

ABSTRACT

Title of dissertation: EXPORTING UNDER TRADE POLICY
UNCERTAINTY: THEORY AND EVIDENCE

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Policy commitment and credibility are important for inducing agents to make costly, irreversible investments. Policy uncertainty can delay investment and reduce the response to policy change. I provide theoretical and novel quantitative evidence for these effects by focusing on trade policy, a ubiquitous but often overlooked source of uncertainty, when a firm's cost of export market entry is sunk. While an explicit purpose of the World Trade Organization (WTO) and preferential trade agreements (PTAs) is to secure long term market access, little theoretical and empirical work analyzes the value of these agreements for reducing uncertainty to prospective exporters.

Within a dynamic model of heterogeneous firms, I show that trade policy uncertainty will delay the entry of exporters into new markets and make them less responsive to applied tariff reductions. Policy instruments that reduce or eliminate uncertainty such as PTAs or binding trade policy commitments at the WTO can increase entry even when applied protection is unchanged. I test the predictions for WTO commitments by a developed country, Australia, and the value of securing

preferences through a PTA for a developing country, Portugal circa 1986.

I test the model using a disaggregated and detailed dataset of product level Australian imports in 2004 and 2006. I use the variation in tariffs and binding commitments across countries, products and time, to construct model-consistent measures of uncertainty. The estimates indicate that lower WTO commitments increase entry. Reducing trade policy uncertainty is at least as effective quantitatively as unilateral applied tariff reductions for Australia. These results illuminate and quantify an important new channel for trade creation in the world trade system.

I use Portugal's accession to the European Community (EC) in 1986 to test whether securing pre-existing preferences reduced trade policy uncertainty for firms. I use a firm-level dataset of Portuguese exporters to show that net entry into EC was higher than what could have been achieved if the EC had simply lowered tariffs without admitting Portugal to the EC. Structural estimates from the model suggest that EC accession reduced the probability of preference reversals to higher tariffs by up to 24 percent.

EXPORTING UNDER TRADE POLICY UNCERTAINTY:
THEORY AND EVIDENCE

by

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2011

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Acknowledgments

I am grateful to my committee chair, Nuno Limão, for many helpful discussions, suggestions and encouragement. Substantial sections of Chapter 3 are based on joint research with Nuno. I also gained invaluable experience working with large firm-level datasets and much advice from my four years as a research assistant to John Haltiwanger. I want to thank the additional members of my committee: I.M. Destler, Ingmar Prucha and John Shea. All of them have spent substantial time teaching me economics and econometrics, reviewing my research or providing numerous helpful comments.

I also received helpful comments over the past five years from students, colleagues and faculty at Maryland and other institutions. These include Teresa Fort, Russ Hillberry, Hiro Kasahara, Don MacLaren, Javier Miranda, Tim Moore and Belén Sbrancia as well as seminar participants at Maryland, the US Census Bureau, the Rocky Mountain Empirical Trade Conference, University of Adelaide, University of Melbourne, the Kansas City Federal Reserve, the Federal Reserve Board, Michigan Ross School of Business, Dartmouth Tuck School of Business, Oregon State, and Stanford.

I thank the Australian Academy of Science for financial support and the Department of Economics at the University of Melbourne which hosted me while portions of this research were completed. This research was funded in part by NSF grant OISE-1015333.

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Introduction

Policy commitment and credibility are extremely important for inducing economic agents to make investments, particularly when they entail large irreversible costs. Trade policy is one area where commitment and credibility are potentially very important. The need for predictability is a founding principle of the World Trade Organization¹. Business and policy makers often cite predictable and secure policy regimes as benefits of joining preferential trade agreements.² Despite this, a substantial portion of global trade occurs under trade policy regimes that are not secure. For example, there was widespread fear of protectionism following the global financial crisis of 2008.³ Yet most theoretical and empirical trade research focuses on trade policy in static, deterministic frameworks. I show theoretically and empirically that when trade policy is uncertain, conducting analysis under *de facto* certainty can be misleading and overlooks a quantitatively important channel of gains from multilateral policy commitments.

The General Agreement on Tariffs and Trade (GATT), the precursor of the WTO, was formed in 1948 to prevent a repeat of the 1930s trade wars by securing multilateral commitments to eschew protectionism. Its founding charter states, “binding against increase of low duties or of duty-free treatment shall *in principle* be recognized as a concession equivalent in value to the substantial reduction of high duties or the elimination of tariff preferences.”⁴ But the principle that constraints

¹Under the principle “Predictability: through binding and transparency” the WTO explains that “Sometimes, promising not to raise a trade barrier can be as important as lowering one, because the promise gives businesses a clearer view of their future opportunities” http://www.wto.org/english/thewto_e/whatis_e/tif_e/fact2_e.htm (accessed October 27, 2010)

²Australian telecommunications provider Telstra contends that trade agreements “lock in existing levels of domestic liberalisation, preventing parties from introducing more restrictive measures in the future. This increases certainty and reduces foreign investment risk,” Telstra Corporation, Submission 31 to the Productivity Commission on Bilateral and Regional Trade Agreements, March 16, 2010, p.1

³To counter this perception the G-20 summit communique pledged “We will not repeat the historic mistakes of protectionism of previous eras.” <http://www.londonsummit.gov.uk/en/summit-aims/summit-communique/> (accessed November 9, 2010).

⁴Emphasis added. United Nations Conference on Trade and Employment, Final Act and Related Documents, Interim Commission for the International Trade Organization, April 1948, p. 31

on future policy could be as valuable as applied tariff concessions has never been widely accepted or quantified; the trade off continues to be a source of controversy in multilateral negotiations (Evenett, 2007).

Even though the potential for large scale “trade wars” currently seems remote, trade policy uncertainty is pervasive in the world trade system . For example, many countries enacted discriminatory and protectionist measures in the wake of the financial crisis. Global Trade Alert has since identified nearly 700 measures that have harmed foreign commercial interests (Evenett, 2010). I discuss these and other sources of uncertainty in section 2. My primary focus is on the tariff, one of several forms of applied protection that fall under the WTO rule-based system. WTO members make enforceable commitments not to raise applied tariffs above maximum binding constraints.⁵ These “bindings” are presently well above applied tariffs in some countries leaving wide scope for protectionism. Over 30 percent of the tariff lines of WTO members could be increased unilaterally without providing compensation to affected trade partners (Bchir et al., 2005). Australia, for example, could raise tariffs from an average of 3.8 to 11 percent; Indonesia from 6.7 to 35.6 percent, and; the average developing country from 8 to 28 percent (Messerlin, 2008). In short, the worst case scenario if governments were to backslide into protectionism, yet not violate any WTO rules is large. A goal of my research is to understand how these constraints affect uncertainty and to quantify their value.

0.1 Trade Policy Uncertainty in the World Trade System

There are good reasons to be concerned about trade policy uncertainty, and yet, there has been 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,

⁵A country that violated its bindings would have to provide compensation to affected trade partners or face WTO sanctioned retaliatory tariffs.

statutory tariff rates are legislated at most on a yearly basis. However, *applied* trade policy can be more volatile than what is suggested by statutory tariff rates, since tariffs are by no means the only type of protection. Limão and Tovar (2009) employ the estimates in Kee et al. (2009) and note that the trade restrictiveness index for the typical country in the world is equivalent to a uniform tariff of 14% , but 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.⁶

The ability to use unregulated policy instruments 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 international agreements; and the use of government procurement measures such as the “buy-American” provision attached to the US stimulus bill. Even though the worst fears of a trade war were not realized, the real possibility of such an outcome created uncertainty. Our model illustrates how these fears can affect investment and exporting decisions.

Turning to more permanent sources of trade policy uncertainty a number of examples stand out: first, concerns with product quality and safety raise the possibility that certain products may be completely banned from a market, e.g. genetically modified foods in the EU; second, the US threat of import duties to counter Chinese currency “manipulation”; third, the possibility of using “environmental” duties

⁶For example, in June 2001 the US started an investigation that eventually led to the steel safeguards of about 30% in March 2002. These duties remained in place for almost 20 months and were only removed after a negative ruling from the WTO. Foreign exporters of steel were not compensated for this loss. More generally, Grinols and Perrelli (2006) report that the typical U.S. dispute under the WTO lasts about 18 months with a large standard deviation of about 10 months. Another example of NTBs include anti-dumping duties, which can be punitive.

at the border to offset differences in carbon emissions in production. Even if these policies are a remote possibility, the fact that they would be significant and possibly permanent, if they materialize, can have important impacts on *current* investment and export decisions. It is conceivable that these effects could be larger than those of temporary exchange rate movements that may be hedged against.

One measure of governments' concern with this source of policy uncertainty are their attempts to negotiate trade agreements. 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. Reductions in applied tariffs after 1945 were small, but Irwin (1994) suggests the credibility of the GATT regime may have played a role in the trade and economic growth of post-war western Europe. 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 and allow(s) consumers to fully enjoy the benefits of competition."⁷ These channels will be central in the model below.

However, multilateral agreements are themselves uncertain in terms of timing, negotiation outcomes and implementation. Successive rounds of trade negotiations have repeatedly failed and later been resurrected. For example, an aborted attempt was made to start the Uruguay Round in 1982 and negotiations only restarted in 1986. After the UR, attempts to start a new round failed at Seattle in 1999. Moreover, each successive round has taken longer to complete than the previous—the UR took over 7 years to complete, twice as long as expected, and the Doha Round was launched in 2001 and it is still unresolved over nine years later. Even when an agreement is successfully concluded the implementation takes some time, disputes arise and not all policies are covered.

Moreover, multilateral agreements do not regulate all types of trade policy. This

⁷Accessed April 28 2010 at <http://www.wto.org/english/thewto_e/whatis_e/tif_e/fact2_e.htm>

can generate uncertainty in periods of crisis, as discussed above, but also in quieter times. To see why, note that two firms exporting a similar product to the same market may face very different policy barriers. While the tariffs that countries negotiate multilaterally must be available to all WTO members, this so called Most-Favoured-Nation (MFN) tariff is in practice often the policy faced by the “least-favoured-nation”. The reason is the myriad of preference schemes available. These include not only the standard PTAs but also unilateral preferences that the US, EU and several other developed countries extend to developing nations, e.g. through the Generalized System of Preferences (GSP). These preferences generate uncertainty for the “least-favoured-nations,” whose firms don’t know if they will face more competition from firms that receive preferences, and also are less certain of any future multilateral tariff reductions⁸.

Unilateral preference schemes, such as GSP, are also extremely uncertain for the recipients themselves. These preferences are often conditional not only on trade but also non-trade-related criteria that can and have triggered non-renewal for specific countries. Because these preferences are frequently altered or withdrawn on a country-specific basis, they create additional uncertainty for the intended recipients. The resulting instability is an oft-cited reason these programs may have been ineffective (Panagariya, 2006).⁹ This is one reason why recipients of such unilateral preferences try to negotiate more permanent arrangements, even if that requires them to open up their markets. For example, Peru and Colombia received unilateral preferences along with other Andean countries through the ATPA, and then sought FTAs with

⁸Limão (2006) and Karacaovali 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 UR.

⁹For example, the United States has allowed its Generalized System of Preferences (GSP) program to expire 7 times for periods lasting 2-14 months between 1993-2008 (Jones, 2008). China was subject to annual and contentious votes on renewal of its most favored nation (MFN) status in the U.S. Congress until joining the WTO in 2002. Bolivia was ejected from the Andean Trade Preferences and Drug Eradication Act in 2008 for a lack of cooperation in drug interdiction efforts.

the US to secure permanent preferential access.¹⁰ A USITC report describes the issue as follows:

”The probable future effects of ATPA are likely to be minimal, as investor uncertainty over ATPA renewal and concerns about the impact of recently negotiated U.S. bilateral FTAs with Colombia and Peru have dampened regional interest in investment to produce ATPA-eligible exports, particularly in Bolivia and Ecuador. (p. ix)” (USITC, 2008)

As just noted, preferences tend to be more secure when they are part of a formal and reciprocal preferential trade agreement (PTAs). There are currently hundreds of such arrangements, reflecting both trade and non-trade motives (Limão, 2007). Potential trade benefits include not only guaranteeing access to specific markets to secure pre-existing unilateral preferences (as described for US-Colombia, and as I will argue for Portugal’s EC accession) but also insuring (i) against some forms of protection in that country (e.g. U.S. PTA partners were exempt from the steel safeguards) or (ii) against a trade war breaking out in the rest of the world (Perroni and Whalley, 1994). But even the best laid plans to move forward on regional and bilateral arrangements are fraught with uncertainty. Plans for an FTA of the Americas began in the 1990s and have been abandoned. The US signed FTAs with Korea and Colombia that still await ratification years after the main negotiations ended. Similar issues have affected accessions to the European Market: the United Kingdom was initially vetoed for membership in the 1960s, but later joined the club in 1972; Turkey has been in negotiations for over 20 years; and Portugal’s road to full membership was also long and fraught with uncertainty, as I now describe.

¹⁰Singapore, Chile and Thailand were motivated for similar reasons to do the same with Australia (Pomfret et. al, 2010).

0.2 Literature Review

To examine the impact of policy uncertainty I focus on a dynamic model of firm investment and entry. If entry costs are sunk and 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 exchange rate processes 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 heterogenous, a fact that is important in 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.¹¹ Moreover, there is evidence of self-selection into exporting: i.e. that the larger, more productive firms are the ones that can overcome fixed costs and export. A large number of recent models incorporate firm heterogeneity and show it has important theoretical and empirical implications for trade (cf. Melitz, 2003, and Bernard et al. 2003). Especially important from my perspective is the fact that in this type of model the extensive margin may dominate the response of trade flows to reductions in trade barriers (as argued by Chaney, 2008) and that the failure to control for firm heterogeneity in gravity models results in an upward bias to aggregate estimates of trade frictions (Helpman

¹¹We 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.

et al., 2008). Therefore I will focus on a dynamic model of entry into exports where firms have heterogenous productivity.

The evidence of sunk costs in export-market entry (cf. Roberts and Tybout, 1997) has lead some to consider alternative sources of uncertainty that can generate hysteresis and real option problems in trade models. These sources of uncertainty include exchange rate, demand, productivity, and our focus, policy uncertainty. However, most theoretical and nearly all empirical analysis of uncertainty remains confined to the impact of exchange rate volatility, about which evidence remains mixed.¹² Das et al. (2007) find that sunk costs are quantitatively important in explaining export participation of marginal firms in Colombia and use a structural model to show that subsidies to sunk costs could raise entry substantially. They find limited evidence that exchange rate volatility affects entry and exit. More broadly, studies of the impact of exchange rate volatility on aggregate trade flows find that the effect is negative but “fairly small and is by no means robust” (IMF, 2004, p.6).¹³

Policy uncertainty in general has received only limited attention in the literature. The difficulty is that most policy variations are not readily modeled by a standard stochastic process, in part because major regime changes may be large but low frequency “rare events.”¹⁴ Even if feared reversals to disastrous trade protection or threatened trade wars never materialize, the small possibility of these worst case scenario outcomes can have measurable economic effects, as Barro (2006) has recently shown for asset markets. Most work in this area is theoretical. Rodrik (1991), for

¹²Campa (2004) finds evidence of sunk costs of entry for Spanish firms but smaller than anticipated effects of exchange rate volatility. Baldwin (1988) uses aggregate data and finds that large exchange rate shocks in the 1980s may have led to “beachhead effects”. But given the aggregate nature of the data he is unable to rule out alternative explanations for the findings.

¹³Irrarazabal and Oromolla (2009) incorporate evolving productivity uncertainty into a heterogeneous firms model to show that sunk costs can generate a large number of small persistent exporters, which is consistent with having an option value of waiting to exit. Arkolakis (2009) explains this same pattern by assuming increasing fixed costs of market penetration to reach consumers in a model without an option value of waiting to enter.

¹⁴This leads Hassett and Metcalf (1999) to model the application and removal of an investment tax credit as a Poisson jump process. They find such a model is more consistent with observed firm behavior when output prices are already subject to uncertainty.

example, develops a model of capital investment when firms believe an investment tax credit reform may be reversed in the future. If the probability of a policy reversal is high, a reform to promote investment may produce exactly the opposite outcome.¹⁵

A small body of work has considered the impact of trade policy uncertainty on entry, exit and trade. Irwin (1994) analyzes the impact the GATT for western Europe in the decade following World War II. He concludes that tariff reductions under the GATT were limited, but the commitment to lock-in existing tariffs under a credible international agreement may have played an important role in post-war economic recovery and trade growth. Evenett et al. (2004) use the differences between preferential tariffs and MFN tariffs in the period before and after WTO accession to test the importance of tariff security. Results for Bulgaria and Ecuador are mixed. Francois and Martin (2004) demonstrate that tariff volatility can have negative welfare implications. They provide simulation evidence that by truncating the distribution of tariffs, WTO bindings on agricultural products within the OECD could reduce the tariff volatility. An older body of literature examines optimal trade policy under risk aversion. For example, Anderson and Young (1982) show that import quota ceilings can reduce uncertainty about domestic and foreign demand conditions.

More broadly, this research is related to the ongoing empirical debate regarding the value of multilateral and bilateral agreements. Rose (2004), for example, questions whether there are any tangible benefits to WTO membership. Subramanian and Mattoo (2008) contend that there is little need to conclude a multilateral round of new commitments because the proliferation of PTAs has locked in low applied tariff rates. But the aggregate evidence on trade growth following PTAs is also mixed. Some studies have found PTAs increase trade by nearly 100% or more over the long run (Baier and Bergstrand, 2007; Magee 2003). In other cases, trade growth is small

¹⁵Johnson et al. (1997) show that reform credibility is essential to inducing firms to switch to costly but more productive technology. Empirically, Aizenman and Marion (1993) show that high volatility of monetary and fiscal aggregates has negative effects on investment and growth in cross-country regressions.

or even negative. The effects vary by agreement, region and time period (Frankel, 1997; Baier, Bergstrand and Vidal, 2007). Much less is known about the mechanism behind this growth because most empirical work does not examine the details of PTA policy changes (Hillberry, 2009). For example, Kehoe (2005) shows how applied general equilibrium models grossly under-predicted trade growth following NAFTA on an *ex-ante* basis. Ruhl (2008) provides a related explanation to the mechanism in this paper. If PTAs are large permanent reductions in trade frictions, then expected profits in all future states of the world are higher. This induces entry and increases trade flows on average.

Other explanations for large increases in trade following PTAs include competitive reallocation and productivity enhancing investment following trade liberalization (Constantini and Melitz, 2008; Chaney, 2005; Treffer, 2004) and vertical specialization where goods cross multiple borders in stages of production (Yi, 2003; Hummels, Ishii and Yi, 2001). Both channels leave room for trade policy uncertainty to play a complementary role. Reallocation from entry, exit and investment and the choice to vertically fragment production are firm decisions made under uncertainty about trade policy. Reductions in uncertainty over the joint distribution of tariffs across multiple borders could amplify the effects of reallocation or vertical specialization on trade flows.

Recent research has examined the effects of time-varying aggregate uncertainty on firm investment. Bloom et al. (2007) examine investment at a panel of UK firms. They measure aggregate uncertainty using the volatility of the stock market. Bloom (2007) discusses the effect of uncertainty on R&D spending. A central finding of this research is that uncertainty diminishes planned investment in two ways. The first is a “delay effect” whereby firms put off investments in response to increasing uncertainty. The second is a “cautionary effect” that leads firms to reduce the responsiveness of planned investment to positive demand shocks under uncertainty. These measures

and concepts of uncertainty differ from trade policy uncertainty in important ways. Policy processes are distinct from the standard stochastic processes often posited for other macroeconomic variables. The actual degree of aggregate uncertainty is not observed. This requires proxy measures of uncertainty such as stock market volatility and firm growth rate dispersion. Unlike trade policy uncertainty, there is also little to no measurable variation in aggregate uncertainty across firms or products to study and exploit empirically. Nevertheless, I do adopt the same “caution” and “delay” terminology since the underlying mechanism driving these effects is related.

0.3 Outline of Thesis

0.3.1 Theory

I consider how changes in trade policy regimes such as preferential trade agreements (PTAs) and multilateral commitments could reduce trade policy uncertainty. When the costs of market entry are sunk, uncertainty over future conditions can generate an option value of waiting until uncertainty is resolved or conditions improve (Dixit, 1989). There is strong empirical evidence of sunk costs to export market entry, but most previous research has focused on the impact of exchange rate uncertainty with mixed findings (Roberts and Tybout, 1997; Das et al., 2007; Alessandria and Choi, 2007; Campa, 2004). Of the many sources of uncertainty faced by a prospective exporter (e.g. exchange rate or demand shocks), the trade policy toward the firm’s goods poses a country and product specific risk that is difficult if not impossible to diversify.

I use a dynamic, heterogeneous firms trade model similar to Chaney (2008) in which firm productivities are known *ex-ante*. Firms must decide whether and when to begin exporting when foreign market entry costs are sunk and there is uncertainty

over trade policy.¹⁶ I use a stochastic process which incorporates uncertainty over the timing of trade policy changes and the magnitude of those changes when they arrive. Prospective entrants compare the value of beginning to export today versus waiting. On the margin, the expected value of waiting to enter until applied policy conditions improve exactly offsets the expected upside from future reductions in protection conditional on entry. The present value of the difference between exporting and waiting reflects only the potential for “bad news” and this leads firms to delay entry. Several roles emerge for policy constraints and stability on the extensive margin: first, I show that bindings reduce uncertainty by censoring the range of observable tariffs and limiting losses in the worst case scenario; second, the frequent arrival of policy changes reduces the level of firm entry; and third, firms respond more cautiously on the extensive margin when tariff changes are likely to be quickly reversed or when tariffs can reach substantially higher levels in the future.

0.3.2 Product Level Evidence: Australia

Despite the dynamic nature of the model, I provide a closed form solution for the firm entry decision as a function of applied policy and uncertainty parameters. I derive a structural equation and measures of uncertainty from the model to test whether binding commitments and PTAs reduce trade policy uncertainty. I formulate this in terms of a latent variable capturing the value of entry and estimate a linear probability model of observing trade in a disaggregated product as a proxy for firm entry. The method is novel for two reasons: first, I am able to use the observable levels of tariff bindings to *test* for the impact of uncertainty with the standard deterministic model nested as a null hypothesis; second, the uncertainty measures can be directly controlled by policy so I can use the estimated model to quantify the relative impact

¹⁶In contrast, a firm in the standard Melitz (2003) model has initial uncertainty about its productivity which is resolved *ex-post* after paying a sunk cost of entry. A free entry condition combined with an unbounded mass of identical potential entrants drives the option value of waiting to zero.

of reducing applied protection versus the impact of reducing tariff uncertainty.

The empirical method requires detailed product level trade data and corresponding data on applied and bound tariffs for a single importer. I focus on Australia's "most favored nation" trade partners in the years 2004 and 2006. High quality and detailed data on products and tariffs are available during this period and, more importantly, there is wide variation across products in binding commitments. As described in Section 2.1, other aspects of Australian trade policy raise issues of uncertainty that are hardly unique to this application. I find that lower bindings, holding applied tariffs fixed, bring the entry decision forward and make firms more responsive to tariff changes on the margin. My estimates indicate that cautionary effects due to uncertainty make firms over 30 percent less responsive to tariff reductions in the average Australian tariff line. The model predicts that if Australia unilaterally reduced tariffs to free trade levels, the number of traded products would increase by 6 percent. Alternatively, if Australia both reduced tariffs to zero and bound them through WTO commitments, the combined impact of removing the motives for caution and delay would increase the number of traded products by over 12 percent. These estimates empirically quantify the value of binding tariff commitments for the first time.

0.3.3 Firm Level Evidence: Portugal

In Chapter 3, I study Portugal's accession to the European Community in the 1980s using firm-level export data. The application is complementary to the findings in Chapter 2 for several reasons. First, Portugal was a developing country in 1980s. Understanding the role of uncertainty in EC accession carries lessons for other developing countries joining regional PTAs. Second, the application studies firm-level data on exports from a single country, Portugal, to many potential destinations. This permits direct estimation and interpretation of some structural parameters from the model. Third, the primary risk to Portuguese exporters at the time of accession was

losing preferential market access to the EC rather than a reversal to binding tariff levels.

To approach this application, I derive a structural equation for net export market entry at the industry level to estimate whether EC accession reduced trade policy uncertainty. The estimates imply that Portuguese firms placed a 24% probability on the possibility of losing preferential access to the EC before accession. Entry following accession was higher than what would have occurred if the reduction in current tariffs had not been credible.

Chapter 1

A Theory of Export Market Entry Under Trade Policy Uncertainty

1.1 Deterministic Model

The basic setup is similar to Chaney (2008) and Helpman et al. (2008), but extended to a deterministic multi-period framework. The world has J exporting countries indexed by j . Each country has L_j consumers that inelastically supply labor to the market. I consider a single importer, but the model can be extended to a multi-country world. Goods shipped to the importing country are subject to tariffs which may vary by export country of origin and industry. The focus of the model is the effect on trade and market entry patterns of different trade policy regimes. In the following section, I extend this analysis to a stochastic tariff process and compare the results to the deterministic outcomes in order to draw out the role of policy uncertainty for trade.

1.1.1 Preferences

Utility in the importing country is a Cobb-Douglas function over a homogeneous traditional good traded on world markets at zero cost and a continuum of differentiated varieties indexed by v :

$$U = q_0^{1-\mu} \left(\int_{v \in \Omega} q(v)^\alpha dv \right)^{\mu/\alpha}, \quad \alpha = \frac{\sigma - 1}{\sigma} \quad (1.1)$$

where $\sigma > 1$ is the elasticity of substitution between varieties. The total set of varieties available Ω is the union of all domestically produced varieties and those

that are imported from abroad with an expenditure share of $\mu \in (0, 1)$. Utility is maximized subject to the budget constraint on total income Y :

$$p_0 q_0 + \int_{v \in \Omega} p(v) q(v) dv = Y. \quad (1.2)$$

This yields the usual demand function for any particular variety v :

$$q(v) = \mu Y \frac{p(v)^{-\sigma}}{P^{1-\sigma}} \quad (1.3)$$

The price $p(v)$ is the delivered consumer price in the importing country. The price index is

$$P = \left[\int_{v \in \Omega} (p(v))^{1-\sigma} dv \right]^{1/(1-\sigma)} \quad (1.4)$$

In each exporting country j , some product varieties are only consumed domestically, but a fraction are exported overseas. Varieties are differentiated by the producing firm and country of origin. The set of foreign varieties available in the importing country is endogenous and derived below.

1.1.2 Production and Tariff Barriers

The homogeneous good is freely traded and produced under CRS such that one unit of the good is produced for $1/w_j$ units of labor in country j . I take the homogeneous good as numeraire and normalize its price to unity, $p_0 = 1$. Labor market clearing implies that the wage for country j is w_j . The differentiated goods are subject to trade costs. These take the form of ad-valorem tariffs that may vary by exporter j . I let $\tau_j \geq 1$ equal one plus the ad-valorem tariff for goods shipped from country j . Tariffs are paid at the border by consumers on the factory price. If an exporter of variety v charges price $p_j(v)$ at home, the final consumer abroad

pays $p(v) = \tau_j p_j(v)$. There are no tariffs on domestic sales for firms in the importing country (i.e. $\tau = 1$).

A firm producing variety v in exporter j is identified by its unit labor requirement $c_j(v)$. The total variable costs to produce q units of a differentiated product are $w_j c_j(v) q_j(v)$. Operating profits from exporting for a firm with unit labor costs c_j are

$$\pi_j(p) = p_j(v) q_j(\tau_j p_j(v)) - w_j c_j q_j(\tau_j p_j(v)) \quad (1.5)$$

In this setup, the exporter takes account of the fact that import tariffs will reduce demand and scale down revenues. Profit maximization by monopolistically competitive firms yields the standard markup rule over marginal cost. The consumer price on a good shipped from country j is

$$p_j = \frac{w_j \tau_j c_j}{\alpha} \quad (1.6)$$

Combining the formulas for the markup rule, consumer demand and variable costs, the per period operating profits of exporting from country j can be expressed compactly as

$$\pi_j(v) = A_j \tau_j^{-\sigma} c_j(v)^{1-\sigma} \quad (1.7)$$

where $A_j = (1 - \alpha) \mu Y \left[\frac{w_j}{P \alpha} \right]^{1-\sigma}$.

The quantity A_j summarizes exporter cost and importer demand conditions.

I index variation in aggregate productivity across exporting countries by $1/M_j$. I then assume there is a distribution of firms, $G(c)$, which summarizes the heterogeneity in unit costs within each country and is bounded below at c^L . The lowest unit cost firm in country j , c_j^L has a productivity of $\frac{1}{M_j c^L}$.

1.1.3 Entry, Exit and Sunk Costs

There is a fixed cost of market entry K_e paid by a firm to begin exporting. Entry costs cover the expenses of setting up a distribution network, on-site visits or agency costs, marketing, tailoring products to local markets and complying with safety regulations. There are no fixed entry or per period maintenance costs in a firm's domestic market. Since operating profits are always positive, albeit potentially quite small, every firm sells in its home market. A subset of firms pay the entry cost and begin exporting if their unit costs are below a threshold cutoff level. Following Melitz (2003), exit is induced by an exogenous death shock δ . A firm that is hit by the death shock exits immediately without recouping its sunk costs.

In a deterministic environment, where $\pi_j(t) = \pi_j$ in the foreseeable future, the firm will enter an export market if the net present discounted value of entry is positive. The value of entry today is

$$V^D = \sum_{t=0}^{\infty} \beta^t \pi_j - K_e \quad (1.8)$$

$$= \frac{\pi_j}{1 - \beta} - K_e \quad (1.9)$$

where superscript D denotes “deterministic” tariffs. The discount factor combines the true discount rate ρ and the death shock such that $\beta = (1 - \delta)/(1 + \rho)$. Free entry implies that in equilibrium $V^D = 0$ for the marginal entrant. Imposing this condition yields a multi-period zero cutoff profit threshold for unit labor costs c_j^D

$$c_j^D = \left[\frac{A_j \tau_j^{-\sigma}}{(1 - \beta) K_e} \right]^{1/(\sigma-1)} \quad (1.10)$$

All firms with unit costs below c_j^D will pay the entry cost and begin exporting. It is straightforward to derive that the elasticity of c_j^D to a once-and-for-all change in τ is $\frac{\sigma}{\sigma-1}$.¹

1.2 Stochastic Setup

1.2.1 A framework for trade policy uncertainty

In practice, the level of future tariffs is uncertain. Many factors can affect the formation of trade policy over time. I take shocks to trade policy as given and do not explicitly model their source. Tariffs are a random variable with two sources of variation: uncertainty over the timing of policy changes, and uncertainty over the magnitude of those changes when they arrive. Even though the outcome of policy changes is unknown *ex-ante*, firms can form expectations over the likely tariff outcomes.

To model tariff uncertainty, I assume shocks to the path of tariffs arrive with probability γ per unit of time.² When a shock arrives, a policy maker sets a new tariff τ' . Firms know the value of γ and can assign probability measures to different tariff outcomes. The space of potential tariff outcomes and their likelihood are summarized by the distribution function $H(\tau')$ with support $[1, \tau_{max}]$. The support allows the possibility of free trade ($\tau = 1$) or a theoretical maximum tariff τ_{max} . Conceptually, letting $\tau_{max} \rightarrow \infty$ admits the possibility of total autarky.

Given τ_t , the arrival rate of shocks and the policy distribution, the conditional

¹This is higher than the usual elasticity of unity because tariffs are paid at the border, rather than as part of the firm's variable trade cost technology.

²In continuous time, a similar Poisson process for the arrival of tax policy changes can be found in Rodrik (1991) and Hassett and Metcalf (1999).

expected value and variance of the tariff next period are

$$E_t(\tau_{t+1}) = (1 - \gamma)\tau_t + \gamma E(\tau') \quad (1.11)$$

$$\text{Var}_t(\tau_{t+1}) = \gamma(1 - \gamma)[\tau_t - E[\tau']]^2 + \gamma \text{Var}[\tau']. \quad (1.12)$$

The quantity $E(\tau')$ is the unconditional expected tariff drawn from $H(\tau')$, given that a policy shock occurs. The expected tariff in the next period depends only on the level of the tariff today and the stochastic process for tariff changes. The long run autocorrelation of the tariff is $1 - \gamma$. A stable trade policy regime will have a low value of γ and as a result will display high persistence in tariffs. Even with persistence, this structure allows for the possibility of large shocks if $H(\tau')$ has thick tails. In contrast, frequent policy changes (high γ) do not necessarily generate high uncertainty if $H(\tau')$ has small dispersion.

The model permits a straightforward treatment of the impact of PTAs and bindings on the entry decision. PTA implementation affects two parameters: the probability of the tariff change γ , and the levels of current and future tariffs τ_t . If a PTA is credible, the firm's problem approaches the deterministic cutoff and this is modeled by letting $\gamma \rightarrow 0$.

Even if the PTA does not reduce γ to zero, tariff bindings can have an effect on entry by limiting the magnitude of a worst case scenario tariff shock. A credible WTO binding is the maximum tariff permitted by WTO rules. The commitment to bind tariffs is a constraint on observable tariff outcomes such that the distribution of future tariffs, $H(\tau')$, is censored at the binding. By analogy to Tobit regression, censoring captures the idea that a policy maker might want to set a tariff above the binding but WTO legal constraints mean that only the binding tariff is actually observed.

I let B denote the binding level of the maximum tariff. For a binding to be

effective, it must be below the maximum of the unbound tariff distribution such that $B < \tau_{max}$. Binding commitments induce a mixed discrete and continuous distribution over tariffs. A formal statement of the *bound* tariff distribution appears in the appendix. When a policy shock arrives, the new tariff is a random draw from $H(\tau')$. There is a discrete probability $H(B)$ that the tariff draw is below the binding. But with probability $1 - H(B)$, the tariff draw is above the binding and only the bound tariff rate is observed. The probabilities of extreme draws in the unbound distribution of τ are placed at the binding, thus reducing the mean and variance of tariffs.

1.2.2 Entry and Exit under Uncertainty

Under a stochastic tariff process, there is an option value of waiting with a structure similar to Baldwin and Krugman (1989). While the current tariff is known, future profit flows are subject to the stochastic process for tariffs. The firm's decision to enter an export market is an optimal stopping problem. Firms can be divided into exporters, state 1, and non-exporters, state 0. The value of being an exporter in the current period is V^1 . A firm that is in state 1 exits only when hit by the death shock. Non-exporters hold an option value of waiting to enter in the future V^0 . Non-exporters will enter a foreign market only when the value of exporting less sunk entry costs exceeds the value of waiting such that $V^1 - K_e \geq V^0$.

The decision rule for each firm is defined by the trigger tariff τ_1 that makes the firm just indifferent between entry and waiting. For each firm, identified by its unit labor requirement c , the entry trigger τ_1 implicitly solves the indifference condition

$$V^1(\tau_1) - K_e = V^0(\tau_1) \tag{1.13}$$

A firm will enter the export market if $\tau_t \leq \tau_1$.

Four equations define the initial problem at time t of a firm with unit labor

requirement *c*. For clarity of exposition, I drop the country of origin subscripts. The value of exporting is

$$V^1(\tau_t) = \pi(\tau_t) + \beta \left[\underbrace{(1 - \gamma)V^1(\tau_t)}_{\text{No Shock}} + \underbrace{\gamma EV^1(\tau')}_{\text{Shock Arrives}} \right]. \quad (1.14)$$

The quantity $V^1(\tau_t)$ is the expected present discounted value of operating profits conditional on the current tariff τ_t . With probability $1 - \gamma$, the firm continues to the next period with the same value $V(\tau_t)$. With probability γ , a policy shock arrives and the tariff changes. The *ex-ante* expected value of exporting following a policy change to a new tariff τ' is

$$EV^1(\tau') = E\pi(\tau') + \beta[(1 - \gamma)EV^1(\tau') + \gamma EV^1(\tau')] \quad (1.15)$$

In time period t , the unconditional expected value of being an exporter next period given that a policy shock arrives is $EV^1(\tau')$ in (1.15). This expectation is time invariant because I assume that the distribution of future tariffs $H(\tau')$ is time invariant. If a policy shock arrives in the next period or ten periods from now, the *ex-ante* expected value of the tariff draw and profits remain the same. Equation (1.15) can be solved explicitly for $EV^1(\tau')$ to obtain

$$EV^1(\tau') = \frac{E\pi(\tau')}{1 - \beta}.$$

The resulting time invariance of $EV^1(\tau')$ does not mean that the value of exporting is time invariant. $V^1(\tau_t)$ is a function of the current tariff and firms can re-compute it on an *ex-post* basis following every tariff policy change.

The second part of the firm's problem is the value of waiting

$$V^0(\tau_t) = 0 + \beta \left[\underbrace{(1 - \gamma)V^0(\tau_t)}_{\text{No Shock}} + \underbrace{\gamma(1 - H(\tau_1))V^0(\tau_t)}_{\text{Shock Above Trigger}} + \underbrace{\gamma H(\tau_1)(EV^1(\tau_1 | \tau \leq \tau_1) - K_e)}_{\text{Shock Below Trigger}} \right] \quad (1.16)$$

A firm that waits receives zero profits in the current period. If no policy shocks arrive or the shock is above the entry trigger, the value of waiting remains V^0 . If a policy shock arrives next period, it will be below τ_1 with probability $H(\tau_1)$. If the new tariff draw is below the entry trigger, $\tau' \leq \tau_1$, the firm will pay the sunk cost and transition to exporting. Conditional on waiting until the tariff falls below the entry trigger, the expected value of exporting is now

$$EV^1(\tau_1 | \tau \leq \tau_1) = E\pi(\tau' | \tau' < \tau_1) + \beta[(1 - \gamma)EV^1(\tau_1 | \tau_t \leq \tau_1) + \gamma EV^1(\tau')] \quad (1.17)$$

This equation is structurally the same as (1.14), but it is evaluated *ex-ante* to obtain the expected value of exporting to a firm that delays entry until a more favorable policy shock arrives. If a firm waits to enter in the current period, it must be the case that $\tau_t > \tau_1$. Expected profits at the time of entry are greater than profits today such that $\pi(\tau_t) < E[\pi(\tau') | \tau' \leq \tau_1]$. Inevitably, a policy shock will eventually occur and the value of exporting after an initial delay will transition to the unconditional expected value of exporting given by (1.15).

The set of four equations (1.14),(1.15),(1.16), and (1.17) is a linear system in the four quantities $V^1(\tau_t), EV^1(\tau'), V^0(\tau_t)$, and $E[V^1(\tau_1 | \tau \leq \tau_1)]$ and can be solved explicitly. A full derivation appears in the appendix, but the results that follow require expressions for only the current values of entry and waiting for the marginal firm. The entry margin corresponds to the firm with unit labor requirement c^U that

is just indifferent to entry or waiting at time t .³ For this marginal firm, the current tariff equals the entry trigger such that $\tau_t = \tau_1$. The corresponding value functions are

$$V^1(\tau_1) = \frac{\pi(\tau_1)(1 - \beta) + \beta\gamma E[\pi(\tau')]}{[1 - \beta(1 - \gamma)](1 - \beta)} \quad (1.18)$$

$$V^0(\tau_1) = \beta\gamma H(\tau_1) \frac{(1 - \beta)E[\pi(\tau') | \tau' < \tau_1] - \beta\gamma E[\pi(\tau')] - (1 - \beta)[1 - \beta(1 - \gamma)]K_e}{[1 - \beta(1 - \gamma)][1 - \beta(1 - \gamma H(\tau_1))]} \quad (1.19)$$

The expression in (1.13) defines a zero cutoff profit condition for the entry margin. Despite the apparent complexity of (1.18) and (1.19), a closed form expression for the cost cutoff c^U exists. I solve for the cutoff in two steps to draw out more intuition from the model. Setting the difference between V^1 and V^0 equal to entry costs K_e and simplifying terms yields

$$K_e = \left[\frac{\pi(c^U, \tau_1)}{1 - \beta(1 - \gamma)} + \frac{\beta\gamma E(\pi(c^U, \tau'))}{(1 - \beta)[1 - \beta(1 - \gamma)]} + \frac{\beta\gamma H(\tau_1)[\pi(c^U, \tau_1) - E(\pi(c^U, \tau') | \tau' < \tau_1)]}{(1 - \beta)[1 - \beta(1 - \gamma)]} \right] \quad (1.20)$$

The first term in brackets is the PDV of profits at the entry tariff where the discount factor is scaled down by the probability that no policy shock arrives. If this model were deterministic, the firm would discount by $1 - \beta$ and the next two terms would disappear. The second term is the present value, following a shock, of profits at the *ex-ante* expected tariff. The third term is a negative opportunity cost of entry. It is the present value of the expected loss of entering today, given that a future policy change is below the tariff entry trigger.

In the second step, I solve (1.20) directly for c^U and express it in terms of an

³Superscript U denotes the “uncertain” environment in contrast the the “deterministic” environment D .

uncertainty component $\Theta(\tau_t)$ and the deterministic cutoff c^D :

$$c^U = \Theta(\tau_t) \times c^D \quad (1.21)$$

$$\text{where } \Theta(\tau_t) = \left[\frac{1 - \beta + \beta\gamma\Delta(\tau_t)}{1 - \beta + \beta\gamma} \right]^{\frac{1}{\sigma-1}} \quad (1.22)$$

As shown in the appendix, $\Theta(\tau_t) \leq 1$ since $\Delta(\tau_t) \leq 1$. For a given current tariff, uncertainty over the tariff generates a lower cost cutoff than a deterministic model. The productivity premium necessary to overcome this hurdle is the ratio of c^D and c^U , or $\frac{1}{\Theta}$.

The expression for $\Delta(\tau_t)$ captures the random variation in the tariff conditional on a policy shock arrival. In the appendix, I show the following:

$$\Delta(\tau_t) = \frac{E(\tau^{-\sigma}) + H(\tau_t)[\tau_t^{-\sigma} - E(\tau^{-\sigma} | \tau \leq \tau_t)]}{\tau_t^{-\sigma}} \quad (1.23)$$

$$\Delta(\tau_t) - 1 = (1 - H(\tau_t)) \left[\frac{E(\tau^{-\sigma} | \tau \geq \tau_t) - \tau_t^{-\sigma}}{\tau_t^{-\sigma}} \right] \leq 0$$

I interpret $\Delta(\tau_t) - 1$ as the expected proportional reduction in operating profits that occurs following a bad shock. The leading term $(1 - H(\tau_t))$ is the probability of a shock that exceeds the current tariff for the marginal firm. The term in brackets is the expected proportional loss in profits, starting from τ_t , if a bad shock arrives. The inequality is always strict except when the current tariff is at the maximum of the tariff distribution, in which case $c^D = c^U$.

Even though another policy shock could induce a new tariff that is higher or lower than the current tariff, it is only the prospect of a bad shock that affects the decision of whether to enter today. This is an example of the “bad news” principle identified in Bernanke (1983) which holds despite the convexity of profits in tariffs. When a firm enters, it weighs the expected PDV of profits from entering today against the value of waiting for a better shock in the future. Because good news in the future

is offset by the opportunity cost of entry, only bad news matters when the entry investment is irreversible.

In terms of the stochastic process for tariffs, the model includes the deterministic environment as a special case. When $\gamma = 0$ exactly, the option value of waiting vanishes in equation (1.19). Both the stochastic value of entry in equation (1.18) and the zero cutoff profit threshold collapse to their deterministic counterparts. In effect, implementing a PTA can move firms toward the solution of the deterministic problem.

Lastly, since the prospect of “bad news” is a key element in a firm’s entry decision, bindings play an important role by limiting losses in tariff reversals. This effect feeds through to a reduction in the firm’s expected proportional reduction in profits given a reversal to higher tariffs.⁴

1.2.3 Implications of Uncertainty for the Entry Cutoff

Uncertainty about future trade policies delays entry at the margin relative to the deterministic model. Reducing uncertainty will lead prospective firms to bring entry forward even if applied tariffs remain unchanged. Uncertainty also makes firms on the margin more cautious. For a given tariff reduction, the elasticity of the entry cutoff to changes in tariffs is attenuated by uncertainty. These results, caution and delay, can be derived analytically and have important implications for policy. Detailed derivations appear in the appendix.

PROPOSITION 1 [*Caution*] *The entry cutoff c^U is less elastic with respect to tariff changes in the stochastic model relative to once-and-for-all deterministic tariff changes. Formally,*

$$\varepsilon^U(\tau_t) = \frac{\partial \log c_j^U}{\partial \log \tau_t} > -\frac{\sigma}{\sigma-1} = \frac{\partial \log c_{ij}^D}{\partial \log \tau_t} = \varepsilon^D(\tau_t)$$

⁴A binding augmented version of the profit loss term $\Delta(\tau_t, B)$ is derived in the appendix.

PROOF:(see appendix)

The expected profit loss of a bad shock is decreasing in the current tariff τ_t . As the current tariff τ_t increases, the expected reduction in profits given a reversal grows smaller. Formally, I show in the appendix that the semi-elasticity of the profit loss term $\Delta(\tau_t)$ to tariff changes is

$$\frac{\partial \Delta(\tau_t)}{\partial \ln \tau_t} = \frac{\sigma[(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)]}{\tau^{-\sigma}} \geq 0$$

If $\tau_t = \tau_{max}$, $\Delta(\tau_t)$ equals one, $c^U = c^D$ and the derivative goes to zero since there is no scenario worse than the present. This implies the proportion of profits lost in a tariff reversal, $\Delta(\tau_t) - 1$, is reduced.

By log differentiating the expression for c_j^U from equation (1.21), I derive the elasticity as

$$\begin{aligned} \varepsilon^U(\tau_t) &= \frac{d \ln c_t^D}{d \ln \tau_t} + \frac{d \ln \Theta_t}{d \ln \tau_t} \\ &= -\frac{\sigma}{\sigma - 1} \left[1 - \left(\frac{\beta\gamma}{(1 - \beta + \beta\gamma\Delta)} \left(\frac{[(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)]}{\tau_t^{-\sigma}} \right) \right) \right] \end{aligned}$$

The term in brackets, denoted by $\phi(\tau_t)$ in the proposition, is less than or equal to one.

In absolute magnitudes $|\varepsilon^U(\tau_t)| < |\varepsilon^D(\tau_t)|$ and the responsiveness of the entry margin is reduced under uncertainty. The two exceptions (limiting cases) are when $\gamma = 0$ (i.e. tariffs are deterministic) or when τ_t is already at the maximum of the tariff distribution. In either case, the elasticity of the cutoff under uncertainty evaluated at the tariff maximum equals the elasticity at the deterministic cutoff.

Trade policy uncertainty also generates first order reductions in the entry margin. These are summarized in the following proposition.

PROPOSITION 2 [*Delay*] Higher bindings or higher arrival rates of policy shocks reduce the entry cutoff, c^U , by delaying investment in market entry. In elasticity terms:

(a) *Arrival Rates*

$$\varepsilon(\gamma) = \frac{d \ln c_t^U}{d \ln \gamma} = \frac{d \ln \Theta_t}{d \ln \gamma} = \frac{\beta\gamma}{\sigma - 1} \left[\frac{1 - \beta}{(1 - \beta(1 - \gamma))((1 - \beta(1 - \gamma\Delta)))} \right] (\Delta - 1) < 0$$

(b) *Bindings*

$$\varepsilon(B) = \frac{d \ln c_t^U}{d \ln B} = \frac{d \ln \Theta_t}{d \ln B} = -\frac{\sigma}{\sigma - 1} \left(\frac{\beta\gamma}{(1 - \beta + \beta\gamma\Delta)} \left(\frac{(1 - H(B))B^{-\sigma}}{\tau_t^{-\sigma}} \right) \right) < 0$$

PROOF:(see appendix)

This proposition isolates the effects of policy shock timing and magnitudes into two components. First, increases in the arrival rate of policy shocks reduce entry. In the deterministic limit $\varepsilon(\gamma) = 0$ and this delay effect vanishes. The effect is independent of the form of the tariff distribution $H(\tau')$. Future tariffs could have a lower expected value than current tariffs and some firms would still delay entry. This follows from the option value of waiting. If a more favorable tariff regime is on the horizon, delaying entry may be optimal. Similarly, when current tariffs are low and expected tariffs are high, firms on the margin will wait to enter. Second, binding reductions can increase entry, even if they do not constrain the current applied tariff, by mitigating the worst case scenario and bringing entry forward. In an environment where policy shocks cannot be eliminated, lower bindings can raise trade even if the binding is above the current period applied tariff. On the extensive margin, binding reductions could be just as effective as applied tariff reductions for increasing trade.

1.2.4 Testable Predictions

These propositions provide theoretical grounding for the empirical application that follows. Trade policy uncertainty reduces the number of firms exporting and the responsiveness of the extensive margin to policy shocks. Lower binding tariff commitments increase entry, even if the current binding is above the applied tariff. The figurative “insurance” against backsliding through binding commitments could be empirically relevant if prospective entrants place some probability weight on the possibility of large scale tariff reversals. In theory, further reductions in binding commitments through WTO negotiations would be meaningful. This is a testable implication of the model.

The derived elasticities for tariffs and bindings can be applied to the policy controversy over the value of non-binding, bound tariff commitments. Consider a current tariff τ_0 that is below its binding B_0 . Suppose the current tariff and binding are changed by $d \ln \tau$ and $d \ln B$, respectively. The comparative static for a change in the entry cutoff $d \ln c^U$ is computed as follows

$$d \ln c^D = \varepsilon^U(\tau_0) d \ln \tau + \varepsilon(B_0) d \ln B \quad (1.24)$$

$$= \varepsilon^D(\tau_0) d \ln \tau - \varepsilon(B_0) \times (d \ln B - d \ln \tau) + r_0 \times d \ln \tau \quad (1.25)$$

$$\text{where } r_0 = \frac{\sigma}{\sigma - 1} \left(\frac{\beta\gamma}{(1 - \beta + \beta\gamma\Delta)} \left(\frac{(H(B_0) - H(\tau_0))E[\tau^{-\sigma} | \tau \in (\tau_0, B_0)]}{\tau_0^{-\sigma}} \right) \right).$$

The first term is the deterministic elasticity. The second term captures relationship between simultaneous binding and tariff changes. If the binding is unchanged, say in a unilateral tariff reduction, then the impact on the entry cutoff is reduced. However if both the binding and tariff change by the same amount then $d \ln B - d \ln \tau = 0$ and the second term drops out. The third term is the residual uncertainty about tariff outcomes in the policy space between the τ_0 and the binding B_0 . Residual uncertainty will reduce the elasticity of the cutoff if the gap between B_0 and τ_0 is large and the

probability mass in that range of the tariff distribution is high.

This comparative static result is summarized in the following corollary to propositions 1 and 2.

COROLLARY 1 [*Bound tariff changes*] *Tariff changes accompanied by equal or greater changes in binding commitments will generate more new entry than unbound, unilateral tariff changes.*

When tariffs are reduced unilaterally, without constraining future policy makers through binding, the impact on the entry cutoff is mitigated. I confirm the broader implications of this prediction in the empirical quantification exercise in Chapter 2.

Chapter 2

Evidence from Australia

2.1 The Application to Trade Policy in Australia

I focus on Australia, a country with a confluence of high quality data and policy variation relevant to uncertainty. In recent history, Australia maintained fairly high applied trade barriers. Unilateral liberalization means there are now large gaps between applied protection and binding commitments. Like many developed countries, it has recently implemented a series of PTAs. Several of the agreements were with developing countries that already had preferential, but discretionary, market access. These factors encompass several of the sources of trade policy uncertainty reviewed in the introduction. Theoretically grounded empirical estimates of the role of policy uncertainty and the interaction of various trade policy instruments for Australia should have validity in a host of outside applications and forthcoming policy negotiations.

While Australia has low applied tariffs at present, this has not been the case historically. Lloyd's (2008) careful construction of a 100 year time series for Australian tariffs shows that some sectors were highly protected as recently as the early 1990s. There was a legacy of protection for non-competitive industries and political interference in the tariff making process during the pre- and post-war period (Glezer, 1982). Gradual and, more importantly, *unilateral* liberalization began in the late 1980s and continued into the 1990s.¹ Even in sectors with low applied tariffs, a prospective exporter in the years 2002-2006 could look back little more than a decade to justify fear of a high tariff regime.

Since higher historical tariffs were the starting point for concessions in the

¹Coincidentally, journalist Paul Kelly titled his exhaustive book documenting the economic and political upheaval of these reforms "The End of Certainty."

Uruguay Round (1986-1994) of multilateral negotiations (see Corden, 1996), Australia's binding commitments today are high and dispersed.² Although applied tariffs are at or near zero in many products, the maximum bound rates range from zero to 55 percent. This variation in the binding gap between applied and bound rates is exploited empirically. Importantly, Australia removed most quotas and other quantitative import restrictions in a process known as "tariffication" as part of its Uruguay Round concessions (Snape et al. 1998). Measurement of trade barriers is now mostly homogeneous across products.

Australia's own Productivity Commission recently cited the prevention of "backsliding" on liberalization as a potential benefit of preferential trade agreements. In their comprehensive review of Australia's trade agreements, the Commission notes that

... even where agreements do not result in a reduction in existing barriers, they can be used to lock in current policies, restricting countries from increasing barriers in the future (Productivity Commission, 2010, p. 6.21)

As a case in point, if Australia were to revert all tariffs to their bindings this would substantially shift the tariff profile. In 2004, only 24% of Australia's MFN tariffs are equal to the binding tariff commitment. The magnitude of changes in a reversal to bindings can be large. As the histogram in Figure 1 shows, nearly 73% of MFN tariffs could increase, some by up to 35% in the worst case scenario. Were such reversals to occur, an exporter in the average tariff line could see his profits reduced by 19% each year. As Figure 2 shows, the profit losses extend to nearly all product lines. A full reversal to bindings would shift the distribution of profits down substantially relative to the level at applied tariffs in 2004.³

²Policy makers in Australia had adopted a so-called "midway" position in multilateral negotiations. Australia maintained it was neither a developing nor a fully industrialized country and required the flexibility to impose tariffs to protect infant industries with cost disadvantages (Snape et al. 1998).

³I compute the percentage profit reductions from the uncertainty measures derived in the pre-

2.2 Empirical Approach

2.2.1 Data Overview

To help understand basis for my estimation method, I provide a brief overview of my data with additional details in section 2.3.1 and the appendix. I have annual import data at the 10-digit level of detail for Australia from 2002-2006. There are over 8,300 products that are potentially tradable and these are matched to country-product specific tariff lines. These product classifications are extremely detailed. For instance, Australian customs tracks 67 different varieties of tubes and pipes. If I break the data down to its nuts and bolts, literally, I find there are ten different varieties of bolts which can be fastened with two types of nuts.

These data encompass the entire population of potential importers whether a good is traded or not. Because I know there is heterogeneity at the industry level, I adapt the model to account for this. There are 1243 industries at the 4-digit Heading level of the Harmonized System for product classifications. I then estimate the model on a pooled cross-section in 2004 and 2006.

The broader empirical strategy is to use measures of uncertainty derived from the model to test if exporters place positive weight on the probability of a reversal to binding tariff levels. The approach exploits the cross section variation in tariffs and bindings to model the probability that a product is traded. I use the data to address whether uncertainty over reversals to binding tariff levels affects the long-run pattern of entry across industries.

2.2.2 Estimation Method

I estimate the model on disaggregated product data. Trade is observed at the product level if the unit cost of the most productive firm in country j is below the

ceding empirical section. See appendix for further details.

cutoff for a particular variety, i.e. $c_j^L < c_{tjv}^U$. Data on firms from a multitude of potential import partners are not available. A reasonable proxy for firm entry is whether a disaggregated product is traded.⁴

The unit cost of the marginal firm c_{tjv} from country j in product variety v is not observed, but it must equal the cutoff threshold $c_{tjv} = c_{tj}^U$. It turns out the ratio of the cutoff for the marginal firm in product v to that of the most productive firm in the industry c_j^L can be defined in terms of observables as a latent variable.⁵ If the expected PDV of entering today is greater than or equal to the fixed cost of entry, I observe the decision of at least one firm to enter when a product is traded. I define a latent variable Z_{tjv} for the v -th product variety from country j in as

$$Z_{tjv} = \left(\frac{c_{tj}^U}{c_j^L} \right)^{\sigma-1} = \frac{\Theta_t^{\sigma-1} \tau_{tjv}^{-\sigma} A_{tj} (c_{jI}^L)^{1-\sigma}}{(1-\beta)K_{tjv}} \equiv \frac{\text{PDV Operating Profits}}{\text{Entry Cost}}$$

where the second equality follows from substitution of equations (1.21) and (1.10) for c_{tj}^U . This quantity is the ratio of the PDV of operating profits for the most productive firm in an industry to sunk entry costs. If $Z_{jv} \geq 1$ for at least one exporter, then trade is observed in that product variety. Otherwise, no trade is observed.

I assume that sunk export costs are common within each industry group such that $K_e = K_I$. Taking logs and substituting for Θ using equation (1.22) yields

$$z_{tjv} \propto -\sigma \ln \tau_{tjv} + \underbrace{\ln \left[\frac{1-\beta+\beta\gamma\Delta}{1-\beta+\beta\gamma} \right]}_{=\ln \Theta_{tjv}^{\sigma-1}} + d_{tj} + d_{tI} + \varepsilon_{tjv} \quad (2.1)$$

where $\varepsilon_{tjv} \sim N(0, \sigma_\varepsilon^2)$ is i.i.d measurement error. The exporter-year effect $d_{tj} = (1 -$

⁴The evidence of firm level entry following trade liberalizations from detailed firm studies such as Eaton et al. (2007) is confirmed in disaggregated product level studies such as Kehoe and Ruhl (2009) and Debaere and Mostashari (2010). Even if firm data were available, it would be difficult to identify the set of potential exporters and estimate entry probabilities at the tariff line level for the universe of all firms. A method for evaluation of trade policy reforms under uncertainty with more widely available product data a contribution of this paper.

⁵A similar cross-country latent variable formulation is used in Helpman et al. (2008).

$\sigma) \ln(M_j + (1 - \sigma) \ln w_j$ encompasses unobserved heterogeneity in aggregate productivity and wages. The industry-year effect $d_{tI} = k_{jI} + \ln \mu_I + y_t + (1 - \sigma) \ln w_j + (\sigma - 1)p_{tI}$ combines unobserved heterogeneity in entry costs and demand conditions from the price index and aggregate expenditure. Trade is observed when $z_{tjv} = \ln(Z_{tjv})$ is positive.

This specification differs from a deterministic model due to the bracketed term, which is non-linear in the parameters of interest. In the deterministic limit where $\gamma = 0$ the bracketed uncertainty term drops out entirely. Since I ultimately test for presence of uncertainty, I take $\gamma = 0$ as a testable null hypothesis and linearize around this point. The first-order Taylor approximation to $\Theta_{tjv}^{\sigma-1}$ around $\gamma = 0$ is

$$U_{tjv} = \Theta_{tjv}^{\sigma-1}|_{\gamma=0} = \frac{\beta\gamma}{1-\beta}(\Delta(\tau_{tjv}) - 1). \quad (2.2)$$

The linearized uncertainty term parsimoniously represents the two components of the uncertainty process: the magnitude of the expected proportional loss in profits given a policy shock arrives is captured by $\Delta(\tau_{tjv}) - 1$; the arrival rate of trade policy shocks appears linearly in γ . Estimation requires measures of the profit losses that could occur in a reversal.

A strength of the analytical simplicity of this model and the focus on trade policy is that measures of the expected profit loss can be constructed from tariff data. I discretize the expected loss for a reversal to the binding tariff with probability $p_B = 1 - H(\tau_{tv, MFN})$. The discrete decomposition is

$$\begin{aligned} \Delta(\tau_{tjv}) - 1 &= (1 - H(\tau_{tjv})) \frac{E(\tau_{tjv}^{-\sigma} \mid \tau > \tau_{tjv}) - \tau_{tjv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} \\ &= -p_B \frac{\tau_{tv, MFN}^{-\sigma} - B_{tv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} = -p_B U_{tjv}^B \end{aligned} \quad (2.3)$$

These uncertainty measure is bounded below at zero and bounded above at 1 for a re-

versal to total autarky. For any partner and tariff line where the bound tariff is above the applied tariff, the “binding uncertainty” measure U_{tjv}^B is positive. For example, “Windscreens of toughened (tempered) safety glass of a kind used as components in passenger motor vehicles” had a tariff of 5% at the MFN rate and 10% at the bound rate in 2004. These correspond to a profit loss of 17% for binding uncertainty (U^B) when $\sigma = 4$.

Substituting the uncertainty measure into equation (2.1) yields

$$z_{tjv} = -\sigma \ln \tau_{tjv} - p_B \gamma \frac{\beta}{1 - \beta} U_{tjv}^B + d_{tj} + d_{tI} + \varepsilon_{tjv} \quad (2.4)$$

In moving from theory to data, several identifying assumption are necessary. First, I assume a common elasticity of substitution σ across industries. Second, exporters within an industry form the same expectations, using the same tariff distribution, about future policies. This is necessary to identify the probability of reversals, conditional on the current trade policy. The assumption is consistent with a rational expectations environment where there are no arbitrage opportunities.

Let T_{tjv} be a binary indicator defined as $T_{tjv} = \mathbf{1}[z_{tjv} > 0]$. I model the probability that a product is traded as $p_{tjv}^{(T=1)} = \Pr.(T_{tjv} = 1 | Xb) = F(Xb)$ where $F(\cdot)$ is a CDF. The estimating equation using the first-order approximation is

$$p_{tjv}^{(T=1)} = F[b_\tau \ln \tau_{tjv} + b_B U_{tjv}^B + d_{tj} + d_{tI}]. \quad (2.5)$$

Given the assumed normality of the errors, I could estimate a Probit model. However, there are over 2000 industry-year fixed effects in the empirical application. Estimates of these incidental parameters are potentially inconsistent, leading to bias in the parameters of interest. I assume instead that $F(\cdot)$ is linear and estimate a linear probability model (LPM) using OLS.⁶

⁶As a practical matter, I have also found that while computing marginal effects is computationally

A set of exporter-year fixed effects d_{jI} and industry-year effects d_{tI} , control for unobserved variables: differences in aggregate technology, fixed costs of entry, home country wages, w_j , terms of trade shocks, the industry price index, expenditure share and aggregate demand. The parameters are scaled into the marginal effects on the probability a product is traded, but they can still be interpreted in the context of the model. The elasticity of product sales to applied tariffs is negative and estimated by the parameter $b_\tau = -\sigma$ up to a scale factor. The negative impact of uncertainty is estimated up to scale by the parameter $b_B = \frac{\beta}{1-\beta}\gamma \cdot p_B$ where the term in discount factors is a positive constant. These coefficients are proportional to the probability weight placed on reversals to the binding, given by $\gamma \cdot p_B$. Negative coefficients indicate exporters in the average tariff line place some weight on bad news when making entry decisions.

The above first-order approximation used to compute the uncertainty terms decouples the elasticity on applied tariffs from the uncertainty measures. In order to measure and test the cautionary effects derived in Proposition 1 and elaborated in the Corollary, I need to account for the fact that the uncertainty measure is function of tariff and binding levels. The elasticity of entry to tariff and binding changes is computed by log differentiation of the uncertainty measure. In terms of the model, the estimated elasticity of product entry to tariff reductions, $\varepsilon(\tau)$ is the sum of the direct effect to current profits, the first term in (2.5), and the change to future profits

feasible it is extremely memory intensive and time consuming for this model. OLS does not restrict predicted probabilities to the range $(0, 1)$ and raises heteroskedasticity issues. I have verified in unreported results that signs and significance patterns are unchanged in probit fixed effect and conditional logit specifications.

if a reversal occurs, the second term in (2.5):

$$\begin{aligned}
e(\tau) &= b_\tau + b_B \frac{\partial U_{tjv}^B}{\partial \tau} \tau_{tjv} \\
&= b_\tau - b_B \sigma \times \frac{B_{tv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} \\
&= -\sigma \underbrace{\left[1 - \gamma p_b \frac{\beta}{1 - \beta} \frac{B_{tv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} \right]}_{\text{Cautionary Effect} < 1} < 0.
\end{aligned} \tag{2.6}$$

This is simply the first order approximation to the cautionary effect derived in Proposition 1. The elasticity of entry to applied tariff changes will depend on the probability of reversals, $\gamma \cdot p_B$, and their magnitudes $B^{-\sigma} / \tau^{-\sigma}$.

Proposition 2 shows that the elasticity of entry is reduced by increases in bindings. I can also use the empirical model structure to obtain the elasticity of entry to changes in binding levels following the same computation as above:

$$\begin{aligned}
e(B) &= b_B \frac{\partial U_{tjv}^B}{\partial B} B_{tjv} \\
&= -b_B \sigma \times \frac{B_{tv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} \\
&= -\sigma \gamma p_b \frac{\beta}{1 - \beta} \frac{B_{tv}^{-\sigma}}{\tau_{tjv}^{-\sigma}} < 0.
\end{aligned} \tag{2.7}$$

The elasticity of entry to binding changes and the cautionary effect from above are symmetric. If bindings are reduced by the same percentage as applied tariffs, the cautionary effect is exactly offset “as if” tariffs were deterministic. This result follows from the Corollary to Propositions 1 and 2.

2.3 Results

2.3.1 Data Implementation and Sample

A complete description of the data sources appears in the appendix. I focus here on construction of the regression samples, tariffs and uncertainty measures.

The tariff line measure of the ad valorem applied tariff (i.e. $1 +$ tariff rate) is the MFN rate offered to all WTO members. A large number of developing country exporters are eligible for preferences under one or more programs in addition to the MFN tariff. Utilization of these preferential tariffs is not 100% and requires additional documentation and compliance costs (Pomfret et al., 2010). I exclude all countries from the sample that are eligible for unilateral preferences such as the Generalized System of Preferences even though not all tariff lines are covered under these regimes. Since my objective is to estimate the impact of reversals to binding tariffs for WTO members, I excluded all trade partners that have bilateral PTAs. Evidence from Handley and Limão (2010) suggests these PTAs may offer increased security of preferential tariffs and would contaminate my results. This restriction excludes New Zealand in 2004 and 2006 and Thailand, Singapore and the United States in 2006.

The uncertainty measures of the expected loss from reversals to the binding (U_B) are constructed using the theoretical structure above. Using data on MFN applied tariffs and bindings, I construct the uncertainty measures in equation (2.3) for parameterizations of the elasticity of substitution ($\sigma \in \{3, 4, 5\}$). I assume $\sigma = 4$ in my baseline estimates, but show these are robust to the choice of σ .⁷

I define an industry by the HS4 Heading of a product variety, resulting in 1243 industries. All final specifications include exporter-year and industry-year fixed effects which control for several sources of heterogeneity in the estimating equation

⁷Bernard et al. (2003) estimate that $\sigma = 3.8$ using U.S. firm level trade data.

(2.5). The critical factor to absorb in this application are the relative productivity differences between exporters in each industry. However, because many countries trade no products within an HS4 defined industry, they are perfectly predicted by these fixed effects and are dropped from the regression sample.

The final samples contains 600,818 exporter-product observations for the years 2004 and 2006. Table 2.1 reports summary statistics. Within the sample, the average applied tariffs are low at approximately 4.5 and 3.8 log percentage points in 2004 and 2006. The average potential loss is over 19% for binding uncertainty *per annum*.

2.3.2 Product Regressions – Baseline

The baseline linear probability estimates appear in Table 2.2. Estimated coefficients from the baseline model appear in column 2. They conform precisely to the predictions from theory. The coefficients on the applied tariff and uncertainty measures are negative and significant.⁸ For comparison, I run a naive model containing only tariffs and fixed effects as regressors in column 1. Since tariffs are positively correlated with the uncertainty measure, omitting uncertainty imparts a downward bias to the tariff coefficient in column 1. To compare the impact of reducing bindings versus unilaterally reducing applied tariffs, I turn to the lower panel of Table 2.2. Caution and delay effects are large and evident after I compute the elasticities at the mean of the uncertainty measure using expressions (2.6) and (2.7). The elasticity of entry to tariff reductions is reduced from 28 percent to 18.5 percent, a reduction of nearly one third due to the cautionary effect. When uncertainty is present, the responsiveness of entry to tariff reductions is substantially mitigated by caution. Delay effects are also important. The elasticity of the probability of being traded increases by 9 percent for every 1 percent decrease in bindings. In sum, for every 1 percentage

⁸Bindings are set at the 6 digit sub-heading level of the Harmonized System and do not change through time during the sample. I have verified in unreported results that the results are robust to clustering standard errors at the 6 digit level.

point reduction in *applied* tariffs the same effect can be achieved by a 2 percentage point reduction in binding commitments not to raise tariffs in the future.

It is possible that other types of protection are driving these results. In all regressions, I include a binary indicator for a positive MFN tariff at the tariff line level. Australia's current tariff profile tends to have zero tariffs in products that are not produced domestically or less frequently imported. Where there is both domestic production and import competition, positive tariffs are levied. Failure to control for this confounds the effect of tariff protection on exporting with policymakers' motive to protect import-competing sectors. Some lines are subject to non-tariff barriers (NTBs) and these forms of protection could bias my results if Australia substitutes NTB protection for applied protection near the binding. I use the ad-valorem equivalent NTB measures from Kee et al. (2009) to construct additional controls. Because these measures have no time variation, I interact them with a year indicator. These NTBs slightly reduce the probability a product is traded, but they are not significant in column 3. A small fraction of tariff lines levy some mixture of specific and ad-valorem tariffs; I include tariff line indicators for these "complex" tariffs in column 4 of Table 2.2 interacted with year indicators. The added variable is significant with a positive sign but does not change the main results.

2.3.3 Quantification

I quantify the effects of applied tariff reductions relative to uncertainty reductions by using the econometric model to predict the number of new products under different regimes.⁹ In this exercise, I take the sum of predicted probabilities generated by the model for each exporter in terms of changes to applied tariffs and bindings. The exporter-year and industry-year effects absorb a large share of total variation in the pattern of traded goods. This is not surprising given the well-known, traditional

⁹A similar quantification exercise is used by Debaere and Mostashari (2010) in a different context.

roles of technology driven comparative advantage, distance, transport costs and endowment differences in predicting the pattern of trade. Nevertheless, most of these factors cannot be directly influenced by trade policy, even over the long run. I focus on comparing the relative impacts of alternative trade policy instruments. I will show however, that in some scenarios the aggregate impact of trade policy uncertainty is substantial.

I use the estimates to run policy experiments which compare the scope for new product creation given the margins of policy adjustment available to Australia in 2004 and 2006. I focus on three channels: setting all applied tariffs to zero, reducing bindings to zero, or both together. The predicted values of product creation for 2004 and 2006 appear in Table 2.3. For 2004, the model predicts a 6.54% increase in products, or 2630 new products, if Australia were to set all its remaining MFN tariffs to zero on a unilateral basis. Relative to the deterministic environment, the caution effect reduces the number of new products created by 1069 products. The delay effect is of similar magnitude in terms of products. If Australia reduced all bindings to the current applied tariffs, eliminating the risk of future “bad news”, the number of traded products would increase by 2.9 percent, or 1167 products, in 2004. The remarkable aspect of this effect is that not a single *applied* policy measure would need to change. Merely the commitment never to raise tariffs above 2004 or 2006 levels would generate a 3 percent increase in traded products with MFN partners. The greatest increase in traded products is achieved by reducing tariffs to free trade levels and binding them through the WTO. Eliminating the motives for both caution and delay while reducing tariffs would increase the number of traded products by over 12 percent in 2004 or 2006.

A caveat is that these predictions ignore general equilibrium effects. It is possible that if all trade partners uniformly faced less uncertainty, the level of product creation would be attenuated by increased competition. This suggests a need for

future work on theoretical and empirical effects of policy uncertainty in general equilibrium. While some predicted effects appear to be quite large, it is possible these product measures actually understate the true level of entry by firms. There is undoubtedly within product firm entry. If a product is already traded or becomes traded due to the policy change, multiple firm entry can only be counted once. But whether the estimates over- or understate the true impact is less relevant when evaluating the relative efficacy of reducing unilateral applied tariffs versus reducing uncertainty. As long as the predictions are not systematically skewed toward applied protection or uncertainty, the relative contribution of uncertainty reductions are at least as effective as tariff reductions.

2.3.4 Robustness

2.3.4.1 Parameterization of Uncertainty Measures

The uncertainty measure requires a parametric assumption about the elasticity of substitution given by σ . The strength of using the model based measure is that it has a clear interpretation in going from the model to the regression specifications. Results could be sensitive to the assumption that the elasticity of substitution is $\sigma = 4$ when constructing the measures. Table 2.4 reports the results across values of σ with the baseline specification included for easy comparison in column 2. Signs and significance are largely unchanged. Moving from high to low values of σ tends to increase the magnitude of estimated coefficients on the uncertainty measures.

2.3.4.2 Reduced-Form Specification

The model has reduced-form predictions about the elasticity of entry to bindings that can be used to avoid parameterization of the uncertainty measures. I regress the traded product indicator on logs of applied tariffs, bindings and their interaction.

Results with log levels of tariffs and bindings appear in Table 2.5. The elasticity of entry to the binding is negative and significant. To capture the caution effect, I include an interaction term for tariffs and bindings in column 2. The positive and significant coefficient on the interaction indicates that caution is present in the reduced form specification as well.

2.4 Conclusion

Trade policy is inherently uncertain. I account for this in a tractable model that delivers clear theoretical predictions for export market entry patterns along with an estimation strategy. Evidence from Australia suggests that prospective exporters place weight on the possibility of trade policy reversals. This leads to delay of the entry decision and less responsiveness on the entry margin. I find that multilateral policy commitments at the WTO help to reduce this uncertainty and increase product entry. Within the space of trade policy tools available, policy commitments could generate nearly as much product entry as unilateral tariff reductions. These results are important for quantifying the value and modeling the impact of tariff binding commitments at the World Trade Organization. The evidence of greater product entry in tariff lines with lower bindings, a key policy instrument for guaranteeing predictable market access, indicates that these commitments are valuable to exporters.

Several theoretical extensions to the model would be useful in broader contexts. The first is to extend the model to a general equilibrium framework. As mentioned in the quantification exercise, the uncertainty reducing benefits of policy commitment may diminish if all trade partners have more secure market access. But if such effects are present, then the benefit of multilateral over regional liberalization may be even greater.

Extending and verifying these results to a broader group of countries and applications outside of international trade is important. Fortunately the methodology

developed here, by using product data and model-based uncertainty measures, can be applied more broadly within international trade applications and to other forms of policy uncertainty. An important extension is the impact of trade policy uncertainty on foreign direct investment where sunk costs of opening a production facility are even higher. Trade policy uncertainty takes many other forms in the world trade system. Modeling and testing the risk of non-renewal in preferential tariff programs, temporary trade bans, economic sanctions and the risk of anti-dumping measures are all subjects for future work.

Table 2.1: Summary Statistics –Means with standard deviation in parentheses

	2004	2006	Total
Product Traded (binary)	0.133 (0.340)	0.117 (0.321)	0.125 (0.331)
Applied Tariff(ln)	0.045 (0.057)	0.038 (0.041)	0.041 (0.050)
Binding(ln)	0.105 (0.098)	0.106 (0.098)	0.105 (0.098)
Binding Uncertainty	0.194 (0.176)	0.210 (0.188)	0.202 (0.182)
Complex Tariff	0.002 (0.042)	0.002 (0.042)	0.002 (0.042)
NTB AVE (ln)	0.043 (0.153)	0.043 (0.154)	0.043 (0.154)
Pos. MFN Tariff	0.570 (0.495)	0.574 (0.495)	0.572 (0.495)
Observations	298,794	302,024	600,818

mean coefficients; sd in parentheses

Table 2.2: Probability a product is traded in 2004 and 2006

Dependent Variable: Product Traded (binary)				
	(1)	(2)	(3)	(4)
Marginal Effects:				
Applied Tariff(ln)	-0.233*** (0.026)	-0.275*** (0.027)	-0.276*** (0.027)	-0.285*** (0.027)
Binding Uncertainty		-0.028*** (0.004)	-0.029*** (0.004)	-0.028*** (0.004)
<i>Controls</i>				
Pos. MFN Tariff(binary)	0.039*** (0.002)	0.039*** (0.002)	0.039*** (0.002)	0.040*** (0.002)
NTB AVE(ln)–2004			-0.008 (0.005)	
NTB AVE(ln)–2006			-0.004 (0.005)	
Complex Tariff(binary)–2004				0.053*** (0.014)
Complex Tariff(binary)–2006				0.033* (0.013)
Elasticities (at mean of Binding Uncertainty Measure) w. r. t.				
Applied Tariff		-0.185 (0.028)	-0.185 (0.028)	-0.196 (0.028)
Binding		-0.090 (0.013)	-0.091 (0.013)	-0.089 (0.013)
Cautionary Effect (p.p.)–Relative to Marginal Effect in Row 1		-32.792 (5.258)	-32.976 (5.244)	-31.331 (5.025)
Observations	600818	600818	600818	600818
Adjusted R^2	0.299	0.299	0.299	0.299
Exporter x Year FE	YES	YES	YES	YES
Industry(HS4) x Year FE	YES	YES	YES	YES

Notes: Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$\sigma = 4$ for uncertainty measure. See text for description of elasticity calculations.

Table 2.3: Quantification – cross-section policy experiments in terms of products for 2004 and 2006

Predicted New Products – Totals and Growth Rates (p.p.)	Year	
	2004	2006
Policy Experiments		
<u>A. Tariff Reductions</u>		
1. Reduce all applied tariffs to zero (Deterministic)	3699 (362)	3099 (303)
2. Less the Caution Effect (Uncertainty)	-1069 (158)	-860 (127)
3. Net effect of tariff reduction (A1+A2)	2630 (365)	2239 (304)
Growth Rate (Uncertainty)	6.54 (0.908)	6.42 (0.872)
<u>B. Binding Reductions</u>		
1. Reduce Bindings to Current Applied Tariff(Delay Effect)	1167 (173)	1228 (182)
Growth Rate	2.91 (0.431)	3.52 (0.522)
2. Reduce Bindings to Zero (Free Trade)	2237 (332)	2087 (310)
Growth Rate	5.57 (0.826)	5.98 (0.888)
<u>C. Tariff and Binding Reductions</u>		
Reduce and bind all tariffs to zero (A3+B2)	4868 (432)	4326 (384)
Total Growth Rate	12.11 (1.076)	12.39 (1.101)
Total Traded Products	34,905	40,194

Notes: Estimates computed from column 2 of Table 2.2. Totals do not add precisely due to rounding error.

Robust standard errors computed via delta method in parentheses.

Growth rates are relative to number of traded products in 2004 and 2006 (bottom row)

Table 2.4: Robustness across alternative elasticity of substitution parameters (σ) for uncertainty measure

Elasticity Parameter:	(1) $\sigma = 3$	(2) $\sigma = 4$	(3) $\sigma = 5$
Applied Tariff(ln)	-0.276*** (0.027)	-0.275*** (0.027)	-0.274*** (0.027)
Binding Uncertainty	-0.035*** (0.005)	-0.028*** (0.004)	-0.024*** (0.004)
Pos. MFN Tariff(binary)	0.039*** (0.002)	0.039*** (0.002)	0.039*** (0.002)
Observations	600818	600818	600818
Adjusted R^2	0.299	0.299	0.299
Exporter x Year FE	YES	YES	YES
Industry(HS4) x Year FE	YES	YES	YES

Notes: Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

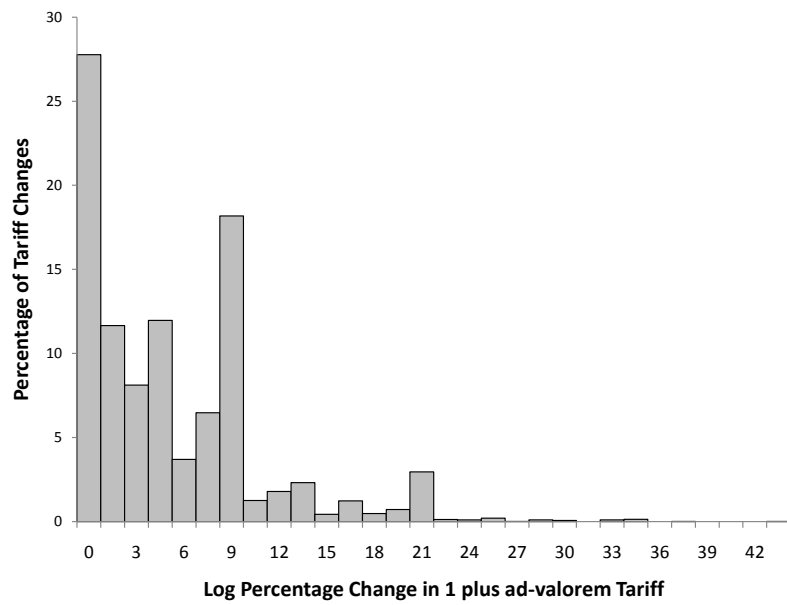
Table 2.5: Robustness to reduced-form estimation on log of bindings and tariffs

Dependent Variable: Product Traded (binary)		
	(1)	(2)
Applied Tariff(ln)	-0.207*** (0.027)	-0.433*** (0.043)
Binding(ln)	-0.066*** (0.010)	-0.128*** (0.013)
Tariff×Binding(ln)		0.981*** (0.129)
Pos. MFN Tariff (binary)	0.039*** (0.002)	0.047*** (0.002)
Observations	600818	600818
Adjusted R^2	0.299	0.299
Exporter x Year FE	YES	YES
Industry(HS4) x Year FE	YES	YES

Notes: Robust standard errors in parentheses

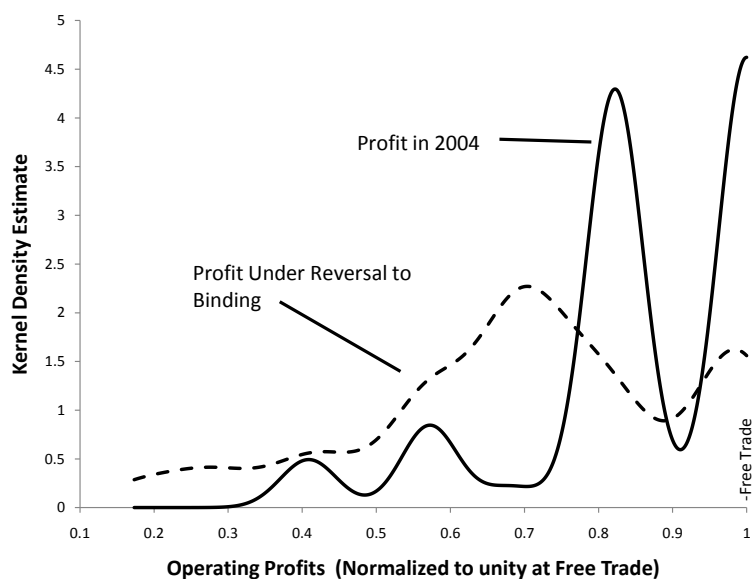
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 2.1: Distribution of tariff changes under a binding reversal in 2004



Notes: Change in log points from the MFN tariff to the bound tariff in 2004. $100 \times \ln(B_v/\tau_v)$ where $B, \tau = (1 + \text{ad-valorem rate})$. Bin width is 1.5 log points.

Figure 2.2: Shift in distribution of profits under a binding reversal in 2004 at applied (MFN rate) vs bound tariff levels



Notes: Kernel densities. Profits are normalized to unity at $\tau = 1$. Higher tariffs scale down profits by $\tau^{-\sigma}$ in the model. I compute the operating profit for all product lines at the applied MFN tariff in 2004. I then compute profits in 2004 as if there had been reversal to the worst case bound tariffs.

Chapter 3

Evidence from Portugal's EC Accession

3.1 Trade Policy Uncertainty and Portugal's European Integration

The main purpose of this section is to provide some facts and a preliminary aggregate analysis of Portugal's European trade integration. We then provide background information on Portugal's preferential agreements with various European countries. The EC accession in 1986 generated considerable export growth towards those partners and it was characterized by the entry of new firms into those markets (rather than higher sales per firm). The aggregate evidence is consistent with an uncertainty-reducing role of EC accession but possibly also with other explanations thus in section 5 we explore the firm-level predictions.

3.1.1 Overview of Trade Policy toward Portuguese Firms

Portugal's market access to its European partners in the 1970s and early 80s displayed many of the same characteristics associated with uncertainty outlined above. Prior to joining the European Community (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 1977.¹

Portugal's trade with neighboring Spain remained highly restricted until the

¹The schedules appear in the GATT submission "Agreement between the European Communities and Portugal", L/3781/Add.1, December 29, 1972.

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%.²

A second phase of reductions over a period of indeterminate length was to commence in 1984. The EFTA-Spain agreement contained no definite timetable or scheduled reductions for the second phase. This so-called "dynamic clause" was possibly incompatible with the criteria of Article XXIV of the GATT allowing preferential trade agreements. It was uncertain at the time if and when further liberalization would commence. In a working party report to the GATT secretariat on the EFTA-Spain agreement covering Spain's preferences to Portugal, one member noted that the agreements

"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".³

By 1984 both Spain and Portugal were in protracted negotiations for accession to the EC. Notifications to the GATT show that the preferential reductions in place by 1983 were simply extended and then renewed multiple times by an oversight committee.⁴ The Articles of Accession required another round of tariff reductions between Portugal, Spain and the EC-10 countries and harmonization with the EC

²Details 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).

³"AGREEMENT BETWEEN THE EFTA COUNTRIES AND SPAIN, Report of the Working Party," L/5405, October 24, 1980, p.3

⁴Agreement Between the EFTA Countries and Spain, Information Furnished by Parties to the Agreement" L/5886, October 31, 1985.

Common Customs Tariff (CCT). The agreement was signed in the middle of 1985 and the accession entered into force on March 1, 1986. Protocol 3 of the Acts of Accession required Spain to fully liberalize industrial tariffs against Portugal immediately to harmonize with the preferences already granted by the existing EC-10 countries. 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. Some non-tariff measures and quantitative restrictions were not slated for full or partial liberalization until 1996. Both Spain and Portugal would implement the external CCT immediately on products with tariffs that were within 15 percentage points of the CCT. For tariffs outside this range, the CCT was phased in by 1993. The EC-10 countries phased in full liberalization by 1992 of agricultural tariffs against Portugal at 14.3% per year.

3.1.2 Portugal's European Trade Integration

Before modelling and estimating the impact of uncertainty it is useful to examine the broader impacts of these preferences on Portugal's trade and investment in exporting. In the recent past Portugal has been a fairly open economy; in 2006 its import and export to GDP ratios were respectively 39 and 31%. But during the 1950's and 60's the overall goods trade/GDP ratio only averaged about 30%, rising above 40% only in the 1970's and 50% in the 1980's.⁵ Between 1985 and 1992 real exports grew by 90% and imports by about 300%.⁶ 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 200,000.⁷

The historical impact of European preferential agreements on Portugal's agree-

⁵The 2006 ratio is from Bank of Portugal online statistics. The historical ratios for trade in goods are calculated from current price data in Pinheiro et al (1997).

⁶Authors' calculations based on data from Pinheiro et al, 1997)

⁷Authors's calculation from merged information of Quadros de Pessal and International Trade statistics available from INE.

gate trade/GDP ratio is sometimes clear (for instance, imports/GDP rose rapidly upon EC accession). What is more clear is that these agreements had a strong effect on the trade orientation towards preferential partners. The trade share with EFTA countries increased from about 20% in 1960 to 30% in 1973, as shown in Figure 1.⁸ The figure also reveals that the termination of agreements is important. 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 decline in Portugal's trade share with these countries.

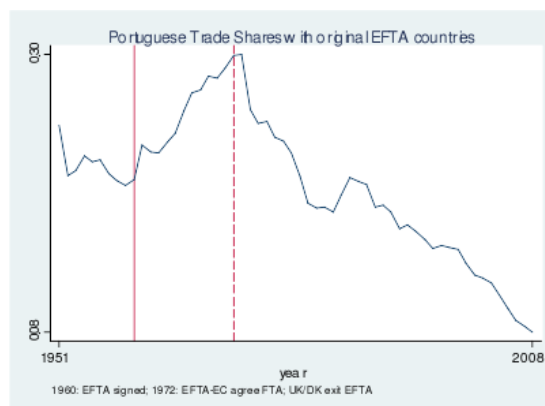


Figure 1

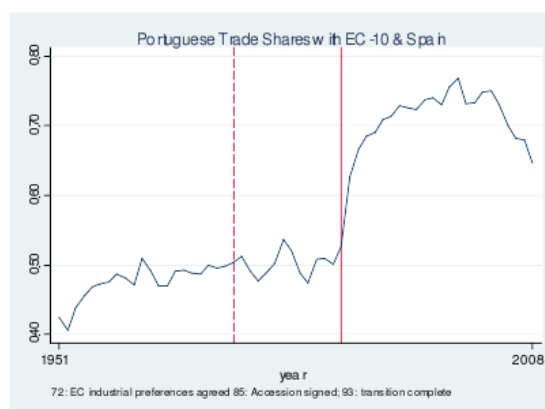


Figure 2

Figure 2 shows the re-orientation of Portugal's trade toward its EC preferential

⁸Source of the trade data: IMF Direction of Trade Statistics.

partners starting in 1985. The share with the EC-11 rose from 52% in 1985 to 72% in 1992. If we exclude Spain we still find that the trade share with EC-10 went from 47 to 57% over that period. Also, after the transition period was complete (around 1993) the trade share flattened and eventually began to fall; this latter fall was driven by trade with the EC-10 since trade with Spain continued growing and currently stands at just below 30%. The other interesting point is that Portugal's initial preferential agreements with the EC (agreed to in 1972, fully implemented by 1977) and Spain (early 1980's) left its trade share nearly unchanged at about 50% between 1972 and 1985.⁹

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). Starting in 1981 we have access to data from the Portuguese census (INE) that reports trade by Portuguese firms at the transaction level that, to our knowledge, has never been analyzed for this period. This allows us to examine whether the source of the growth in trade is related to Portuguese firms entering the preferential markets.

To determine 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 3 shows there was positive and rather substantial net entry of exporting firms into the US between 1981 and 1985 but almost *none* between 1985 and 1992. In contrast, the number of Portuguese firms exporting to Germany (dashed line) grew by 65 log points between 1985 and 1992.¹⁰ Entry into the Spanish market was even more pronounced, over 150 log points in the

⁹We can detect more of an effect during this period if we focus on Portuguese export shares alone, which go from 50% to 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.

¹⁰Other 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.

1985-1992 period with an apparent upward break in the trend around 1985.^{11,12}

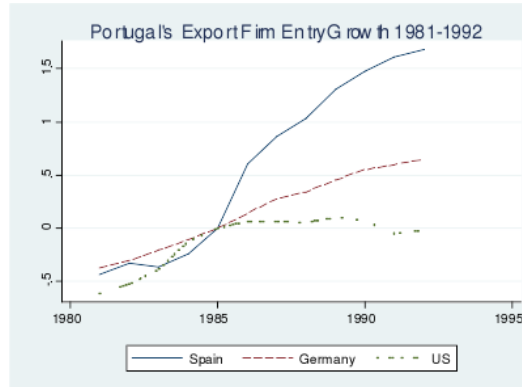


Figure 3

We get a clearer sense of the relative importance of the entry channel in real export growth if we decompose the latter into two margins: the growth in the number of firms and in exports/firm. As figure 4 shows, real export growth to the US was characterized by increases in both margins prior to 1985, but after that period net entry is flat and the reduction in exports is largely driven by reductions in average sales per firm. The picture for Germany is considerably different, with sales per firm flat while the number of firms grew at the same rate as exports between 1985 and 1988. Spain is similar to Germany, but even more striking, since the pattern holds between 1985 and 1992 and the growth in real exports is almost 200 log points in that period.

¹¹Our analysis stops in 1992 for two reasons. First, as discussed above this was the end of the initial period accession. Second, there was a major change in the data collection procedures in 1993 due to the removal of physical customs barriers within the EC. The new system, Intrastat, is based on self-reporting and has minimum export value thresholds, both of which imply that the number of firms in the data in 1993 exhibits a discrete fall that affects only EC partners.

¹²We focus on net rather than gross entry because currently the data does not contain consistent firm identifiers for the full period 1981-1992. We do have a set of consistent identifiers before 1985 and another starting in 1986. Using these we find that in 1987 there was 42% growth in the number of new exporting firms to any market (relative to 1986). The gross entry rate in the period before accession was lower, e.g. in 1985 it was only 35%.

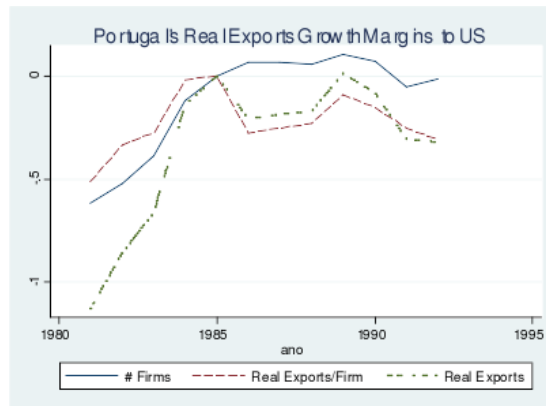


Figure 4

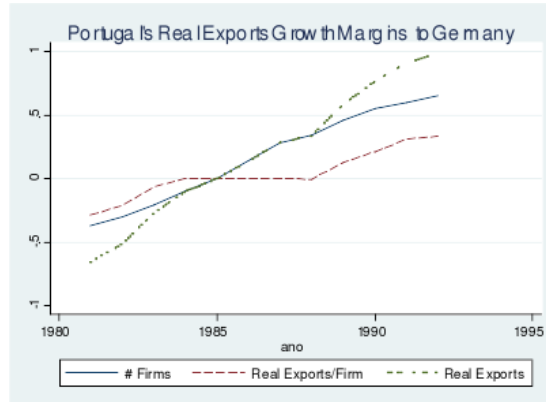


Figure 5

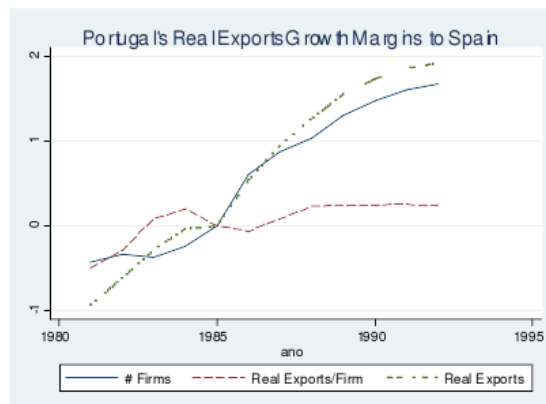


Figure 6

The EC accession was not the only notable economic event Portugal experienced in the 1980's. Earlier, in August 1983, Portugal completed an agreement with the IMF to help it resolve a balance of payment crisis. The *nominal* Portuguese exchange rate continued to depreciate against the major European currencies until 1990, but starting in 1985 it experienced some appreciation relative to the US dollar.¹³ To account for this and other effects, e.g. in incomes and prices, we can estimate an aggregate gravity equation for Portuguese exports. This is by now a standard tool (Anderson and van Wincoop, 2003). We include country effects to account for time invariant differences in exports between Portugal and each of its partners (distance, colonial ties, etc.) and year effects to control for Portuguese productivity, nominal export price or exchange rate changes. We also allow the time effects to differ between advanced economies and others to control for any differences in the composition of exports. 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 1986-1992) with the member country dummies (Spain or EC-10) we can then test if Portuguese exports to these preferential markets grew differentially relative to other advanced economies.¹⁴

We find an increase, reported in Table 3.1, of about 24 log points towards the EC-10 in the post-accession period that cannot be accounted for by the standard determinants. That increase is about 5 times larger for Spain. Given our interest in uncertainty and 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 in column 2.¹⁵ These results confirm that the pattern seen in the figures above is robust to various controls: the number of firms exporting to Spain and the EC-10 rose significantly

¹³The *aggregate real* exchange rate did not exhibit large changes between 1980-1991 according to the IMF IFS statistics.

¹⁴In addition to the EC-10 and Spain these include EFTA countries, US, Canada and Japan.

¹⁵Our model will provide a formal justification for using this dependent variable in a gravity regression. Bernard et al. (2007) present similar type specifications for the U.S.

relative to other countries after accession. If we include a similar variable for the US as a falsification test we see no statistically significant increase in net entry, and the same is true for the EFTA countries.

In column 3 of Table 3.1 we run a similar regression using exports/firm as the dependent variable and find it increased by only about 6 log points for the EC-10. The growth of this margin is about one third of the firm entry growth and a similar ratio holds for Spain. Since these two margins must add up to total exports the results suggest that net entry was quite important. In fact, if entering, exiting and continuing firms had similar average sales then the regressions indicate that net entry accounts for about three quarters of the total export growth to the EC after 1986 that is not explained by standard gravity measures.¹⁶

Given the importance of exchange rate volatility in Portugal and the prominence of this channel in discussions of trade and uncertainty we also extended the specifications to include it (results available upon request). This did not affect any of the results previously discussed. Moreover, the elasticity of exports with respect to volatility is fairly small, both for aggregate exports (-0.096) and for firm entry (-0.07). This is consistent with previous studies that find conflicting and typically small effects of exchange rate volatility on aggregate trade flows.¹⁷ To get a sense of the magnitudes, a two standard deviation reduction in this variable (1.74) leads only to a 17 log point increase in exports and 12 in number of firms, which are small

¹⁶An alternative decomposition is to focus on the fraction of new exports due to changes in the average exports of continuers vs. the fraction of new exports due to net entry. The data allows us to compute this decomposition for 81-85 and 86 onwards but at this point no firm match exists between 85 and 86. This alternative decomposition and the one in the text match if firms that enter and exit have the same average exports as continuing firms did in the initial period. If, as is likely, new entrants are smaller, then the true net entry fraction is smaller than 75%. But exiters are also likely to be smaller, which goes in the opposite direction. We are currently working on the alternative decomposition for the years where firms are linked to provide additional evidence for the fraction of new exports due to net entry.

¹⁷For a recent review of the academic literature see the IMF report at <http://www.imf.org/external/np/res/exrate/2004/eng/051904.pdf>. The measure we use is the one the report cites as the preferred one: $\log(\text{standard deviation of monthly exchange rate changes})$.

fractions of the standard deviations of these variables. Moreover, the exchange rate variation for most of the EC-10 countries and Spain over this period was below two standard deviations. So this was clearly not important in generating the export and firm entry boom we observe.¹⁸

In sum, there is strong evidence of an increase in the direction of aggregate due to accession and that firm entry played an important role even after we control for standard aggregate determinants. Given that Portuguese exporters already enjoyed some trade preferences in Spain and zero or close to zero tariffs in the EC-10 this evidence seems puzzling. The model in the next section provides a potential explanation: the agreement removed policy uncertainty faced by exporters, which we subsequently test.

3.2 Theory

The model and notational exposition in Chapter 1 center around a set of firms exporting to a single importing country. For the application to Portugal, we focus instead on the decision of firms to enter a set of foreign export destination. In order to maintain consistency of notation in the model and empirical setup, some elements of the basic setup are repeated in this section.

3.2.1 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 homogeneous and freely traded on world markets, and a subutility index defined over differentiated goods Q with constant expenditure share μ . We consider a CES aggregator

¹⁸It is still possible that the entry into the euro had stronger effects both because it eliminated the volatility completely and possibly more permanently than any earlier changes. We do not use data after 1992 so the results above would not capture this but our approach can be extended to analyze this interesting question.

over a continuum of differentiated goods, indexed by v and with mass Ω . For simplicity of exposition we focus on a symmetric structure with common elasticity of substitution, $\sigma = 1/(1 - \rho) > 1$.¹⁹

$$Q = \left[\int_{v \in \Omega} (q_v)^\rho dv \right]^{1/\rho} \quad (3.1)$$

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

$$q_{iv} = \frac{\mu Y_i}{P_i} \left(\frac{p_{iv}}{P_i} \right)^{-\sigma} \quad (3.2)$$

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}/τ_{iV} where τ_{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 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 monopolist simply chooses prices (or quantities) to maximize operating profits in each period, $\pi_{iv} = (p_{iv}/\tau_{iV} - w c_v) q_{iv}$, leading to the

¹⁹We 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, e.g. if Q is a Cobb-Douglas aggregator across H sectors, each representing a distinct CES aggregate.

standard mark-up rule

$$p_{iv} = \frac{wc_v}{\rho} \tau_{iV} \quad (3.3)$$

The consumer price in country i , p_{iv} , reflects the price received by the producer in e — the markup over cost wc_v/ρ — augmented by the ad valorem tariff if the good is imported.

Substituting revenues into the operating profit expression and simplifying we obtain

$$\pi_{iv} = (\tau_{iV})^{-\sigma} c_v^{1-\sigma} A_i \quad (3.4)$$

where $A_i \equiv (1 - \rho) \mu Y_i \left(\frac{w}{P_i \rho} \right)^{1-\sigma}$, summarizes aggregate conditions, e.g. domestic wage, w , and foreign demand.

3.2.2 Firm Value, Investment and Export Entry Setup

We focus on how foreign trade policy uncertainty 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 group of products 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.²⁰ 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.

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 ,

$$\frac{\pi_{iv}}{1 - \beta} \geq K_{iV} \quad (3.5)$$

²⁰This 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.

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 set of varieties. In a purely deterministic environment, the discount factor β 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, δ , 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

$$c^D(\tau_{iV}) = \left[\frac{A_i (\tau_{iV})^{-\sigma}}{K_{iV} (1 - \beta)} \right]^{1/(\sigma-1)} \quad (3.6)$$

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 τ 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 $c_v < c_{iV}^D(\tau_{iV})$ enter.²¹

As I discuss in Chapter 1 there are several potential sources of trade policy uncertainty 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. 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.²² Firms can be divided into exporters and non-exporters. The

²¹The cutoff elasticity with respect to tariffs exceeds unity because the tariff is not paid by the exporter, so profit decreases more rapidly in the tariff than in the unit cost, as seen in (3.4).

²²Formally, our approach is similar to the one Baldwin and Krugman (1989). There are some key differences. First, they focus on exchange rates whereas we analyze trade policy, which as we describe below has a different stochastic process and is more permanent than exchange rates. Second, they

value of being an exporter is denoted by Π_e and such a firm exits only when hit by a “death” shock since it has no other fixed costs after it enters.²³ 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, Π_w . The value of this option in our model arises from the fact that 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 that firm indifferent between entry and *waiting*.

$$\Pi_e(\bar{\tau}, c) - K = \Pi_w(\bar{\tau}, c) \quad (3.7)$$

Therefore, any tariff $\tau_t \leq \bar{\tau}(c)$ triggers entry into the export market by any firm with cost c . To determine this cutoff and the impact of changes in policy uncertainty we now describe the policy process and define these value functions.

3.2.3 Value of Credible vs. “Incredible” Policies

The prospective exporter’s decision to enter or wait given the current trade policy τ_t depends on four value functions. These are: (i) the value of export market entry today, (ii) the value of exporting following the next policy change for incumbent exporters, (iii) the value of waiting, and (iv) the value of entry after waiting for policy to improve. We now briefly describe each of these value functions that apply for each firm with cost c , which we omit to simplify the notation.

The expected value of starting to export at time t conditional on having observed

focus on homogenous firms whereas we incorporate firm heterogeneity, which allows us to analyze the affect of policy uncertainty both between and within industries that already have some export participation.

²³While 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.

τ_t is

$$\Pi_e(\tau_t) = \pi(\tau_t) + \beta \left[\underbrace{(1 - \gamma)\Pi_e(\tau_t)}_{\text{No Shock}} + \underbrace{\gamma\mathbb{E}_t\Pi_e(\tau')}_{\text{Shock}} \right]. \quad (3.8)$$

which includes current operating profits upon entering and the discounted future value. The *ex-ante* expected value of exporting following a shock, which is given by

$$\mathbb{E}_t\Pi_e(\tau') = \mathbb{E}_t\pi(\tau') + \beta\mathbb{E}_t\Pi_e(\tau') \quad (3.9)$$

Notice that this is simply $\mathbb{E}_t\Pi_e(\tau') = \mathbb{E}\pi(\tau')/(1 - \beta)$, which is time invariant and simplifies the analysis.

We then compute the value of waiting

$$\Pi_w(\tau_t) = 0 + \beta \left[\underbrace{(1 - \gamma)\Pi_w(\tau_t)}_{\text{No Shock}} + \underbrace{\gamma(1 - H(\bar{\tau}))\Pi_w(\tau_t)}_{\text{Shock Above Trigger}} + \underbrace{\gamma H(\bar{\tau})(\mathbb{E}_t\Pi_e(\tau' | \tau' \leq \bar{\tau}) - K)}_{\text{Shock Below Trigger}} \right] \quad (3.10)$$

The conditional expected value of exporting if $\tau \leq \bar{\tau}$ in the last term is given by

$$\mathbb{E}_t\Pi_e(\tau' | \tau' \leq \bar{\tau}) = \mathbb{E}_t\pi(\tau' | \tau' \leq \bar{\tau}) + \beta \left[(1 - \gamma)\mathbb{E}_t\Pi_e(\tau' | \tau' \leq \bar{\tau}) + \gamma\mathbb{E}_t\Pi_e(\tau') \right] \quad (3.11)$$

This equation is structurally the same as (3.8). The key difference is that profit flows are evaluated *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 (3.8),(3.9),(3.10), (3.11) is linear in four unknowns: $\Pi_e(\tau_t)$, $\mathbb{E}_t\Pi_e(\tau')$, $\Pi_w(\tau_t)$, $\mathbb{E}_t\Pi_e(\tau' | \tau' \leq \bar{\tau})$. Thus we can solve explicitly for the value

exporting and waiting at the current tariff for a firm that has a threshold tariff $\bar{\tau}(c)$ ²⁴

$$\Pi_e(\tau_t, c) = \frac{\pi(\tau_t)}{1 - \beta(1 - \gamma)} + \frac{\beta\gamma}{1 - \beta} \frac{\mathbb{E}\pi(\tau')}{1 - \beta(1 - \gamma)} \quad (3.12)$$

$$\Pi_w(c) = \frac{\beta\gamma H(\bar{\tau}(c))}{1 - \beta(1 - \gamma H(\bar{\tau}))} \left\{ \frac{\mathbb{E}\pi(\tau' | \tau' \leq \bar{\tau}(c))}{1 - \beta(1 - \gamma)} + \frac{\beta\gamma}{1 - \beta} \frac{\mathbb{E}\pi(\tau')}{1 - \beta(1 - \gamma)} - K \right\}$$

if $\tau_t > \bar{\tau}(c)$ (3.13)

We can now ask what is the value for an exporter of alternative policy changes. Consider first a situation where governments announce that the current tariff is being reduced. We will call this a credible policy change or agreement if the exporters expect it to remain in place, i.e. if $\gamma = 0$. We will call it an “incredible” agreement otherwise, i.e. if it is 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

$$-\frac{\partial}{\partial \tau_t} \Pi_e(\tau_t, c, \gamma = 0) = -\frac{\partial}{\partial \tau_t} \frac{\pi(\tau_t)}{1 - \beta} > -\frac{\partial}{\partial \tau_t} \frac{\pi(\tau_t)}{1 - \beta(1 - \gamma)} = -\frac{\partial}{\partial \tau_t} \Pi_e(\tau_t, c, \gamma > 0) \quad (3.14)$$

The second, and closely related point, 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 primary impact of a formal agreement may simply be to eliminate uncertainty. When the tariff in the initially incredible agreement is low, e.g. if $\tau_t = 1$, the reduction of uncertainty increases the value of exporting as shown by this expression

$$\Pi_e(\tau_t = 1, c, \gamma_{post} = 0) - \Pi_e(\tau_t = 1, c, \gamma_{pre} > 0) = \frac{\pi(1) - \mathbb{E}\pi(\tau')}{1 - \beta} \frac{\beta\gamma_{pre}}{1 - \beta(1 - \gamma_{pre})} > 0 \quad (3.15)$$

This value captures one motive why the recipients of unilateral preferential tariffs

²⁴The expressions for the other two values are given in the appendix.

spend considerable resources in attempting to make them permanent through formal PTAs. Examples include GSP preferences provided by most developed countries as well as European and US 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.

3.2.4 Policy Impacts on Investment and Entry

Using (3.13), (3.12) and the expression in (3.7) 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 CDF that is monotone increasing. Therefore for any current tariff τ_t we can determine a cutoff cost c_t^U that satisfies $\bar{\tau}(c_t^U) = \tau_t$.

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 Π_e and Π_w equal to entry costs and by simplifying the terms we obtain

$$K = \frac{\pi(\tau_t, c_t^U)}{1 - \beta(1 - \gamma)} + \frac{\beta\gamma}{1 - \beta} \frac{\mathbb{E}\pi(\tau, c_t^U)}{1 - \beta(1 - \gamma)} + \frac{\beta\gamma}{1 - \beta} \frac{H(\tau_t)[\pi(\tau_t, c_t^U) - \mathbb{E}\pi(\tau | \tau \leq \tau_t, c_t^U)]}{1 - \beta(1 - \gamma)} \quad (3.16)$$

We combine the expression in (3.16) with the operating profit function in (3.4) 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

$$c_t^U = \underbrace{\left[\frac{1 - \beta + \beta\gamma\Delta(\tau_t)}{1 - \beta + \beta\gamma} \right]^{\frac{1}{\sigma-1}}}_{=U_t} \underbrace{\left[\frac{A}{K} \frac{\tau_t^{-\sigma}}{(1 - \beta)} \right]^{\frac{1}{\sigma-1}}}_{=c_t^D} \quad (3.17)$$

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 τ_t .

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. This result along with the fact that at $\gamma = 0$ we obtain the deterministic cutoff implies that increases in uncertainty lower the cutoff under the option approach at *any* initial tariff below the maximum. As an intermediate step to deriving the estimation equation it is useful to record here the semi-elasticity of the cutoff with respect to γ

$$\frac{d \ln c_t^U}{d\gamma} \Big|_{\tau_t} = \frac{\beta}{1 - \beta(1 - \gamma)} \frac{1 - \beta}{1 - \beta(1 - \gamma\Delta(\tau_t))} \frac{\Delta(\tau_t) - 1}{\sigma - 1} \leq 0$$

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

Consider now the impact of applied tariffs on the cutoff. In the absence of uncertainty that elasticity is simply $-\frac{\sigma}{\sigma-1}$, as shown for the deterministic case. It is simple to see that is also the limit value for $\frac{d \ln c_t^U}{d \ln \tau_t} \Big|_{\gamma \rightarrow 0}$. 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 $c_t^U(\gamma_t, \tau_t)$ around $\gamma = 0$ and the original applied policy values (τ_0) . We provide the derivation in the

appendix. The general form for any period t is

$$\ln(c_t^U) |_{\tau_t=\tau_0, \gamma=0} = \gamma_t \left(\frac{\beta}{1-\beta} \right) \frac{\Delta(\tau_0) - 1}{\sigma - 1} - \frac{\sigma}{\sigma - 1} \ln \tau_t + \frac{1}{\sigma - 1} \ln \frac{A_t}{K_t(1-\beta)} + r_t \quad (3.18)$$

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 $-\frac{\sigma}{\sigma-1}$, the deterministic elasticity.²⁵

3.3 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 3.1.2, secured pre-existing preferences in some goods and lowered tariffs faced by Portuguese exporters. The empirical section of Chapter 3 describes how to compute a theory-based measure of uncertainty: the profit loss profit term, $\Delta(\tau)$; and how to relate the unobserved cost cutoff to observables, namely firm export decisions. We then describe

²⁵While the applied tariff effect around no uncertainty is similar to the deterministic case, it will be dampened by the presence of uncertainty. We provide the exact expression in the appendix, but the intuition should be clear from equation (3.14) 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. Handley (2010) also shows this effect within a similar framework but where the tariff distribution H can be constrained by policy commitments.

the data and implementation; the baseline estimates and their quantification as well as additional evidence. The baseline estimates follow the model closely and so are parsimonious, so in the last section we provide robustness tests.

3.3.1 Empirical Approach

3.3.1.1 Measuring policy uncertainty

In general, to construct $\Delta(\tau_t)$ precisely we require a specific probability distribution H . Therefore, we consider a discrete state space for tariffs 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*.

$$\tau_t = \tau_s, \quad \Pr(\tau_s) = p_s \text{ for each } s \in \{l, m, h\}$$

We take $\tau_l=1$ so it captures the many industrial goods that Portugal exported to the EC free of ad valorem tariffs both after the accession *and* before it. The high tariff captures the 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 represents an intermediate level that captures the 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 3.1.1. 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 appendix we show that whether the tariff was initially at the high or medium states we can use the derivation in (1.23) to derive

$$\Delta(\tau_{0iV}) - 1 = -p_h \left(\frac{\tau_{0iV}^{-\sigma} - \tau_{hiV}^{-\sigma}}{\tau_{0iV}^{-\sigma}} \right) \quad (3.19)$$

This is the percentage profit reduction of a shock that moves tariffs from τ_0 to the worst case scenario, which happens with probability p_h . The same term applies to cases when the initial tariff is low and p_m is negligible.²⁶ Alternatively, if we consider only a two state world, $s = h, l$ the expression above applies to tariffs with either history.

We model the uncertainty parameter γ_{ti} by assuming that prior to an agreement there is a common probability of policy reversal, γ_{pre} , and that after an agreement with a country i (or set of countries) such as the entry into the EC then $EC_{it} = 1$ and the probability is now γ_{post} . So we use

$$\gamma_{ti} = \gamma_{pre} (1 - EC_{it}) + \gamma_{post} EC_{it} \quad (3.20)$$

We will test if $\gamma_{post} < \gamma_{pre}$ and subsequently also if $\gamma_{post} = 0$.

3.3.1.2 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. We could then examine the probability of individual firms exporting. However, our model focuses on variation in policies over time and across products, and the cutoffs we derived are assumed to be common across some sets of firms. In

²⁶In the 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. Since, (a) there is no obvious empirical counterpart for the medium 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, we ignore this extra term.

particular, producers of a variety v exporting to i will all face a tariff that does not discriminate by firms, but rather by product classification, denoted V , and so those producers also face the *same* critical cutoff c_{tiV}^U . Therefore we examine the fraction of exporters in an “industry” V to each country pair.

In the model, all potential exporters of a given good in industry V that have productivity above the threshold (or equivalently a cost below c_{tiV}^U) will invest and export good v to i . If that productivity follows a Pareto distribution $G(\cdot)$ with shape k and minimum productivity $1/c_V$, then the model predicts that *at least* a fraction

$$G(c_{tiV}^U) = \left(\frac{c_{tiV}^U}{c_V} \right)^k \quad (3.21)$$

of domestic producers in industry V will actually export to market i .

The empirical counterpart to the fraction of firms exporting at time t to i in an industry V is simply the observed number of exporters relative to the potential number, n_{tiV}/n_{tV} . The relationship with the theoretical measure is

$$\ln \frac{n_{tiV}}{n_{tV}} = \ln G(c_{tiV}^U) + u_{tiV} \quad (3.22)$$

where u_{tiV} is a random disturbance term due to measurement error. The term can also capture the potential for “legacy” firms. If demand or cost conditions in earlier periods had been considerably more favorable this would generate a legacy of firms that may survive until period t even though they have costs above c_{tiV}^U . A sufficient condition to rule out legacy firms is that $c_{tiV}^U \geq \max\{c_{TiV}^U \forall T < t\}$, i.e. if current conditions are better than in the past. In this case, $G(c_{tiV}^U)$ captures the fraction of firms in the 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 are particularly important for our analysis. Nonetheless, in the appendix we argue that our approach and results are robust to

certain instances where legacy firms are present.

3.3.1.3 Baseline model

Our basic estimation equation can then be obtained by substituting (3.20) and (3.19) into the cutoff expression (3.18); substitute this into the share equation in (3.22) and use the distribution assumption in (3.21) to obtain for each t, i, V

$$\begin{aligned} \ln n_{tiV} = k & \left[-(\gamma_{pre}(1 - EC_{it}) + \gamma_{post}EC_{it}) \frac{\beta}{1 - \beta} \frac{p_h (\tau_{0iV}^{-\sigma} - \tau_{hiV}^{-\sigma}) / \tau_{0iV}^{-\sigma}}{\sigma - 1} - \frac{\sigma}{\sigma - 1} \ln \tau_{tiV} \right] \\ & + k \left[\frac{1}{\sigma - 1} \ln \frac{A_{ti}}{K_{iV}(1 - \beta)} + r_{iVt} - \ln c_V \right] + \ln n_{tV} + u_{tiV} \end{aligned} \quad (3.23)$$

We note a couple of relevant points for the estimation. First, it is not obvious how to measure the potential producers in an industry, moreover for some of our results it will be useful to know what happens to the number, not just the fraction of exporters, so we move the $\ln n_{tV}$ term to the RHS and control for it via industry by time effects. Second, there are three assumptions that we use in the baseline estimation to identify the effect of uncertainty: (i) the shape parameter k is common across V (but we allow the other parameter c_V to be flexible); (ii) conditional on a policy shock for the policy in a particular importer we assume that producers share a common p_h among them and across importers. However, they have market specific information about the impact of that worst case scenario on profits (captured by the tariff uncertainty measure); (iii) the elasticities of substitution are similar across sectors. In the robustness section we will discuss the impact of relaxing some of these assumptions.

Given these assumptions we can write the estimation equation in terms of vari-

ables and parameters as follows

$$\begin{aligned} \ln n_{tiV} = & (b_{\gamma pre} (1 - EC_{it}) + b_{\gamma post} EC_{it}) \frac{(\tau_{0iV}^{-\sigma} - \tau_{hiV}^{-\sigma}) / \tau_{0iV}^{-\sigma}}{\sigma - 1} + b_{\tau} \ln \tau_{tiV} \\ & + a_{ti} + a_{iV} + a_{tV} + \tilde{u}_{tiV} \end{aligned} \quad (3.24)$$

for each t, i, V where $b_{\gamma} = -\gamma p_{0h} \frac{\beta k}{1-\beta}$ captures the impact of uncertainty on entry. In effect, we estimate the joint probability of a reversal to the high tariff $\gamma \times p_h$, scaled by $\frac{k\beta}{1-\beta}$. The coefficient on the applied tariff is $b_{\tau} = -\frac{k\sigma}{\sigma-1}$. The a_x terms represent country-year, country-industry and industry-year effects that absorb, among other things, the demand and cost conditions in A_{ti} , the investment cost K_{iV} , the productivity 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_{iVt} , and in u_{iVt} . The remaining part of the disturbance that varies at the iVt level are included in \tilde{u}_{tiV} .

Since the central question for the estimation is whether the agreement reduced uncertainty, i.e. $\gamma_{post} < \gamma_{pre}$, we focus on testing if $b_{\gamma post} - b_{\gamma pre} > 0$ by estimating (3.24) in differences taking a period after the agreement was implemented and one before it.

$$\begin{aligned} \Delta_t \ln n_{tiV} = & (b_{\gamma post} - b_{\gamma pre}) EC_i \frac{(\tau_{0iV}^{-\sigma} - \tau_{hiV}^{-\sigma}) / \tau_{0iV}^{-\sigma}}{\sigma - 1} + b_{\tau} \Delta_t \ln \tau_{tiV} \\ & + a_i + a_V + \tilde{u}_{iV} \quad \text{for each } i, V \end{aligned} \quad (3.25)$$

In equation (3.25), $b_{\gamma post} - b_{\gamma pre}$ estimates the change in the probability of a reversal to the high tariff. If p_h is time invariant, then this coefficient measures the change policy uncertainty coming through γ .

In sum, we are interested in understanding the impact of the EC accession agreement on investment and entry in export markets by Portuguese firms. To isolate the impact from trade policy we explore the variation across industries and countries.

To isolate the uncertainty effect we control for changes in applied tariffs and ask if there was larger entry in industries that were previously subject to more trade policy uncertainty. The importer effects address any shocks specific to export markets. We also control for industry effects in the changes specification to account for, among other things, the fact that these industries could have been expanding to both markets for other reasons. Therefore the identification will rely on differential changes in uncertainty that Portuguese exporters within each industry faced in the EC vs. the Spanish market.

3.3.2 Data and Implementation

To estimate (3.25) 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. However, we argue this is not the correct level of disaggregation to test the model 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, which is clearly broader than the 6-digit level. Second, even though the policy is recorded at a fine product level, most of the variation in the policy occurs across industries, rather than within them. For example, about 80% of the variation in applied tariffs faced by Portugal in exporting to the EC 10 before the agreement is accounted for by differences across 2-digit industries (of which there are 99). For the main uncertainty variable, 75% of the variation is across 2-digit industries. 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. This is clear if he exports more than one good in an industry, but it is relevant even if he exports a single 6-digit good. To see why note that goods can face tariff changes simply because they are reclassified. For example, there were product reclassifications in 1983, 1988, 1992, 1996, 2002. Between 1987 and 1988 for example the classification system changed dramatically with the introduction of the harmonized system. However, the top level 2-digit classification, the so-called chapters, are actually quite similar even across these two systems.²⁷ Therefore it seems more reasonable that an exporter of a good in a 2-digit industry consider the uncertainty for a typical good in that industry rather than only considering the uncertainty for a particular 6-digit product.²⁸

To construct the uncertainty measure we first take τ_{hi} for a product to be the ad valorem conventional GATT tariff that country i (EC-10 or Spain) had before the agreement. If that tariff was not bound in the GATT then we use the autonomous ad valorem tariff that i applied. We take τ_{0i} 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 3.1.1. We then construct the uncertainty measure in (3.19) using elasticity values that are consistent with the data for these countries (σ between 2 and 4). 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

²⁷Thus another advantage of defining the relevant industry at the 2-digit level is that it will allow future work to examine the uncertainty impacts even after the product classification changes in 1988.

²⁸If we were to run the model at the 6-digit level there would be a large number of 0’s. Since our estimation equation is in logs we would eventually have to drop those categories, which could be those where uncertainty was most important. In a different context, Handley (2010) recasts the model at the detailed product level using a latent variable specification that can handle the zeros. But as we just argued, policy uncertainty varies at a higher level in this application and would be unlikely to explain a lot of variation for within industry participation.

1987 appear in Table 3.2. The typical industry in Portugal enjoyed preferential tariffs that were nearly 50% below the tariff levied on the rest of the world. Figure 7 also shows that this difference is not driven by any one set of goods but occurs along the full distribution of tariffs, which is shifted towards zero for Portuguese exporters (blue line) relative to the rest of the world (red). If Portugal were to lose these preferences, the typical exporter would see his profits reduced by over 16% per annum. 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.

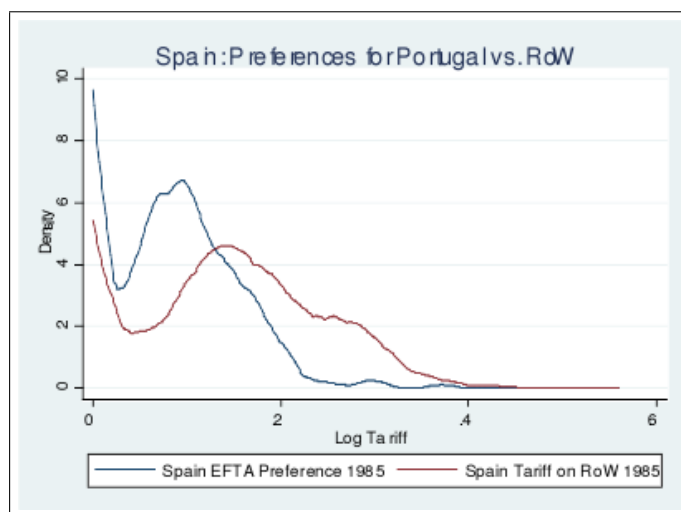


Figure 7

3.3.3 Baseline Estimates

Table 3.3 provides estimates of the parameters in (3.25). We find that firm entry is negatively affected by applied tariffs, as predicted by the theory. Moreover, entry was strongest in the industries that initially faced more uncertainty. In particular, $b_{\gamma_{post}} - b_{\gamma_{pre}} > 0$, which according to our model implies that the agreement reduced uncertainty, i.e. $\gamma_{post} < \gamma_{pre}$, and this lead Portuguese exporters to enter the EC and

Spanish markets.

One potential concern with the results in column 1 is that ad valorem tariffs were only one part of the protection faced by Portuguese exporters. If applied protection that used other instruments fell by more in those industries where there was higher uncertainty this would bias the estimates. Therefore in column 2 we control for changes in specific tariffs and in column 3 for changes in “non-tariff barriers.”²⁹ Both have the predicted negative sign but they are insignificant. Neither affects the baseline results for uncertainty and applied ad valorem tariffs.³⁰ The results are robust to other changes, which we discuss in detail in the following section.

The theory has implicitly assumed 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. That cost may be present even if the firm already sells another good in that market. If most firms are single product, this should not affect our results, but if the trade expansion was driven by multi-product firms introducing new products then the results in table 3.3 would understate the impact of the uncertainty reduction. We observe in the data that the typical Portuguese exporter sells only two types of products (at 6-digit Nimexe) both in 1985 and 1987. We do not expect these multi-product exporters to affect our results (the average number is also approximately unchanged at about 6), but we can test this directly by re-estimating (3.25) using the number of varieties (i.e. total number of product firm combinations in an industry). The results in Table 3.4 confirm the baseline estimates both in terms of magnitude and significance.

²⁹To construct these measures we use information in the tariff schedules on whether a product line was subject to specific tariffs, special import authorization or other conditions that were not translated into an advalorem tariff. As is standard in this type of literature we construct a coverage ratio measure: fraction of products in industry V that are subject to a particular measure (e.g. specific tariff, or other NTB) and took the difference before and after the agreement.

³⁰Note that the policy measures vary across industry and for Spain vs. the EC-10 but not within the EC-10. To address this we also re-estimated the standard errors allowing for clustering with arbitrary correlation across EC-10 countries within each industry, and similarly for Spain. This makes no difference to the statistical significance reported in the table. The same applies to subsequent results in tables 4 and 5.

3.3.4 Quantification

We now provide some quantification of the impact of the alternative policy dimensions—applied tariffs and uncertainty—on both net entry and the value of exporting.

One way to compare the relative impact of the policies is to ask how much variation in net entry they explain. 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 uncertainty that effect is 0.4, which is almost 3 times larger (0.4/0.14). If we focus on the EC-10, we find that uncertainty is 5.8 times more important than applied tariffs since there was little variation in the applied tariffs in the EC-10 before or after accession.

Since the applied tariffs went to zero post-accession and, as we will argue below, so did uncertainty, we can also ask what the estimates imply for the relative impact of the removal of the applied tariffs and uncertainty. The elimination of applied tariffs only generated about 4% growth in entry overall, 2% into EC-10 (their mean reduction was only 0.7 p.p.) and 20% for Spain (mean reduction of about 7 p.p). The elimination of uncertainty, on the other hand, generated a 31% growth in entry overall, similar in both Spain and the EC-10. The overall growth explained by both these effects is about 35%, which roughly matches that of the sample (33%).³¹

We can also quantify the impact of policy on exporting profits. It is simple to do so for applied tariffs, since the elasticity of operating profits with respect to τ is simply $-\sigma$ and the same is true for the value of exporting around $\gamma = 0$. So if after the agreement the EC and Spain were to *raise* tariffs back up to pre-levels and we assumed there was no uncertainty then the percent reduction in profits of Portuguese exporters would be simply $-\sigma \Delta \ln \tau \approx 4.2\%$, assuming $\sigma = 3$ and using the sample

³¹Naturally, there are other factors affecting the sample value, some of which are accounted for by the country and industry effects, while others unexplained by the model.

mean tariff change of 1.4%. The impact is larger for exports to Spain ($\approx 20\%$) given their higher initial tariffs.³²

To compare the figure above with the impact of uncertainty, we first recall our interpretation of the term $(\tau_{0V}^{-\sigma} - \tau_{hV}^{-\sigma}) / \tau_{0V}^{-\sigma}$ as the percentage profit reduction from a shock that moves tariffs from τ_0 to the worst case scenario. This variable ranges from zero to 44% and, as the summary statistics in table 2 indicate, its average is about 16% (similar for the EC-10 and Spain). For the many industries in which the EC was already providing full preferences to Portugal the pre-accession mean is 19%. Once we accumulate these values over time we can understand why exporters may be reluctant to pay a sunk fixed cost to invest that would have to be amortized over a long period of time.³³

To quantify the uncertainty reducing impact of the agreement on the value of exporting we now use our baseline estimates. The counterfactual we are interested in mirrors the one described above for the applied tariff. Namely, we ask what is the percent change in the value of exporting if we were to reverse the uncertainty effect of the agreement but maintain *current* tariffs at free trade. To do so, we divide the difference in the exporting value function derived in (3.15) by $\Pi_e(\tau_t = 1, \gamma_{post} = 0)$ to obtain

$$\begin{aligned} -\frac{\Pi_e(\tau = 1, \gamma_{post} = 0) - \Pi_e(\tau = 1, \gamma_{pre} > 0)}{\Pi_e(\tau = 1, \gamma_{post} = 0)} &= -\frac{\beta\gamma_{pre}}{1 - \beta(1 - \gamma_{pre})} \frac{\pi(1) - \mathbb{E}\pi(\tau')}{\pi(1)} \\ &\approx -\frac{\beta\gamma_{pre}p_h}{1 - \beta(1 - \gamma_{pre})} (1 - \tau_{hV}^{-\sigma}) \end{aligned} \tag{3.26}$$

³²This assumes $\sigma = 3$ and provides intermediate values to the alternative cases $\sigma = 2, 4$. While the estimated impact on profits is clearly sensitive to the σ value, the relative magnitude when we compare to the impact of uncertainty is less so.

³³We think these may be underestimates for some industries of the true loss in profit if a bad shock hits, for the following reason: to obtain these values, we must take τ_{hV} to be an observed tariff that is imposed on the rest of the world. While this captures a situation where Portugal loses its preferences, it is an underestimate relative to a worst case scenario where the importer raises temporary protection via other trade policies, e.g. anti-dumping.

where the last line uses the definition of operating profit and the approximation is exact in a two-state world (since in that case $\mathbb{E}\pi(\tau') = (1 - p_h)\pi(1) - p_h\pi(\tau_h)$).

We can use our estimates in Table 3.3 to back out a measure of $-(\gamma_{pre} - \gamma_{post})p_h$, and we can then use data for the discount factor, β , and tariffs to obtain $(1 - \tau_h^{-\sigma})$. Using the structure of the model we can provide an estimate of the change in the probability of a policy shock that generates the worst case scenario. In Table 3.3 we estimate $b_{\gamma_{post}} - b_{\gamma_{pre}} = (\gamma_{pre} - \gamma_{post})p_h k \frac{\beta}{1-\beta}$ and $b_\tau = -\frac{k\sigma}{\sigma-1}$ so we can calculate $(\gamma_{pre} - \gamma_{post})p_h = \frac{\sigma}{\sigma-1} \frac{1-\beta}{\beta} \left(\frac{b_{\gamma_{post}} - b_{\gamma_{pre}}}{-b_\tau} \right)$. We use $\sigma = 3$, the value used to construct the uncertainty measure and a discount factor $\beta = 0.9$. We obtain that the change in probability was about 0.24 or 24 percentage points. First, we note that it is striking that the result is within the admissible range $[-1, 1]$ since nothing in the estimation ensures that would be the case. Second, this seems to be a significant but not unreasonably large effect.³⁴

We can now compute (3.26). Since the latter assumes $\gamma_{post} = 0$ (and we will provide evidence below that supports this), our previous calculation implies that $\gamma_{pre}p_h = 0.24$ and so γ_{pre} and p_h are each bounded to be at least 0.24. Therefore we obtain that the change in the value of exporting if the uncertainty effect of the agreement were reversed is at least 4.1% ($= \frac{0.9}{1-0.9(1-1)} 0.24 \times 0.19$, when $p_h = 0.24$ and $\gamma = 1$) but may be as high as 13% ($= \frac{0.9}{1-0.9(1-0.24)} 0.24 \times 0.19$, if $p_h = 1$ and $\gamma = 0.24$). Given our interpretation of γ as the arrival rate of shocks it seems unlikely that exporters expected a large shock that would lead to all policies being reviewed every year so an intermediate value of $\gamma = 0.5$ seems more reasonable and implies an effect equal to 7.5% ($= \frac{0.9}{1-0.9(1-0.5)} 0.24 \times 0.19$). This indicates that the value of the agreement for Portuguese exporters attributable to the uncertainty reduction alone

³⁴Recall that $\beta = (1 - \delta)/(1 + R)$ so our assumption is equivalent to alternative reasonable combinations of these parameters such as a real interest rate $R = 0.03$ (average for Portugal in 1983-1995 period) and $\delta = 0.08$. For a reasonable range of alternative discount factors ($\beta \in (0.85, 0.95)$) we continue to obtain reasonable values for the change in probability ranging from 12-39 percentage points. No assumptions are required on k since it cancels.

is almost twice as large as the value generated by applied tariff changes.

3.3.5 Additional Evidence

If γ_{post} is zero then our estimate of 0.24 above also captures exactly $\gamma_{pre}p_h$, the level effect of uncertainty before the agreement. If that is the case we should find a negative impact of uncertainty on the level equation prior to the agreement and that coefficient should be similar in magnitude to the one estimated in differences. To test this we need an additional identification assumption. Namely, to identify the $b_{\gamma_{pre}}$ we can estimate

$$\ln n_{0iV} = b_{\gamma_{pre}} \frac{(\tau_{0iV}^{-\sigma} - \tau_{hiV}^{-\sigma}) / \tau_{0iV}^{-\sigma}}{\sigma - 1} + b_{\tau} \ln \tau_{0iV} + a_i + a_V + \tilde{u}_{0iV} \quad \text{for each } i, V \quad (3.27)$$

The key difference is that we can no longer include industry by importer effects (although we can and do include industry effects). In terms of the structural model this amounts to a restriction that $\ln K_{iV}$ be additively separable into an importer and industry component and a random disturbance uncorrelated with tariffs. Column 1 in table 5 estimates this and indicates that $b_{\gamma_{pre}} = -4$ which is nearly identical to our estimate for $-(b_{\gamma_{post}} - b_{\gamma_{pre}})$. The results for varieties (column 3) have a similar implication. This suggests that the impact of uncertainty on entry we estimate in the baseline is coming from the elimination of that uncertainty.³⁵ We also obtain more direct evidence of this when we run the equation above but pool all years 1983-1987 and allow the uncertainty effect to be different post agreement, we then find that $b_{\gamma_{post}} = 0$ and $b_{\gamma_{pre}} < 0$ and significant. So the interpretation of the change effect estimated in the baseline as simply capturing $-b_{\gamma_{pre}}$ is reasonable.

³⁵The results are also consistent with another prediction from the theory: if there is uncertainty in the period before the agreement then the tariff impact on entry is attenuated and if this effect is large enough it will bias down the first order effect of the tariff that is estimated prior to the agreement. This can explain why the magnitude of the tariff impact in this estimation is lower and less precise and indicates one reason why estimates of the impact of policy changes that focus on the applied policy alone and are done prior to the agreement can understate their true impact.

Table 3.5 also indicates the importance of using firm level data to detect these effects and provides some additional evidence for the model. It runs a similar regression for the period prior to the agreement using total exports (column 5). It finds no significant effect of the uncertainty measure. We investigate this in column 2. We can decompose total exports into an extensive margin (e.g. number of firms or variety) and an intensive one (average sales/firm or variety). When we do so the effect of any given variable x on the log of total sales to a destination can be decomposed into the sum of the effects on each of these margins

$$\frac{\partial}{\partial x} \ln \sum_{v \in V} p_{iv} q_{iv} / \tau_{iV} = \frac{\partial}{\partial x} \ln n_{tiV} + \frac{\partial}{\partial x} \ln \frac{\sum_{v \in V} p_{iv} q_{iv} / \tau_{iV}}{n_{tiV}}$$

The theory predicts that uncertainty depresses entry, as we have verified, but also that the impact should not be the same for the intensive margin. It predicts that we should observe higher sales per firm in industries where uncertainty is higher. The intuition is as follows: in industries with higher uncertainty only the more productive firms enter and sell, as the cutoff equations showed. Moreover, as we can see from (??), sales are higher for more productive firms. That selection effect is visible in the positive impact of uncertainty on the intensive margin in columns 2 and 4 of Table 3.5. However, it is not statistically significant, perhaps because it is attenuated at this level of aggregation.

The fact that applied tariffs are insignificant prior to the agreement, as in Table 3.5, but significant in changes, Table 3.3, is also consistent with the model. It supports the prediction that the uncertainty prior to the agreement attenuate applied tariff impacts, as shown for the value of exporting in (3.14) and for the cutoff directly in the appendix. This can help explain why ex-ante estimates of tariff preferences on trade often underestimate the ex-post impact of PTAs.

The figure below also provides direct evidence that new exporters in 1987 were

smaller than continuing ones, as the theory would predict. It would also be interesting for future work to examine whether the size distribution of this cohort of new exporters in 1987 evolves towards that of previously existing exporters. We may expect the two to converge but the interesting question is how fast and through what mechanism.³⁶

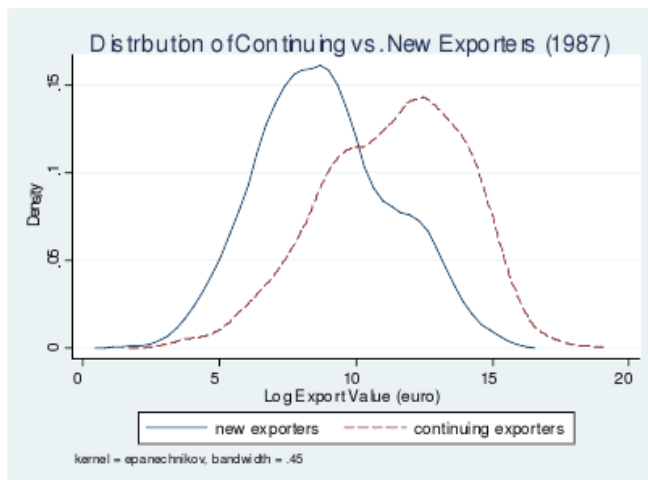


Figure 8

3.3.6 Robustness

We now discuss some robustness tests of the baseline results.

Column 3 of Table 3.3 adds the change in the standard deviation of the tariff faced by Portugal in each industry, i.e. $\Delta(stdev \ln \tau_{tiv})$ where $v \in V$. There are two possible motivations for this control. First, one may argue that our model is misspecified and for some reason the exporters care not only about the mean of the applied tariff in an industry but also its dispersion, particularly since we are aggregating firms up to the industry level. To the extent that our uncertainty variable includes some nonlinear transformation of the applied tariff it may be capturing

³⁶One possibility is selection: there is a larger share of less productive (and smaller) firms that are thus more likely to exit. Other alternatives include growth of the entrants either by learning or by overcoming financial constraints. Cabral and Mata (2003) provide evidence for the financial constraints explanation but their focus is on employment size of all Portuguese manufacturing firms rather than sales size for exporters.

some of that potential effect. The second argument would be that our measure of uncertainty is incorrect and that perhaps the more intuitive measure of change in uncertainty is $\Delta(stdev \ln \tau_{tiv})$. This variable is insignificant and does not change the value or significance of the theoretically based uncertainty measure.³⁷

We now provide some supporting evidence for our use of common elasticities and investigate if the results are sensitive to it. 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 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.

The elasticity of substitution across industries is possibly lower than within industries. Our model can be extended to accommodate this. In particular, if we assume that the subutility index Q in (3.1) is a Cobb-Douglas aggregator with shares μ_V/μ then the elasticity of substitution across industries is unity (so smaller than σ) and the key difference for our model would simply be that the price index is now P_{iV} , which is defined only over the varieties in each industry V . Therefore, we should rewrite the A term as follows

$$\ln A_{itV} = \ln(1 - \rho)\mu_V Y_{it} \left(\frac{w_t}{P_{itV}\rho} \right)^{1-\sigma}$$

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. To see this clearly suppose we can rewrite the price index as a product of four terms, $P_{itV} = P_{it}P_{iV}P_{tV}p_{itV}$, which reflect variation that is only country-time (P_{it}),

³⁷We also find that the applied tariff effect is slightly higher and more precise, suggesting that exporters care about both dimensions of applied policy.

country-industry (P_{iV}) or industry-year specific (P_{tV}) and the last term, p_{itV} , which can vary along all three dimensions. If we consider changes in $\ln A_{itV}$ we then have

$$\Delta_t \ln A_{itV} = (\sigma - 1) \Delta_t \ln p_{itV} + [(\sigma - 1) \Delta_t (\ln P_{it} P_{iV} P_{tV}) + \Delta_t \ln (Y_{it} (w_t)^{1-\sigma})]$$

The key thing to note is that in terms of our differenced estimation equation (3.25) the industry and country effects continue to capture all the variation in the costs and demand ($Y_{it} (w_t)^{1-\sigma}$) and also a substantial part of the variation in the price index, namely $\Delta_t (\ln P_{it} P_{iV} P_{tV})$. We are left with the residual variation in the price index, $\Delta_t \ln p_{itV}$. This is only an issue for our estimates to the extent that it may be correlated with the policy measures. Recall that these price indices reflect the prices of all varieties sold in those industries in country i . Therefore it will be dominated by the domestic varieties and imports from countries other than Portugal since Portugal is a relatively small exporter. Therefore we do not think that Portugal's expansion into their markets had a substantial direct effect on those price indices $\Delta_t \ln p_{itV}$. 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 European 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 $\Delta_t \ln p_{itV}$.

The results that control for industry and country specific price index changes are presented in columns 5 and 6 of Table 3.3. We find a positive relationship between the price index and entry. This is as predicted by the theory: a decrease in the

price index in an export market makes Portuguese exporters less competitive and thus lowers entry. This effect is insignificant whether we use log changes (column 5) or add a quadratic term to account for the non-linearity of the price index in tariffs (column 6). More importantly, controlling for these effects does not change the baseline results regarding uncertainty or the applied tariff effects. The same is true if in addition to these price index terms we also include all the other applied policy controls in columns 2,3 and 4. Since these controls were individually and jointly insignificant we generally focus on the baseline results without them.

We now examine our assumption that the typical elasticity within industries is similar across 2-digit categories. Thus far the estimates assume an elasticity of substitution of $\sigma = 3$. This is based on our calculations using the sub-sample of estimates from Broda, Limão and Weinstein (2008) for Spain and the other EC-10 countries (except for Greece, Belgium and Ireland, which were not in their sample). The median for these countries over all industries is 3.4 and the mean is 4.5. Since they estimate the elasticity at a more disaggregated level (hs-4) than what we use (roughly hs-2), it is possible their estimates are upper bounds on the 2-digit elasticities. To test if our results are sensitive to this we re-estimated the baseline results in Table 3.3 using $\sigma = 2, 4$ and found no significant changes (see Table 3.6).

We can also provide evidence for one of our simplifying assumptions in the model and baseline estimation: similar σ across countries and industries. While this elasticity is not constant within several 2-digit categories, it turns out not to vary that much across those broad industries. For example, if we take the estimates of σ at the hs-4 level for Spain we find that *only* 10% of its variation occurs across 2-digit industries. There is also not considerable dispersion across countries: the median elasticity across all hs-4 categories ranges only from 2.8 in Spain to 3.9 in Austria. Moreover, they are highly positively correlated across countries.³⁸ There is also not

³⁸For example, if we take the parameter on applied tariffs that we assume to be constant, $\sigma_{iV}/(\sigma_{iV} - 1)$, for each industry V in Spain and regress it on the median value for that indus-

a lot of dispersion in the typical elasticity across 2-digit industries in these countries. As we noted the overall median is 3.4 and, in 90 out of the 93 industries for which we have data, the median (over European countries) of σ_V is between 2.2 and 4.8, only 3 industries have higher values: 5.5-6.3. Given these estimates are subject to measurement error it is unlikely that there would be significant statistical differences between most of them. Nonetheless we also re-estimated the baseline specification dropping the three industries with higher elasticities (Nimexe codes 18, 47 and 87) and verified the results are unchanged.

Finally, we note that the variation that does exist across industries is not in any obvious group. For example, industries 1-14 (basic agricultural products) have a median elasticity of 4—only somewhat higher than the overall sample. One potential concern with the agricultural products is that they are subject to non-tariff barriers and a non-negligible fraction of industries and thus about 22% of the sample. So they could bias our results if these NTBs were correlated with our uncertainty measure before the agreement and removed after. One way to address this is to control for NTBs directly. We did so in table 3.3 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 agricultural goods we still find that uncertainty has an effect that is qualitatively and quantitatively similar to the baseline case (for number of firms of varieties). However, the applied tariff coefficient is now less than half in magnitude and statistically insignificant. This is not surprising since the tariff reductions by the EC mostly occurred in those agricultural products so the products that remain in the sample were ones where Portugal was already receiving significant tariff concessions. This again stresses that uncertainty reduction was a key motive for entry.

try across the EC-10 countries we obtain a coefficient of 1.2 with a s.e. of about 0.2.

3.4 Conclusion

The paper provides a framework to study the effect of trade policy uncertainty on firm investment and export decisions. Using this framework we find evidence that Portugal's EC accession in 1986 generated a significant reduction in the uncertainty its exporters faced in EC countries. By combining the insights from a dynamic model with detailed trade policy we can compute a trade uncertainty measure that indicates that Portuguese exporters stood to lose about 16% of exporting profits *if* they lost their preferences in the EC-10 or Spanish markets. Combining this with firm entry data we estimate that exporters thought such an event had a real probability of occurring before 1986 (24%) but not after. This generated considerable investment and firm entry into Spain and the EC-10, more so than the applied tariff changes themselves. We also showed that firm entry was an important margin of growth during this period.

We now highlight some interesting implications of the theoretical and empirical results for policy and future research. Accession to the EC lowered average trade barriers and uncertainty surrounding them for foreign exporters to Portugal as well. This is obvious for the EC exporters but is also true for the rest of the world because Portugal's high tariffs had to be reduced and harmonized with the EC.³⁹ Therefore, the EC accession should have led to a marked improvement in market access for foreign exporters to Portugal. The aggregate data is consistent with this prediction since it shows that real imports increased almost three times between 1985 and 1992. The growth was quite high for consumption, investment and intermediate goods, which indicates that both consumers and firms may have benefited from it.⁴⁰ New trade

³⁹Protection in Portugal had been both high and variable, in addition to tariffs that were about 17-20% in the typical industry, there were also several non-tariff barriers in the early 1980's aimed at constraining imports to address the external deficit.

⁴⁰Further work is required to determine the role of trade policy but the data suggest that this import boom was not simply an income effect. First, imports grew much faster than GDP. Second, the *nominal* prices in escudos for total imports and intermediates remained approximately unchanged between 1985-1992 despite the nominal depreciations, which would tend to make imports more

theory and recent estimates highlight the role of new imported intermediates in increasing firm productivity. So it would be interesting to test if trade agreements, such as Portugal's EC accession, or more generally trade reforms affect the productivity of importing firms via reductions in uncertainty or applied tariffs. Another important issue is the impact of the agreement on foreign direct investment, which involves substantial sunk costs and is subject to much policy uncertainty.

Our framework can also be extended to analyze the interaction of trade with other sources of uncertainty, such as exchange rates. While we did not find much evidence of the impact of exchange rate volatility in the 1981-1992 period, these effects may have become more important during the 1990's during the lead up to adoption of the Euro. One may also examine if trade policy effects are stronger relative to countries with lower exchange rate volatility. These second order effects can be estimated by extending our approach to include interactions of measures of uncertainty in trade policy and the exchange rate.

Our results also have policy implications for the world trade system more broadly. First, as we describe in section 3.1, many countries receive unilateral preferential tariffs that are subject to the discretion and uncertainty of policy making. These programs share some of the characteristics that Portugal's preferences with the EC-10 and Spain did 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. Second, while formal PTAs may reduce uncertainty for members, they are likely to increase it for the majority of countries that are non-members and will face increased competition. Our results suggest why this systemic effect of PTAs may be quite important: by reducing uncertainty the PTAs expand trade between members by more than expected. Moreover, that expansion is driven by entry, which further adds to the uncertainty of

expensive. This downward pressure on prices suggests entry of new foreign exporters, which is consistent with a reduction in trade barriers and uncertainty.

non-members who must face competition from new products and firms.

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.

Table 3.1: Portuguese Export Growth Margins 1981-1992

	(1)	(2)	(3)
Dependent variable (ln):	Exports	Number of Firms	Exports/firm
EC-10*Post_86	0.239*** [0.0595]	0.182*** [0.0460]	0.0573 [0.0766]
Spain*Post_86	1.231*** [0.130]	0.965*** [0.0932]	0.266** [0.116]
US*Post_86	-0.103 [0.132]	-0.152 [0.0952]	0.049 [0.0924]
EFTA*Post_86	0.137** [0.064]	0.068 [0.045]	0.069 [0.079]
Real Importer GDP (ln)	1.208*** [0.259]	0.628*** [0.117]	0.580*** [0.224]
Importer Price Index (ln)	0.165** [0.0668]	0.0501 [0.0365]	0.115** [0.0546]
Exchange Rate (ln)	0.163** [0.0670]	-0.0188 [0.0341]	0.182*** [0.0554]
Observations	1590	1590	1590
Adj R2	0.912	0.967	0.682
Margins of Growth Decomposition			
EC-10	1	0.76	0.24
Spain	1	0.78	0.22

Notes:

Includes dummies for country, year and year*advanced country.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$

Sample: Aggregate values to each country of destination where data is available.

See the appendix for variable description and sources and Table B1 for summary statistics.

Table 3.2: Summary statistics for firm-level baseline regressions

	EC-10	Spain	Total
Change in No. Firms	24.7 (48.70)	91.1 (62.55)	32.9 (55.10)
Pre Tariff (Portugal)	2.45 (5.40)	7.89 (5.10)	3.13 (5.66)
Pre Tariff (GATT)	7.95 (4.20)	14.1 (7.75)	8.67 (5.14)
Post Tariff (Portugal)	1.79 (3.96)	1.32 (3.51)	1.74 (3.91)
Tariff Change (Port)	-0.65 (1.44)	-6.56 (4.78)	-1.39 (2.90)
NTM Share Change	0.00 (0.00)	-18.66 (25.44)	-2.32 (10.85)
Specific Tariff Share Change	0.00 (0.00)	-3.01 (7.45)	-0.37 (2.80)
Price Index Proxy Change (ln)	0.00 (0.00)	-1.52 (2.06)	-0.19 (0.88)
SD of Price Index Proxy change	0.00 (0.00)	-0.96 (0.85)	-0.12 (0.44)
Proportion of Profits Lost if Preference Reversed	15.40 (11.10)	16.00 (9.54)	15.50 (10.92)
Observations	640	91	731

Notes:

Means of variables in percentage points. Standard deviations in parentheses.

Tariffs are natural logs of 1 plus ad-valorem tariff aggregated to the industry level evaluated in 1985 (pre-accession) and 1987 (post-accession).

Profit loss computed for an elasticity of substitution of $\sigma = 3$. We normalize the loss measure in regressions by dividing it by $\sigma - 1$.

Table 3.3: Firm entry growth into EC-10 and Spain (by industry)

Dependent variable (ln):	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Number of Firms					
Uncertainty Measure	3.952**	3.857**	3.975**	3.653**	4.223**	3.848**
	[1.716]	[1.759]	[1.731]	[1.810]	[1.783]	[1.887]
Applied Tariff Change (ln)	-2.719**	-2.783**	-2.655**	-3.385***	-3.117**	-2.847*
	[1.182]	[1.177]	[1.165]	[1.131]	[1.242]	[1.604]
NTM Share Change (ln)		-0.159				
		[0.258]				
Specific Tariff Share Change			-0.434			
			[1.162]			
Applied Tariff SD Change				2.912		
				[3.994]		
Price Index Proxy Change (ln)					1.5	0.453
					[2.243]	[3.730]
SD of Price Index Proxy Change						3.479
						[10.56]
Observations	731	731	731	731	731	731
R-squared	0.48	0.48	0.48	0.48	0.48	0.48
Change in probability of policy reversal	-0.24	-0.24	-0.25	-0.18	-0.23	-0.23

Notes:

All specifications include country and industry effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Sample: Spain and EC 10 countries, 1987-1985

Parameters: For uncertainty measure and computing probability of reversal, $\sigma = 3$, $\beta = 0.90$

Probability of reversal computed as $(\gamma_{pre} - \gamma_{post}) p_h = \frac{\sigma}{\sigma-1} \frac{1-\beta}{\beta} \left(\frac{b_{\gamma post} - b_{\gamma pre}}{-b_{\tau}} \right)$. See Section 5.4 for details.

Table 3.4: Firm-product growth into EC-10 and Spain (by industry)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (ln):	Change in Number of Varieties (Firm*Product)					
Uncertainty Measure	4.399**	4.301**	4.431**	4.351**	4.752**	4.415**
	[1.844]	[1.884]	[1.858]	[1.914]	[1.929]	[2.151]
Applied Tariff Change (ln)	-3.006**	-3.072**	-2.919**	-3.113**	-3.520***	-3.279*
	[1.301]	[1.305]	[1.288]	[1.333]	[1.328]	[1.724]
NTM Share Change (ln)		-0.166				
		[0.269]				
Specific Tariff Share Change			-0.579			
			[1.042]			
Applied Tariff SD Change				0.468		
				[4.243]		
Price Index Proxy Change (ln)					1.946	1.006
					[2.276]	[3.923]
SD of Price Index Proxy Change						3.121
						[11.13]
Observations	731	731	731	731	731	731
Adj R2	0.379	0.379	0.379	0.378	0.378	0.378
Change in probability of policy reversal	-0.24	-0.24	-0.25	-0.23	-0.23	-0.23

Notes:

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

All specifications include country and industry effects

Sample: Spain and EC 10 countries, 1987-1985

Parameters: For uncertainty measure and computing probability of reversal, $\sigma = 3$, $\beta = 0.90$ Probability of reversal computed as $(\gamma_{pre} - \gamma_{post}) p_h = \frac{\sigma}{\sigma-1} \frac{1-\beta}{\beta} \left(\frac{b_{\gamma_{post}} - b_{\gamma_{pre}}}{-b_{\tau}} \right)$. See Section 5.4 for details.

Table 3.5: Pre-Agreement (1985) Intensive and Extensive Margins of Firms and Firm-Products

	(1)	(2)	(3)	(4)	(5)
Dependent variable (ln):	Number of Firms	Exports per Firm	Number of Varieties	Exports per Variety	Exports
Uncertainty Measure	-4.064** [1.829]	2.435 [4.841]	-4.711** [2.299]	3.082 [4.394]	-1.629 [6.190]
Applied Tariff (ln)	-1.426 [1.952]	-3.688 [2.760]	-1.331 [2.412]	-3.783 [2.461]	-5.113 [4.351]
Observations	781	781	781	781	781
R-squared	0.869	0.569	0.864	0.558	0.722

Notes:

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

All specifications include country and industry effects

Sample: Spain and EC 10 countries, 1985

Parameters: For uncertainty measure and computing probability of reversal, $\sigma = 3$, $\beta = 0.90$

Table 3.6: Firm entry growth into EC-10 and Spain (Robustness across σ)

	(1)	(2)	(3)
Dependent variable (ln):	Change in the Number of Firms		
Uncertainty Measure	2.721** [1.209]	3.952** [1.716]	4.823** [2.051]
Applied Tariff Change	-2.686** [1.184]	-2.719** [1.182]	-2.751** [1.180]
Observations	731	731	731
Adj R2	0.389	0.389	0.39
σ	2	3	4
Change in Probability of Policy Reversal	-0.23	-0.24	-0.26

Notes:

All specifications include country and industry effects

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Sample: Spain and EC 10 countries, 1987-1985.

Parameters: For uncertainty measure and computing probability of reversal, $\sigma = 2, 3, 4$ as indicated; $\beta = 0.90$.

Appendix A

Theory Appendix

A.1 Value functions and stochastic cutoff condition

Deriving the full set of value functions is a basic application of linear algebra.

The solutions to the set of equations is

$$\begin{aligned}
 V^1(\tau_t) &= \frac{\pi(\tau_t)[1 - \beta(1 - \gamma E[\pi(\tau')])]}{[1 - \beta(1 - \gamma)](1 - \beta)} \\
 EV^1(\tau') &= \frac{E[\pi(\tau')]}{1 - \beta} \\
 V^0(\tau_t) &= \beta\gamma H(\tau_1) \frac{(1 - \beta)E[\pi(\tau') | \tau' < \tau_1] - \beta\gamma E[\pi(\tau')] - (1 - \beta)[1 - \beta(1 - \gamma)]K_e}{[1 - \beta(1 - \gamma)][1 - \beta(1 - \gamma H(\tau_1))]} \\
 EV^1(\tau_1 | \tau < \tau_1) &= \frac{\beta\gamma E[\pi(\tau')] - E[\pi(\tau') | \tau' < \tau_1](1 - \beta)}{(1 - \beta + \beta\gamma)(1 - \beta)}
 \end{aligned}$$

A.2 CDF of bound tariff distribution

The observed tariff in the bound regime τ_B is censored at the binding rate of B .

$$\tau_B = \begin{cases} \tau & \text{if } \tau \leq B \\ B & \text{if } \tau > B. \end{cases}$$

The CDF of τ_B is $H_{\tau_B}(\tau_B) = pH_1(\tau) + (1 - p)H_2(\tau)$. Where $p = H_{\tau_B}(B)$ and

$$H_1(\tau) = \begin{cases} \frac{H(\tau)}{H(B)} & \text{if } \tau \leq B \\ 0 & \text{if } \tau > B, \end{cases} \quad \text{and } H_2(\tau) = \begin{cases} 1 & \text{if } \tau \leq B \\ 0 & \text{if } \tau > B. \end{cases}$$

A.3 Profit Loss Term $\Delta(\tau_t)$

A.4 $\Delta(\tau_t) \leq 1$

I denote the maximum tariff by τ_{max} .

$$\begin{aligned}
 \Delta(\tau_t) &= [E(\tau^{-\sigma}) + H(\tau_t)[\tau_t^{-\sigma} - E(\tau^{-\sigma} | \tau \leq \tau_t)]] / \tau_t^{-\sigma} \\
 &= \left[\int_1^{\tau_{max}} \tau^{-\sigma} dH(\tau) + H(\tau_t)\tau_t^{-\sigma} - \int_1^{\tau_t} \tau^{-\sigma} dH(\tau) \right] / \tau_t^{-\sigma} \\
 &= \left[\int_{\tau_t}^{\tau_{max}} \tau^{-\sigma} dH(\tau) + H(\tau_t)\tau_t^{-\sigma} \right] / \tau_t^{-\sigma} \\
 &= [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t) + H(\tau_t)\tau_t^{-\sigma}] / \tau_t^{-\sigma}
 \end{aligned}$$

Then to show that $\Delta(\tau_t) \leq 1$, I take the difference D of the numerator and denominator in the final line above

$$\begin{aligned}
 D &= [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t) + H(\tau_t)\tau_t^{-\sigma}] - \tau_t^{-\sigma} \\
 &= (1 - H(\tau_t))[E(\tau^{-\sigma} | \tau \geq \tau_t) - \tau_t^{-\sigma}] \\
 &\leq 0
 \end{aligned}$$

The inequality follows because $\tau_t^{-\sigma}$ is always greater than $E(\tau^{-\sigma} | \tau > \tau_t)$. When the current tariff is at the maximum of the support of $H(\tau)$ such that $\tau_t = \tau_h$, then the difference in brackets and the term $(1 - H(\tau_t))$ are both zero.

A.5 Derivation of $\Delta(\tau_t, B)$ when tariffs are bound.

$$\begin{aligned}
\Delta(\tau_t) &= [E(\tau^{-\sigma}) + H(\tau_t)[\tau_t^{-\sigma} - E(\tau^{-\sigma} | \tau \leq \tau_t)]] / \tau_t^{-\sigma} \\
&= \left[(1 - H(B))B^{-\sigma} + \int_1^B \tau^{-\sigma} dH(\tau) + H(\tau_t)\tau_t^{-\sigma} - \int_1^{\tau_t} \tau^{-\sigma} dH(\tau) \right] / \tau_t^{-\sigma} \\
&= \left[(1 - H(B))B^{-\sigma} + \int_{\tau_t}^B \tau^{-\sigma} dH(\tau) + H(\tau_t)\tau_t^{-\sigma} \right] / \tau_t^{-\sigma} \\
&= \frac{(1 - H(B))B^{-\sigma} + [H(B) - H(\tau_t)]E(\tau^{-\sigma} | \tau_t < \tau < B) + H(\tau_t)\tau_t^{-\sigma}}{\tau_t^{-\sigma}} \quad (\text{A.1})
\end{aligned}$$

A.6 Proofs of Propositions 1 and 2

PROPOSITION 1 [*Caution*] *The entry cutoff c^U is less elastic with respect to tariff changes in the stochastic model relative to once-and-for-all deterministic tariff changes. Formally,*

$$\varepsilon^U(\tau_t) = \frac{\partial \log c_j^U}{\partial \log \tau_t} > -\frac{\sigma}{\sigma-1} = \frac{\partial \log c_{ij}^D}{\partial \log \tau_t} = \varepsilon^D(\tau_t)$$

PROOF:

As described in the main text, the proof consists of two parts. First, I show that the expected profit loss of a bad shock is decreasing in the current tariff τ_t . Second, I show the stochastic elasticity is proportionally less than the deterministic elasticity.

(1) $\frac{\partial \Delta(\tau_t)}{\partial \tau_t} \geq 0$ implies the proportion of profits lost in a tariff reversal, $\Delta(\tau_t) - 1$, is

reduced as tariffs increase.

$$\begin{aligned}
\frac{\partial \Delta(\tau_t)}{\partial \tau_t} &= \tau_t[-\tau_t^{-\sigma} h(\tau_t) + h(\tau_t) \tau_t^{-\sigma} - \sigma H(\tau_t) \tau_t^{-\sigma-1}] / \tau_t^{-\sigma} \\
&\quad + \tau_t[(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t) + H(\tau_t) \tau_t^{-\sigma}] (\sigma \tau^{\sigma-1}) \\
&= \tau_t[-\sigma H(\tau_t) \tau_t^{-1}] + \sigma \tau^\sigma [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t) + H(\tau_t) \tau_t^{-\sigma}] \\
&= \sigma \tau^\sigma [-H(\tau_t) \tau_t^{-\sigma} + (1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t) + H(\tau_t) \tau_t^{-\sigma}] \\
&= \sigma \tau^{\sigma-1} [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)] \\
&= \sigma [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)] / \tau^{-\sigma}
\end{aligned}$$

In semi-elasticity terms, this becomes

$$\frac{\partial \Delta(\tau_t)}{\partial \ln \tau_t} = \frac{\sigma [(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)]}{\tau^{-\sigma}} \geq 0$$

- (2) Using the expression for c_j^U from in equation (1.21), I log differentiate and derive the elasticity

$$\begin{aligned}
\varepsilon^U(\tau_t) &= \frac{d \ln c_t^D}{d \ln \tau_t} + \frac{d \ln \Theta_t}{d \ln \tau_t} \\
&= -\frac{\sigma}{\sigma - 1} + \frac{1}{\sigma - 1} \left(\frac{\beta \gamma}{(1 - \beta + \beta \gamma \Delta)} \frac{d \Delta_t}{d \ln \tau_t} \right) \\
&= -\frac{\sigma}{\sigma - 1} \left[1 - \left(\frac{\beta \gamma}{(1 - \beta + \beta \gamma \Delta)} \left(\frac{[(1 - H(\tau_t))E(\tau^{-\sigma} | \tau \geq \tau_t)]}{\tau_t^{-\sigma}} \right) \right) \right] \\
&= -\frac{\sigma}{\sigma - 1} \times \phi(\tau_t) \\
&= \varepsilon^D(\tau) \times \phi(\tau_t)
\end{aligned}$$

The term in brackets, represented by $\phi(\tau_t)$, is less than or equal to one. Therefore, in absolute values $|\varepsilon^U(\tau_t)| < |\varepsilon^D(\tau_t)|$. ■

PROPOSITION 2 [*Delay*] Higher bindings or higher arrival rates of policy shocks

reduce the entry cutoff by delaying investment in market entry. In elasticity terms:

(a) *Arrival Rates*

$$\varepsilon(\gamma) = \frac{d \ln c_t^U}{d \ln \gamma} = \frac{d \ln \Theta_t}{d \ln \gamma} = \frac{\beta\gamma}{\sigma - 1} \left[\frac{1 - \beta}{(1 - \beta(1 - \gamma))((1 - \beta(1 - \gamma\Delta)))} \right] (\Delta - 1) < 0$$

(b) *Bindings*

$$\varepsilon(B) = \frac{d \ln c_t^U}{d \ln B} = \frac{d \ln \Theta_t}{d \ln B} = -\frac{\sigma}{\sigma - 1} \left(\frac{\beta\gamma}{(1 - \beta + \beta\gamma\Delta)} \left(\frac{(1 - H(B))B^{-\sigma}}{\tau_t^{-\sigma}} \right) \right) < 0$$

PROOF:

(a) Log differentiating the cutoff under uncertainty with respect to γ , I obtain

$$\begin{aligned} \frac{d \ln c_t^U}{d \ln \gamma} &= \frac{d \ln \Theta_t}{d \ln \gamma} \\ &= \frac{\gamma}{\sigma - 1} \left(\frac{d}{d\gamma} \ln(1 - \beta(1 - \gamma\Delta)) - \frac{d}{d\gamma} \ln(1 - \beta(1 - \gamma)) \right) \\ &= \frac{\beta\gamma}{\sigma - 1} \left[\frac{1 - \beta}{(1 - \beta(1 - \gamma))((1 - \beta(1 - \gamma\Delta)))} \right] (\Delta - 1) \end{aligned}$$

We thus have

$$\text{sgn} \left(\frac{d \ln c_t^U}{d \gamma} \right) = \text{sgn} \left(\frac{\Delta - 1}{((1 - \beta(1 - \gamma\Delta)))} \right) < 0$$

which is negative since $\Delta - 1 < 0$ whenever $\tau_t < \tau_{max}$.

(b) I use the binding censored version of the profit loss term $\Delta(\tau_t, B)$ from equation

(A.1). Log differentiating the cutoff, I obtain

$$\begin{aligned} \frac{d \ln c_t^U}{d \ln B} &= \frac{d \ln \Theta_t}{d \ln B} \\ &= \frac{1}{\sigma - 1} \left(\frac{\beta \gamma}{(1 - \beta + \beta \gamma \Delta)} \frac{d \Delta_{t,B}}{d \ln B} \right) \\ &= -\frac{\sigma}{\sigma - 1} \left(\frac{\beta \gamma}{(1 - \beta + \beta \gamma \Delta)} \left[\frac{(1 - H(B)) B^{-\sigma}}{\tau_t^{-\sigma}} \right] \right) < 0. \end{aligned}$$

The term in brackets is positive and the cutoff is decreasing in the binding. ■

A.7 Real Option vs. NPV Cutoffs

In section 3.2 of the text we note that

- (i) the cutoff under the option approach is always lower than under the NPV approach

To see this note that in the absence of the option to wait the last term in (??) drops out and we obtain the standard NPV cutoff, denoted c_t^M . Since the last term in (??) is non-positive the option cutoff is lower, i.e. $c_t^U \leq c_t^M$, which implies less entry than under the standard NPV case.

- (ii) the cutoff under the NPV approach can be higher or lower than the deterministic and thus reductions in uncertainty can lead to less incentive for entry under the NPV approach.

If the deterministic tariff were such that $\tau_t^{-\sigma} = \mathbb{E}(\tau^{-\sigma})$ then these two cutoffs coincide (as can be seen if we combine the first two terms of (??) to obtain $c_t^M = \left[\frac{AE(\tau^{-\sigma})}{K(1-\beta)} \right]^{\frac{1}{\sigma-1}} = c_t^D$). But if instead we hold the current tariff at its long-run mean, i.e. $\tau_t = \mathbb{E}(\tau')$, then the convexity of profits in tariffs implies that the Marshallian cutoff is higher than the deterministic cutoff. To see this note that if $\tau_t = \mathbb{E}(\tau')$ then $(\tau_t)^{-\sigma} = (\mathbb{E}(\tau'))^{-\sigma} \leq \mathbb{E}(\tau^{-\sigma})$ (Jensen's inequality for $\sigma > 1$) so $c_t^D \leq c_t^M$ at the

long run mean of the tariff distribution. This implies that if we actually eliminate uncertainty while holding the current tariffs equal at the mean in the deterministic case then there would be less incentive for entry, which is the *opposite* effect of uncertainty from what we find using the real option approach.

Appendix B

Data and Estimation Appendix

B.1 Estimation details

B.1.1 Empirical Implementation in Discrete Case

To construct the empirical measure of $\Delta(\tau_t)$ we consider a discrete probability distribution for tariffs. We then ask, given that a policy shock above the current trigger τ_t arrives, what is expected value of the proportional loss in profits? This quantity is summarized neatly by the term $\Delta(\tau_t) - 1$. In the tables below, we compute $\Delta(\tau_t) - 1$ for a two- and three-state tariff process relevant to our empirical implementation.

Two State Tariff Distribution: High, Low		
Initial State ($\tau_T = \tau_s$)	Probability (p_s)	$\Delta(\tau_T = \tau_s) - 1$
τ_h	p_h	0
τ_l	$1 - p_h$	$-p_h (\tau_l^{-\sigma} - \tau_h^{-\sigma}) / \tau_l^{-\sigma}$

In the two state case, any firm with an entry trigger $\tau_t \geq \tau_h$ would enter when the tariff is in the high state. The likelihood of a shock to trade policy leading to a worse outcome is zero. As was the case with a general continuous distribution, the cutoffs in the deterministic and uncertain model will coincide. In the low state, $\Delta(\tau_t) - 1$ is nonzero and less than unity. In the estimations, we construct the observable counterpart to the $\Delta(\tau_t) - 1$ from tariff data and assumptions on σ . We then use this measure to estimate the unobservable parameters γ and p_h via regressions.

Three State Tariff Distribution: High, Medium and Low

Initial State ($\tau_T = \tau_s$)	Probability (p_s)	$\Delta(\tau_T = \tau_s) - 1$
τ_h	p_h	0
τ_m	p_m	$-p_h (\tau_m^{-\sigma} - \tau_h^{-\sigma}) / \tau_m^{-\sigma}$
τ_l	$1 - p_m - p_h$	$- [(p_m + p_h) (\tau_l^{-\sigma} - E(\tau^{-\sigma} \tau > \tau_l))] / \tau_l^{-\sigma}$ $= - \sum_{s=m,h} [p_s (\tau_l^{-\sigma} - \tau_s^{-\sigma})] / \tau_l^{-\sigma}$

The three state distribution is slightly more involved, but makes it clear how to generalize to many discrete states. We argue in the empirical section that Portugal had “medium” preferential tariffs with respect to Spain by 1983 of a tenuous and indefinite nature due to the EFTA-Spain agreement. If $p_m \rightarrow 0$, then we see that the measures in the second and third row coincide with our empirical implementation for the EC and Spain.

B.1.2 Legacy firms

The true fraction of firms in a market at time t is $\frac{n_{tiV}^*}{n_{tV}^*}$ and it is related to the model’s distribution by

$$\frac{n_{tiV}^*}{n_{tV}^*} \begin{cases} = G(c_{tiV}^U) & \text{if } c_{tiV}^U \geq \max c_{t-niV}^U \quad \text{all } n \\ \geq G(c_{tiV}^U) & \text{if } c_{tiV}^U < \max c_{t-niV}^U \end{cases}$$

so if $c_{tiV}^U < \max c_{t-niV}^U$ we can write

$$\frac{n_{tiV}^*}{n_{tV}^*} = G(c_{tiV}^U) \lambda_{tiV}$$

where $\lambda_{tiV} = \left(1 + (1 - \delta_{t-n}) \frac{G(c_{t-niV}^U) - G(c_{tiV}^U)}{G(c_{tiV}^U)}\right)$ and $(1 - \delta_{t-n})$ is the survival probability until time t of firms that were present at the maximum cutoff period, say it is $t - n$. Using the distribution we then get

$$G(c_{tiV}^U)\lambda_{tiV} = G(c_{tiV}^U) \left(1 + (1 - \delta_{t-n}) \left(\frac{(c_{t-niV}^U)^k - (c_{tiV}^U)^k}{(c_{tiV}^U)^k}\right)\right)$$

So if we consider changes in the demand or cost conditions: foreign income, domestic wages, other time variation not product specific, then the policy variables and anything that is product specific and not time varying cancels out in λ term and we get

$$\lambda_{tiV}G(c_{tiV}^U) = G(c_{tiV}^U) \left(1 + (1 - \delta_{t-n}) \left(\frac{[A_{t-ni}]^{\frac{k}{\sigma-1}} - [A_{ti}]^{\frac{k}{\sigma-1}}}{[A_{ti}]^{\frac{k}{\sigma-1}}}\right)\right)$$

The observed fraction is equal to $\frac{n_{tiV}^*}{n_{tV}^*}e_{tiv}$ where e_{tiv} is some random disturbance with a log normal distribution centered around 0 (e.g. measurement error) and

$$\ln \frac{n_{tiV}}{n_{tV}} = \ln G(c_{tiV}^U) + (\ln \lambda_{ti} + \ln e_{tiv}) \stackrel{\equiv u_{tiV}}{=}$$

We can then interpret the error term in the text as $u_{tiV} = \ln e_{tiv}$ if $c_{tiV}^U \geq \max c_{t-niV}^U$ or $\ln \lambda_{ti} + \ln e_{tiv}$ otherwise. Since we control for country-time effects this potential source of legacy does not bias our estimates.

B.1.3 Structural interpretation of parameters

Comparing (3.23) to (3.24) we see that

$$\begin{aligned} b_{\gamma t} &= -\gamma_t \frac{\beta}{1 - \beta} k p_h \\ a_{ti} + a_{iV} + a_{tV} &= \frac{k}{\sigma - 1} \ln A_{ti} + \left(-\frac{k}{\sigma - 1} \ln K_{iV}(1 - \beta) - k \ln c_V\right) + \ln n_{tV} \\ &\quad + (u_{ti} + r_{ti} + u_{iV} + r_{iV} + u_{tV} + r_{tV}) \end{aligned}$$

where the last term in brackets simply accounts for the fact that some of the variation in the $u_{tiV} + r_{iVt}$ term can be broken down into an importer*year, importer*industry and industry*time effect (one of the ways to address the legacy firms issues, as described above)

$$\tilde{u}_{tiV} \equiv u_{tiV} + r_{iVt} - (u_{ti} + r_{ti} + u_{iV} + r_{iV} + u_{tV} + r_{tV})$$

B.2 Chapter 2 Data

B.2.1 Data Sources and Descriptions

I use trade flow and product data for all imported exporter-product pairs from 2004 and 2006. These data are at 10-digit level of disaggregation known as the Harmonized Tariff Items Statistical Codes (HTISC) by Australian Customs. The data were obtained on an annual basis from Trade Data International, an authorized re-seller of trade data from the Australian Bureau of Statistics.¹ In 2004 and 2006, there are over 8,300 products that could be exported from any single country to Australia.² I account for the 153 code changes during the period from 2002 to 2006 to avoid spurious entry and exit of products.

Tariff data were extracted from the WTO's Tariff Analysis On-line system, a comprehensive database tariff concessions. The Integrated Database includes details at the 8-digit tariff line level for Australia's applied MFN tariffs; Generalized System of Preferences; and other unilateral preference programs. The Consolidated Tariff Schedules contain a record of Australia's certified binding concessions at the HS6 level (the level at which bindings are negotiated).

¹The HTISC is equivalent to the Harmonized System in the first 6 digits, known as HS6 level. Following the HS6, the next 2 digits capture "tariff items" and are assigned for further disaggregation of tariff duties. The final 2 digits are "statistical codes" assigned to provide additional disaggregation for statistical purposes.

²This degree of product diversity is comparable to that found in the 10-digit U.S. import data or Combined Nomenclature of the European Union. For comparison, the level of detail in the HS6 data from the UN COMTRADE database tracks just over 5,000 products due to aggregation.

B.2.2 Product Entry Sample

The sample for entry regressions is a sub-sample of the combined 2004 and 2006 cross-sections. I restrict the sample to products that are non-traded in 2004. New Zealand does not appear in the entry sample because there is no time variation in PTA implementation dates or tariffs between 2004 and 2006. As above, because many countries have no entry or possibly 100% switching to entry within an HS2 defined industry they are perfectly predicted by fixed effects and dropped from the regression sample. These criteria leave 420,604 exporter-product observations that were non-traded in 2004 and could potentially switch to traded status in 2006. Summary statistics appear in Table ??.

B.3 Chapter 3 Data

B.3.1 Policy Data

B.3.1.1 Pre-accession policy data

The earliest trade data for Portugal is from 1981 and the closest full EC trade policy schedule before then is for 1980 (OJ L 342, 31.12.1979, p. 1–382). This, and the fact that EC applied tariffs to Portugal in industrial goods were the ones set in the 1977 agreement, and thus remained in place until 1985, lead us to initially digitize and use the 1980 schedule.³ The 1980 schedule already reflects some of the EC multilateral tariff bindings negotiated in the Tokyo Round. However, some of these bindings, which we use to construct our uncertainty measure, continued to be reduced over a period of time.⁴ Therefore, if the worst case scenario for Portuguese exporters between 1981–1985 was the EC binding then it may have entailed a lower

³While ultimately our baseline results only use data for 1985 and 1987 in order to isolate the effect of the agreement in 1986 we also planned and ran robustness tests that include earlier years.

⁴“Implementation of MTN concessions: Note by the secretariat, revision” TAR/W/8/Rev.3, October 15, 1981

tariff than that implied by the 1980 binding. Even for those goods where the binding was falling the 1980 binding may still be the appropriate one to capture the exporter expectations we model if for example the exporters did not immediately update their beliefs about the tariff distribution.

We obtained the 1984 trade policy schedule for Spain. This schedule was published by the International Customs Tariff Bureau in a set of volumes known as the *International Customs Journal*. We believe this was the only full schedule published in the 1980s for Spain.⁵ This schedule contains Spain's preferences relative to Portugal and the EEC as well as its policy relative to the rest of the world. The documentation we found implies that Spain's preferential tariffs for Portugal remained unchanged between 1984 and 1985 because the EFTA-Spain agreement that regulated these had reached a phase requiring additional negotiations of indeterminate length.

B.3.1.2 Post-accession policy data

To construct the tariff profile faced by Portugal immediately after the agreement we applied the concessions schedule in the Articles of Accession, Protocol 3 for Spain (Official Journal L 302 , 15/11/1985 P. 0410) and Article 243 for the EC (Official Journal L 302 , 15/11/1985 P. 0094). These imply staged reductions of 12.5% per year for Spain and 14.2% for EC-10 with some variation across goods.

B.3.1.3 Applied Protection and Uncertainty Measures

The schedules for the EC and Spain were manually keyed into digital format at the tariff line level by a firm specialized in data entry. We performed a number of checks to ensure that the quality of the entry and kept track of the few tariff lines with

⁵These volumes are now published electronically. In the interest of the research community as a whole, we note that the World Bank-IMF Joint Library in Washington, DC is the only location that appears to have a reasonably complete set of International Customs Tariff Bureau publications for the 1960s to 1980s.

various combinations of minimum and maximum tariffs, specific tariffs and seasonal tariffs. We then applied preference margins for the EFTA-Spain and EC-Portugal agreements to compute the applied tariff faced by Portuguese exporters in 1985. We applied the staged reductions of the Articles of Accession to these schedules for the EC and Spain to compute the 1987 tariff profile. This yields our tariff line measures of applied tariffs in 1985 and 1987. The same schedules give us the pre-accession worst case tariff used to compute the uncertainty measure as described in the main text. We keep track of the shares of tariff lines with complex and specific tariffs when aggregating up to the 2-digit Nimexe level and use these as additional controls in the robustness checks.

B.3.2 Firm and Aggregate Data

Our firm level data is from the Portuguese census (INE). We use the transaction level trade data available for the period 1981-1992 from customs declaration forms processed by INE. Since the 1981-1987 trade data had not previously been used we did several basic exercises to check their accuracy. We found no law establishing minimum value thresholds for filling out the customs forms in this period. There are no discontinuities at low values in the shipment value distribution. We confirmed that the aggregate yearly values of both imports and exports matched those reported by the official INE printed publication "Estatísticas do Comércio Externo" for several years. INE converts data for all years into euros at a rate of 200.482 esc/euro even before the euro was implemented.

B.3.2.1 Firm identifiers

One statistic (entry and exit rates in 1985 relative to 1984; and 1987 relative to 1986) and one graph (new vs. continuing exporters in 1987 relative to 1986)

make use of the shipper’s identifier variable (labelled NPC). INE reports that this is a unique firm identifier after 1986 and it is in fact used to match trade data to employment and other firm-level data collected by INE in recent years in other work. We noticed that in the “new” data we received, the NPC variable prior to 1986 contained different codes and so far neither INE nor Portuguese customs have been able to provide a correspondence that would allow linking specific firms between 1985 and 1986. However, INE did confirm with Portuguese Customs that the pre-1986 variable provides a unique identifier between 1981-1985. We further investigated this by calculating statistics by NPC in each year (e.g. industry of modal product exported, # products, # destinations, total shipment value and weight, etc) and verifying they were highly correlated in adjacent years, e.g. the elasticity of total export values by NPC between 1985 and 1984 is one, similarly for other variables. Moreover, these relationships were identical to those found when comparing adjacent years in the post-1986 data where the NPC identifier was known to be unique.

B.3.2.2 Destination country

To ensure that country codes are consistent over time we used the official list of changes in trade partners published yearly in the “Estatísticas do Comércio Externo”. When a country splits, the code for the “larger” unit (e.g. Russia) is the same as the existing (e.g. USSR) and a new code is created for others (e.g. Ukraine). When a country merges (e.g. Germany) we assign the same code as the largest of the existing (West Germany) and drop the other (East Germany).

B.3.3 Data sources and definitions

Aggregate Regressions (Table 1 and B1; 1981-1992):

- Exports (ln): $\ln(\text{nominal value of exports in euro of all goods to country } i \text{ in } t)$

year t). Source: Author's calculations based on INE data.

- Number of Firms Exporting (ln): Number of uniquely identified shippers with positive exports to i in year t . Source: Author's calculations based on INE data.
- Exports per Firm (ln): $\ln(\text{Exports}_{it}/\text{Number of firms}_{it})$. Source: Author's calculations based on INE data.
- Real Importer GDP (ln) country i , year t . Source: IMF IFS.
- Importer Price Index (ln): \ln nominal GDP - \ln real GDP in local currency. Source: IMF International Financial Statistics (IFS)
- Annual exchange Rate (ln): Simple average of \ln monthly rate, where latter is defined as $\ln((\text{escudo}/\text{importer currency})/200.482)$. The fixed conversion factor from esc to euro is 200.482 and plays no role in the regressions. Source: Authors calculations from IMF IFS (monthly).
- Exchange Rate Volatility (ln): standard deviation of log monthly changes in the year. Source: Authors calculations.
- "Advanced" country dummy: equal 1 if country is US, Japan, Canada, Spain, EC10 or, EFTA members in 1986 and 0 otherwise.

B.3.3.1 Firm and policy data in baseline estimates (Tables 3.2-3.6)

- Change in Number of Firms (ln): $\ln(\# \text{ firms exporting to } i \text{ in } V, 1987) - \ln(\# \text{ firms exporting to } i \text{ in } V, 1985)$ where i is an EC-11 country and V corresponds to a NIMEXE 2-digit industry. Source: Authors' calculations.
- Change in Number of Firm-Varieties (ln): $\ln(\# \text{ varieties exported to } i \text{ in } V, 1987) - \ln(\# \text{ varieties exported to } i \text{ in } V, 1985)$ where "varieties" are defined as distinct 8-digit NIMEXE products exported by each firm. Source: Authors' calculations.
- Change in exports (ln): $\ln(\text{export value to } i \text{ in } V, 1987) - \ln(\text{export value to } i \text{ in } V, 1985)$. Source: Authors' calculations.
- Pre Tariff. Source: International Customs Journal: Spain, No. 24, 16th Edition, 1984. EC :Official Journal, L342, 31.12.1979, p. 1-382.
- Post Tariff. Source: Articles of Accession, Official Journal L 302 , 15/11/1985.
- Uncertainty: 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 conventional GATT member tariff). Source: Authors' calculations using equation (3.19) with $\sigma = 3$ in the baseline regressions.
- NTM Share Change: Difference in share of lines in 2-digit industry with min, max or other tariff measures between post and pre-agreement period. Source: Authors' calculations.
- Specific Tariff Share Change: Difference in the share of lines in 2-digit industry with specific tariffs between post and pre-agreement period. Source: Authors' calculations.

- Price Index Proxy Change (ln): Difference in Spain's external tariff between post and pre-agreement period. Source: Authors' calculations.

B.3.3.2 Other data (Figures and text)

- Import & Export to GDP ratios (Text). Source: Pinheiro et al (1997).
- Trade Shares (Figs. 1 and 2): Source: IMF Direction of Trade Statistics
- Export Firm Entry Growth (Fig. 3) $\ln(\# \text{ firms exporting to country } i \text{ at } t) - \ln(\# \text{ firms exporting to } i \text{ in } 1985)$. Source: Authors' calculations.
- Real Export Growth Margins (Figs. 4-6): $\ln(\text{total nominal export value year } t / \text{total nominal value in } 1985) - \ln(\text{export price index})$. Source: Authors' calculations.
- Export price index (ln): 1985 base chain price index for exports. Source: Authors' calculations from yearly price deflators of export goods to all destinations in Pinheiro et al (1997).
- Employment: Source: Authors calculations using trade data matched to firm employment data (Quadros Pessoal) by INE.
- Firm identifier (*NPC*): unique code that can be used 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.
- New exporter in year t : Firm exporting somewhere at t but nowhere in $t-1$. Source: Authors' calculations.
- Gross Entry rate in year t : $(\text{Total } \# \text{ new exporters in } t) / (\# \text{ exporters } t-1)$. Source: Authors' calculations.

- Gross Exit rate in year t: ($\#$ exporters with positive exports in t-1 and none in t)/($\#$ exporters with positive exports in t). Source: Authors' calculations.

Table B1: Summary Statistics for Gravity Regressions

Variable	Mean	SD	Obs
Exports (ln)	13.84	3.09	1590
Number of Firms Exporting (ln)	3.49	2.01	1590
Exports per Firm (ln)	10.35	1.47	1590
Real Importer GDP (ln)	5.181	3.356	1590
Importer Price Index (ln)	-1.283	1.770	1590
Exchange Rate (ln)	-2.191	3.166	1590
Exchange Rate Volatility (ln)	-3.799	0.869	1583
“Advanced” country dummy	0.136	0.340	1590

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