>
</tr>
<tr>
<td>Applied Tariff Stand. Dev. Change***</td>
<td>-0.64</td>
<td>-2.86</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(1.86)</td>
<td>(0.69)</td>
</tr>
<tr>
<td>Price Index Proxy Change***</td>
<td>-0.19</td>
<td>-1.52</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
<td>(2.06)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>NTM Share Change***</td>
<td>-2.32</td>
<td>-18.66</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(10.9)</td>
<td>(25.4)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Specific Tariff Share Change***</td>
<td>-0.37</td>
<td>-3.01</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(2.80)</td>
<td>(7.45)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Proportion of Profits Lost if Preference Reversed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Uncertainty</td>
<td>15.5</td>
<td>16.0</td>
<td>15.4</td>
</tr>
<tr>
<td></td>
<td>(10.9)</td>
<td>(9.52)</td>
<td>(11.1)</td>
</tr>
<tr>
<td>Post Uncertainty</td>
<td>18.8</td>
<td>29.4</td>
<td>17.3</td>
</tr>
<tr>
<td></td>
<td>(10.8)</td>
<td>(15.0)</td>
<td>(9.08)</td>
</tr>
<tr>
<td>Observations</td>
<td>731</td>
<td>91</td>
<td>640</td>
</tr>
</tbody>
</table>

Notes:
Sample means and standard deviations (in parentheses), all multiplied by 100.
* 100 × Δ ln(x) where x = {firms, varieties, exports}.
** 100 × ln(1 + t) where t is the advalorem rate; "Pre tariff" is evaluated in 1985 (pre-accession); one measures Portugal’s preferential rate and the other tariffs faced by GATT members; "Post Tariff" is the 1987 (post-accession) tariff faced by Portugal; "Tariff Change" is a simple difference.
*** See Appendix B for sources and additional details. Profit loss: 1 − (τ_vV / τ_hV)" (assuming σ = 3). We normalize the loss measures in regressions by dividing it by σ − 1.
Table 3: Firm-product entry growth into EC-10 and Spain (by industry)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable:</td>
<td>Change in (ln) Number of Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Uncertainty</td>
<td>4.399**</td>
<td>5.626**</td>
<td>4.301**</td>
<td>4.431**</td>
<td>4.351**</td>
<td>4.752**</td>
</tr>
<tr>
<td>$\beta_{0} &gt; 0$</td>
<td>[1.772]</td>
<td>[2.756]</td>
<td>[1.810]</td>
<td>[1.788]</td>
<td>[1.839]</td>
<td>[1.854]</td>
</tr>
<tr>
<td>$\beta_{T} &lt; 0$</td>
<td>[1.260]</td>
<td>[2.271]</td>
<td>[1.266]</td>
<td>[1.247]</td>
<td>[1.291]</td>
<td>[1.260]</td>
</tr>
<tr>
<td>Post Uncertainty</td>
<td>-1.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{\gamma 1} \leq 0$</td>
<td></td>
<td>[3.277]</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>NTM Share Change</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>[0.256]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Tariff Share Change</td>
<td></td>
<td>-0.579</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.034]</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Applied Tariff SD Change</td>
<td></td>
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<td></td>
<td></td>
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<td>0.468</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[1.034]</td>
</tr>
<tr>
<td>Price Index Proxy Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.946</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[2.066]</td>
</tr>
</tbody>
</table>

| Observations            | 731     | 731     | 731     | 731     | 731     | 731     |
| R-squared               | 0.471   | 0.471   | 0.472   | 0.472   | 0.471   | 0.471   |
| No. of parameters       | 101     | 102     | 102     | 102     | 102     | 102     |
| AIC                     | 1083    | 1085    | 1084    | 1084    | 1085    | 1084    |
| BIC                     | 1551    | 1558    | 1557    | 1557    | 1558    | 1558    |

Notes:
- Structural parameters and expected sign in parentheses below regressor names. All specifications include country and industry effects. Clustered standard errors in brackets (industry x EC-10). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Sample: Spain and EC 10 countries, 1987-1985. Assumes $\sigma = 3$. AIC and BIC denote Akaike and Bayes Information Criterion. See Supplementary Appendix Table 1 for summary statistics.
Table 4: Reversal, attenuation and entry estimates

<table>
<thead>
<tr>
<th>Value of $\sigma$ =</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Reversal</td>
<td>0.36</td>
<td>0.39</td>
<td>0.42</td>
</tr>
<tr>
<td>(standard error)</td>
<td>(0.16)</td>
<td>(0.17)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Tariff elasticity attenuation factor</td>
<td>0.56</td>
<td>0.56</td>
<td>0.55</td>
</tr>
<tr>
<td>Entry growth, uncertainty removal (mean $\omega$)</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Entry growth, uncertainty removal (min $\omega$)</td>
<td>0.24</td>
<td>0.24</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Notes:
We use the initial uncertainty estimate from Table 3 in calculations. Probability of reversal = $\frac{b_0 - \sigma \cdot \frac{1 - \beta}{\beta}}{\sigma \cdot 1 - \beta}$, see Section 5.4, with s.e. obtained using delta method ($\beta = 0.85$). Conditional on $p_h$, the attenuation and theoretical uncertainty term $U$ can be derived using regression estimates independently of $\beta$ assumptions. We take $p_h = (Pr. \text{ reversal})^{0.5}$ and compute attenuation and entry growth at mean $\omega$. The attenuation factor is the ratio of the entry elasticity to tariff changes at initial uncertainty relative to no uncertainty, see equation (28). We compute entry due to uncertainty removal as the log difference in the number of entrants at post vs. initial uncertainty using $k \times [\ln(U_1) - \ln(U_0)]$ and assume post-uncertainty is removed, $U_1 = 1$.

Table 5: Entry counterfactuals and quantification

<table>
<thead>
<tr>
<th>Share of predicted entry probability due to:</th>
<th>Total</th>
<th>Spain</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty removal (at initial tariffs)</td>
<td>0.65</td>
<td>0.28</td>
<td>0.80</td>
</tr>
<tr>
<td>Tariff reduction (at initial uncertainty)</td>
<td>0.19</td>
<td>0.40</td>
<td>0.11</td>
</tr>
<tr>
<td>Complementarity</td>
<td>0.15</td>
<td>0.32</td>
<td>0.09</td>
</tr>
<tr>
<td>Share of predicted entry probability explained by policy</td>
<td>0.61</td>
<td>0.33</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Notes:
We use the initial uncertainty estimate from Table 3 in calculations (but results are similar if $\sigma = 2, 4$). Predicted average entry probability is the sum tariffs reductions, $b_\tau \Delta \ln \tau$, and removal of uncertainty at initial tariffs. Entry growth from uncertainty removal is the log difference in the number of entrants at post vs. initial uncertainty using $k \times [\ln(U_1) - \ln(U_0)]$ (we assume post-uncertainty is removed, $U_1 = 1$). Counterfactual shares of predicted entry hold initial tariffs and uncertainty fixed, respectively. The complementarity share captures the remaining entry growth from simultaneously reducing tariffs and uncertainty. The share of predicted entry probability explained by policy is the ratio of policy predictions relative to the one observed in the data.
Table 6: Value of exporting counterfactuals and quantification

<table>
<thead>
<tr>
<th>Share of predicted exporter value due to:</th>
<th>Total</th>
<th>Spain</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty removal (at initial tariffs)</td>
<td>0.57</td>
<td>0.00</td>
<td>0.79</td>
</tr>
<tr>
<td>Tariff reduction (at initial uncertainty)</td>
<td>0.10</td>
<td>0.22</td>
<td>0.05</td>
</tr>
<tr>
<td>Complementarity</td>
<td>0.34</td>
<td>0.78</td>
<td>0.16</td>
</tr>
<tr>
<td>Predicted growth in average value of exporter (p.p.)</td>
<td>9.6</td>
<td>22</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Notes:
We use the initial uncertainty estimate from Table 3 to calculate the average growth in the value of exporter as $\Pi_e(\tau_1, \gamma_1=0) - 1$, see equation (13) and section 5.4. Using the same formula, the share of uncertainty removal is computed with initial tariffs held fixed at $\tau_0$ followed by the share of tariff reductions with uncertainty held fixed at $\gamma_0 > 0$. The complementarity share captures the remaining exporter value growth from simultaneously reducing tariffs and uncertainty.

Table 7: Probability of reversal robustness

<table>
<thead>
<tr>
<th>Sample</th>
<th>1987-1985</th>
<th>1987-pre mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable (ln), no. of: varieties firms varieties firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of $\sigma = 2$</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>0.42</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Notes:
Assumes $\beta = 0.85$, for any other value of $\beta$, simply divide by $0.15/0.85$ and multiply by the new $(1-\beta)/\beta$. The 1987-1985 sample uses the growth between 1987 and 1985, which is the baseline. The 1987-pre mean sample uses the growth between 1987 and the average of the three years before the agreement: 83, 84, 85.

Table 8: Total exports counterfactuals and quantification

<table>
<thead>
<tr>
<th>Share of predicted total exports due to:</th>
<th>Total</th>
<th>Spain</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty removal (at initial tariffs)</td>
<td>0.59</td>
<td>0.23</td>
<td>0.75</td>
</tr>
<tr>
<td>Tariff reduction (at initial uncertainty)</td>
<td>0.28</td>
<td>0.53</td>
<td>0.17</td>
</tr>
<tr>
<td>Complementarity</td>
<td>0.13</td>
<td>0.24</td>
<td>0.08</td>
</tr>
<tr>
<td>Share of predicted total exports explained by policy</td>
<td>0.87</td>
<td>0.72</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Notes:
Calculations use an initial uncertainty estimate from the total export regression where $\sigma = 3$ and the probability of reversal is estimated at 0.45, see section 5.6 and appendix (results are similar if $\sigma = 2, 4$). Average predicted total exports are the sum of the tariff reduction, $B_\tau \Delta \ln \tau$, and the effect of uncertainty removal at initial tariffs. Total export growth from uncertainty removal is the log difference in exports at post vs. initial uncertainty using $(k-\sigma+1) \times \ln(U_1) - \ln(U_0)$ (we assume post-uncertainty is removed, $U_1 = 1$). Counterfactual shares of predicted exports hold initial tariffs and uncertainty fixed, respectively. The complementarity share captures the remaining export value growth from simultaneously reducing tariffs and uncertainty. The share of total export growth explained by policy is the ratio of policy predictions relative to exports observed in the data net of the aggregate growth in number of Portuguese firms.